THE PORT AUTHORITY OF NY & NJ

FOI Administrator

June 3, 2013

Ms. Anne Ruth
PASSUR Aerospace
One Landmark Square, Suite 1900
Stamford, CT 06901

Re: Freedom of Information Reference No. 13003

Dear Ms. Ruth:

This is a response to your February 13, 2012 request, which has been processed under the Port Authority's Freedom of Information Code (the "Code"), for copies of all proposals that were submitted related to RFP No. 24997 - Surface Management System at JFK.

Material responsive to your request and available under the Code can be found on the Port Authority's website at http://www.panynj.gov/corporate-information/foi/13003-C.pdf.

Certain material responsive to your request is exempt from disclosure pursuant to exemptions (1) and (4) of the Code.

Please refer to the above FOI reference number in any future correspondence relating to your request.

Very truly yours,

Ann L. Qureshi
FOI Administrator

225 Park Avenue South
New York, , NY 10003
T: 212 435 3642 F: 212 435 7555

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Sensis

Detect the Difference

August 2, 2011

KAS:11:629

Ms. Lesley Brown
The Port Authority of NY & NJ
Procurement Department
1 Madison Avenue, 7th Floor
New York, NY 10010

Subject: Response to Request for Proposals (RFP) for Surface Management System at JFK International Airport

Reference: Sensis Proposal dated August 8, 2011

Dear Ms. Brown:

Sensis Corporation is pleased to submit the attached proposal in response to The Port Authority of NY & NJ RFP for a Surface Management System at John F. Kennedy International Airport.

Sensis Aerobahn® is the world's leading Surface Management System (SMS) and is presently being utilized at JFK and sixteen other major airports worldwide. The culmination of over ten years of development, Sensis Aerobahn® currently has thousands of users with millions of hours of collective use. By providing real-time situational awareness through robust metrics, predictions, and alerts, and with its comprehensive data reporting and analytic capabilities, Sensis Aerobahn® defines what a powerful SMS can be.

In addition to leading the industry in SMS technology, Sensis Corporation is recognized as a world leader in deploying surface and wide areas surveillance systems around the globe. Sensis has the breadth and depth of experience, as well as the qualified personnel to ensure the success of this project.

In accordance with the requirements as outlined within the RFP document the following information is provided for your reference:

- Sensis is a corporation organized under laws of the state of Delaware and located at 5717 Enterprise Parkway, E. Syracuse, NY 13057.
- The following individuals have the authority to represent Sensis Corporation in the capacity of negotiation and execution of contractual matters:
    - Mr. James Sullivan - Corporate Director of Contracts

5717 Enterprise Parkway, East Syracuse, NY 13057 Phone: 315-445-0550 Fax: 315-446-2209
www.sensis.com

Phone: (315) 445-5077
Fax: (315) 446-2209
Email: jim.sullivan@sensis.com

- Ms. Kathleen Selmser - Manager, ATS Contracts
  Phone: (315) 634-3059
  Fax: (315) 446-2209
  Email: kselmser@sensis.com

- Mr. Josh Gaul, Manager - Subcontracts
  Phone: (315) 445-5700
  Fax: (315) 446-2209
  Email: jgaul@sensis.com

- Inquiries as related to questions or issues concerning Sensis proposal should be directed to:

  Ms. Kathleen Selmser
  Phone: (315) 634-3059
  Fax: (315) 446-2209
  Email: kselmser@sensis.com

- Sensis response to the above subject RFP is as a single entity acting independently; supported by the following subcontractors:

  - Robinson Aviation - 6913 Ridgewood Avenue, Chevy Chase , Maryland 20815
  - Air Network Simulation and Analysis, Inc. (ANSA) – 216 Crest Avenue, Revere, MA 02151-4180
  - LiveATC.net – P.O. Box 178 Amherst, NH 03031
  - UBM Aviation - 3025 Highland Parkway, Suite 200, Downers Grove, Illinois, U.S.A. 60515
  - Digital Edge - 7 Teleport Drive, Staten Island, NY 10311

- Sensis Corporate officers are as follows:

  - Mr. Judson Gostin, Chairman, President and CEO residing in Syracuse, NY
  - Mr. Laurence Harris, Senior VP and CFO residing in Syracuse, NY
  - Mr. Marc Viggiano, Senior VP and Director of Corporate Development residing in Syracuse, NY
  - Ms. Margaret Dudarchik, Senior VP & Chief People Officer residing in Syracuse, NY
  - Mr. Kenneth Kaminski, VP and GM, Air Traffic Systems residing in Syracuse, NY
  - Mr. Eric Smith, GM Defense and Security Systems residing in Syracuse, NY
  - Mr. Dave Kovarik, VP of Ground Based Programs residing in Syracuse, NY

- Mr. Thomas Uva, VP & Chief Information Officer residing in Syracuse, NY
- Mr. Greg Farnham, VP & Director of Operations residing in Syracuse, NY
- Mr. Michael Gerry, VP FAA Programs residing in Syracuse, NY

- Sensis' Certificate of Incorporation, along with a written declaration, is attached to this letter.

Thank you for considering the enclosed proposal. Sensis looks forward to your reply.

Sincerely,

Kathy Selmser
Manager, ATS Contracts
Sensis Corporation

5717 Enterprise Parkway, East Syracuse, NY 13057 Phone: 315-445-5076 Fax: 315-446-2209
www.sensis.com

Sensis

Detect the Difference

July 5, 2011

The Port Authority of NY & NJ
Attn: Bid/RFP Custodian
Procurement Department
1 Madison Avenue, 7th Floor
New York, NY 10010

Subject: Response to RFP for Proposals for Surface Management System at JFK International Airport

Reference: Letter of Transmittal – Certificate of Incorporation

Dear Sir or Madam,

The purpose of this letter is to certify that the attached Certificate of Incorporation is a true copy of the Certificate of Incorporation as of the date of the opening of the Proposals.

Sincerely,

Margaret Dudarchik

Margaret Dudarchik
Senior Vice President of Human Resources
Sensis Corporation

5717 Enterprise Parkway, East Syracuse, NY 13057 Phone: 315-445-0550 Fax: 315-446-2209
www.sensis.com

Delaware

The First State

I, JEFFREY W. BULLOCK, SECRETARY OF STATE OF THE STATE OF DELAWARE, DO HEREBY CERTIFY THE ATTACHED ARE TRUE AND CORRECT COPIES OF ALL DOCUMENTS ON FILE OF "SENSIS CORPORATION" AS RECEIVED AND FILED IN THIS OFFICE.

THE FOLLOWING DOCUMENTS HAVE BEEN CERTIFIED:

CERTIFICATE OF INCORPORATION, FILED THE TENTH DAY OF JULY, A.D. 1985, AT 9 O'CLOCK A.M.

CERTIFICATE OF AMENDMENT, FILED THE EIGHTEENTH DAY OF NOVEMBER, A.D. 1987, AT 9 O'CLOCK A.M.

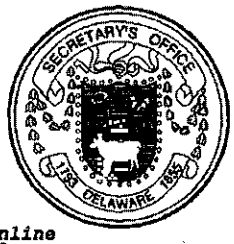
CERTIFICATE OF RENEWAL, FILED THE TENTH DAY OF FEBRUARY, A.D. 1992, AT 9 O'CLOCK A.M.

RESTATED CERTIFICATE, FILED THE SEVENTEENTH DAY OF JULY, A.D. 2007, AT 7:02 O'CLOCK P.M.

CERTIFICATE OF DESIGNATION, FILED THE TWENTY-THIRD DAY OF JULY, A.D. 2007, AT 6:47 O'CLOCK P.M.

CERTIFICATE OF AMENDMENT, FILED THE FIFTH DAY OF JUNE, A.D. 2008, AT 2:21 O'CLOCK P.M.

AND I DO HEREBY FURTHER CERTIFY THAT THE AFORESAID CERTIFICATES ARE THE ONLY CERTIFICATES ON RECORD OF THE AFORESAID CORPORATION, "SENSIS CORPORATION".



Jeffrey W. Bullock, Secretary of State

2066226 8100H

AUTHENTICATION: 7334289

090577930

DATE: 06-02-09

You may verify this certificate online at corp.delaware.gov/authver.shtml

8501910086

FILED

JUL 10 1985 9 AM

CERTIFICATE OF INCORPORATION

-of-

SENSIS CORPORATION

THE UNDERSIGNED, in order to form a corporation for the purposes hereinafter stated, under and pursuant to the provisions of the General Corporation Law of the State of Delaware do hereby certify as follows:

FIRST: The name of the corporation is SENSIS CORPORATION.

SECOND: The registered office of the corporation is to be located at 306 South State Street, in the City of Dover, County of Kent, State of Delaware. The name of its registered agent at that address is the United States Corporation Company.

THIRD: The purpose of the corporation is to engage in any lawful act or activity for which a corporation may be organized under the General Corporation Law of Delaware.

Without limiting in any manner the scope and generality of the foregoing, it is hereby provided that the corporation shall have the following purposes, objects and powers:

> To purchase, manufacture, produce, assemble, receive, lease or in any manner acquire, hold, own, use, operate, install, maintain, service, repair,

process, alter, improve, import, export, sell, lease, assign, transfer and generally to trade and deal in and with raw materials, natural or manufactured articles or products, machinery, equipment, devices, systems, parts, supplies, apparatus, goods, wares, merchandise and personal property of every kind, nature or description, tangible or intangible, used or capable of being used for any purpose whatsoever; and to engage and participate in any mercantile, manufacturing or trading business of any kind or character.

To improve, manage, develop, sell assign, transfer, lease, mortgage, pledge or otherwise dispose of or turn to account or deal with all of any part of the property of the corporation and from time to time to vary any investment or employment of capital of the corporation.

To borrow money, and to make and issue notes, bonds, debentures obligations, and evidences of indebtedness of all kinds, whether secured by mortgage, pledge, deed of trust or otherwise; and generally to make and perform agreements and contracts of every kind and description, including contracts of guaranty and suretyship.

To lend money for its corporate purposes, invest and reinvest its funds, and take, hold and deal with real and personal property as security for the payment of funds so loaned or invested.

To the same extent as natural persons might or could do, to purchase or otherwise acquire, and to hold, own, maintain, work, develop, sell, lease, exchange, hire, convey, mortgage, or otherwise dispose of and deal in lands and leaseholds, and any interest, estate and rights in real property, and any personal or mixed property, and any franchises, rights, licenses or privileges necessary, convenient or appropriate for any of the purposes herein expressed.

To apply for, obtain, register, purchase, lease or otherwise to acquire and to hold, own, use, develop, operate and introduce and to sell, assign, granted licenses or territorial rights in respect

to, or otherwise to turn to account or dispose of, any copyrights, trademarks, trade names, brands, labels, patent rights, letters patent of the United States or of any other country or government, inventions, improvements and processes, whether used in connection with or secured under letters patent or otherwise.

To participate with others in any corporation, partnership, limited partnership, joint venture, or other association of any kind, or in any transaction, undertaking or arrangement which the participating corporation would have power to conduct by itself, whether or not such participation involves sharing or delegation of control with or to others; and to be an incorporator, promoter or manager of other coporations of any type or kind.

To pay pensions and establish and carry out pension, profit sharing, stock option, stock purchase, stock bonus, retirement, benefit, incentive and commission plans, trusts and provisions for any or all of its directors, officers and employees, and for any or all of the directors, officers and employees of its subsidiaries; and to provide insurance for its benefit on the life or any of its directors, officers and employees, or on the life of any stockholder for the purpose of acquiring at his death shares of its stock owned by such stockholder.

To acquire by purchase, subscription or otherwise, and to hold for investment or otherwise and to use, sell, assign, transfer, mortgage, pledge or otherwise deal with or dispose of stocks, bonds or any other obligations or securities of any corporation or corporations; to merge or consolidate with any corporation in such manner as may be permitted by law; to aid in any manner any corporation whose stocks, bonds or other obligations are held or in any manner guaranteed by this corporation, or in which this corporation is in any way interested; and to do any other acts or things for the preservation, protection, improvement or enhancement of the value of any such stock, bonds or other obligations; and while owner of any such stock, bonds or other obligations to exercise all the rights, powers and privileges of ownership

thereof, and to exercise any and all voting powers thereon; and to guarantee the payment of dividends upon any stock, the principal or interest or both, of any bonds or other obligations, and performance of any contracts.

To do all and everything necessary, suitable or proper for the accomplishment of any of the purpose or the attainment of any of the objects or the furtherance of the powers hereinbefore set forth, either alone or in association with other corporations, firms or individuals, to do every other act or acts, thing or things incidental or appurtenant to or growing out of or connected with the aforesaid business or powers or any part or parts thereof, provided the same be not inconsistent with the laws under which this corporation is organized.

The business or purpose of the corporation is from time to time to do any one or more of the acts and things hereinabove set forth, and it shall have power to conduct and carry on its said business, and to exercise any or all of its corporate powers and rights, in the State of Delaware, and in the various other states, territories, colonies and dependencies of the United States, in the District of Columbia, and in all or any foreign countries.

1) The enumeration herein of the objects and purposes of the corporation shall be construed as powers as well as objects and purposes and shall not be deemed to exclude by inference any powers, objects or purposes which the corporation is empowered to exercise, whether expressly by force of the laws of the State of Delaware now or hereafter in effect, or impliedly by the reasonable construction of the said laws.

FOURTH: The total number of shares which the corporation shall have the authority to issue is Ten Million Shares (10,000,000) and the par value of each of such shares is $.01.

FIFTH: The name and address of each of the incorporators are as follows:

NAME	ADDRESS
Leonard N. Budow	Underweiser & Underweiser 405 Park Avenue New York, New York 10022

SIXTH: The following provisions are inserted for the management of the business and for the conduct of the affairs of the corporation, and for further definition, limitation and regulation of the powers of the corporation and of its directors and stockholders:

(1) The number of directors of the corporation shall be such as from time to time shall be fixed by, or in the manner provided in the By-Laws. Election of directors need not be by ballot unless the By-Laws so provide.

(2) The Board of Directors shall have power without the assent or vote of the stockholders to make, alter, amend change, add to or repeal the By-Laws of the corporation; to fix and vary the amount to be reserved for any proper purpose; to authorize and cause to be executed mortgages and liens upon all or any part of the property of the corporation; to determine the use and disposition of any surplus or net profits; and to fix the times for the declaration and payment of dividends.

(3) The directors in their discretion may submit any contract or act for approval or ratification at any annual meeting of the stockholders called for the purpose of considering any such act or contract, and any contract or act that shall be approved or be ratified by the vote of the holders of a majority of the stock of the corporation which is represented in person or by proxy at such meeting and entitled to vote thereat (provided that a lawful quorum of stockholders be there represented in person or by proxy) shall be as valid and as binding upon the corporation and upon all the stockholders as though it had been approved or ratified by every stockholder of the corporation, whether or not the contract or act would otherwise be open to legal attack because of directors' interest, or for any other reason.

(4) In addition to the powers and authorities hereinbefore or by statute expressly conferred upon them, the directors are hereby empowered to exercise all such powers and do all such acts and things as may be exercised or done by the corporation; subject, nevertheless, to the provisions of the statutes of Delaware, of this certificate, and to any by-laws from time to time made by the stockholders; provided, however, that no by-laws so made shall invalidate any prior act of the directors which would have been valid if such by-law had not been made.

SEVENTH: The corporation shall, to the full extent permitted by Section 145 of the Delaware General Corporation Law, as amended from time to time, indemnify all persons whom it may indemnify pursuant thereto.

EIGHTH: Whenever a compromise or arangement is proposed between this corporation and its creditors or any class of them/or between this corporation and its stockholders or any class of them, any court of equitable jurisdiction within the State of Delaware, may, on the application in a summary way of this corporation or of any creditor or stockholder thereof or on the application of any receiver or receivers appointed for this corporation under the provisions of section 291 of Title 8 of the Delaware Code or on the application of trustees in dissolution or of any receiver or receivers appointed for this corporation under the provisions of section 279 of Title 8 of the Delaware Code ordering a meeting of the creditors or class of creditors, and/or of the stockholders or class of stockholders of this corporation, as the case may be, to be summoned in such manner as the said court directs. If a majority in number representing three-fourths in value of the creditors or class of creditors, and/or of the stockholders or class of stockholders of this corporation, as the case may be, agree to any compromise or arrangement and to any reorganization of this corporation as consequence of such compromise or arrangement, the said

compromise or arrangement and the said reorganization shall, if sanctioned by the court to which the said application has been made, be binding on all the creditors or class of creditors, and/or on all the stockholders or class of stockholders, of this corporation, as the case may be, and also on this corporation.

NINTH: The corporation reserves the right to amend, alter, change or repeal any provision contained in this certificate of incorporation in the manner now or hereafter prescribed by law, and all rights and powers conferred herein on stockholders, dorectors and officers are subject to this reserved power.

IN WITNESS WHEREOF, I have hereunto set my hand and seal, the 3rd day of July, 1985.

In the presence of:

Lisa Mayerson

Lisa mayerson

(L.S.)

Leonard N. Budow

877322089

FILED

NOV 18 1987 9 AM

SECRETARY OF STATE

CERTIFICATE OF AMENDMENT
OF
CERTIFICATE OF INCORPORATION
OF
SENSIS CORPORATION

Pursuant to §242 of the General Corporation Law
of the State of Delaware

JUDSON J. GOSTIN , President of Sensis Corporation, does hereby certify as follows:

FIRST: A Certificate of Incorporation of the Corporation was filed in the office of the Secretary of State of the State of Delaware on the 10th day of July, 1985.

SECOND: A new Article Tenth is hereby added to the Certificate of Incorporation as follows:

> TENTH: A director of the Corporation shall not be personally liable to the Corporation or its shareholders for monetary damages for breach of fiduciary duty as a director to the fullest extent permitted by the Delaware General Corporation Law, as the same exists or may hereafter be amended, except for liability (i) for any breach of the director's duty of loyalty to the Corporation or its stockholders; (ii) for acts or omissions not in good faith of which involve intentional misconduct or a knowing violation of law; (iii) under §174 of the Delaware Corporation Law; or (iv) for any transaction from which the director derived an improper personal benefit. Any repeal or modification of this paragraph by the stockholders of the Corporation shall not adversely affect any right or protection of a director of the Corporation at the time of such repeal or modification.

THIRD: Such Amendment has been duly adopted in accordance

with the provisions of §242 of the General Corporation Law of the State of Delaware by a majority of the holders of the outstanding stock of the Corporation entitled to vote thereon after an affirmed vote of its Board of Directors, which contains a direction to call the shareholders meeting.

IN WITNESS WHEREOF, the Corporation has duly authorized this Certificate of Amendment to be executed on its behalf by its President and attested to by its Secretary this 27th day of October, 1987.

SENSIS CORPORATION

By: _____
Judson J. Gostin, President

ATTEST:

_____
Secretary

STATE OF DELAWARE
SECRETARY OF STATE
DIVISION OF CORPORATIONS
FILED 09:00 AM 02/10/1992
2066226 - 2066226

Certificate

for Renewal and Revival of Charter

SENSIS CORPORATION, a corporation organized under the laws of Delaware, the charter of which was voided for non-payment of taxes, now desires to procure a restoration, renewal and revival of its charter, and hereby certifies as follows:

1. The name of this corporation is SENSIS CORPORATION

2. Its registered office in the State of Delaware is located at 32 Loockerman Square, Suite L-100 Street, City of Dover Zip Code 19901 County of Kent the name and address of its registered agent is United States Corporation Company

3. The date of filing of the original Certificate of Incorporation in Delaware was July 10, 1985

4. The date when restoration, renewal, and revival of the charter of this company is to commence is the 28th day of February, same being prior to the date of the expiration of the charter. This renewal and revival of the charter of this corporation is to be perpetual.

5. This corporation was duly organized and carried on the business authorized by its charter until the 1st day of March A.D. 19 90 at which time its charter became inoperative and void for non-payment of taxes and this certificate for renewal and revival is filed by authority of the duly elected directors of the corporation in accordance with the laws of the State of Delaware.

IN TESTIMONY WHEREOF, and in compliance with the provisions of Section 312 of the General Corporation Law of the State of Delaware, as amended, providing for the renewal, extension and restoration of charters, JUDSON J. GOSTIN the last and acting President, and LYNN H. SMITH, the last and acting Secretary of SENSIS CORPORATION, have hereunto set their hands to this certificate this 3rd day of Feb, 1992

Judson J. Gostin
Last and Acting President

ATTEST:

Lynn H. Smith
Last and Acting Secretary

DOCUMENT NO. 20-04-88/08-01

State of Delaware
Secretary of State
Division of Corporations
Delivered 07:19 PM 07/17/2007
FILED 07:02 PM 07/17/2007
SRV 070823922 - 2066226 FILE

AMENDED AND RESTATED CERTIFICATE OF INCORPORATION OF SENSIS CORPORATION

(Pursuant to Sections 242 and 245 of the General Corporation Law of the State of Delaware)

Sensis Corporation, a corporation organized and existing under the and by virtue of the provisions of the General Corporation Law of the State of Delaware,

DOES HEREBY CERTIFY:

1. That the name of this corporation is Sensis Corporation and that the Certificate of Incorporation was originally filed with the Secretary of State of the State of Delaware on July 10, 1985 under the name Sensis Corporation, and such Certificate was subsequently amended on November 18, 1987.

2. The Certificate of Incorporation of Sensis Corporation, as amended, is hereby amended and restated in its entirety to read as follows:

FIRST: The name of this corporation is Sensis Corporation (the "**Corporation**").

SECOND: The address of the registered office of the Corporation in the State of Delaware is 2711 Centerville Road, Suite 400, in the City of Wilmington, County of New Castle. The name of its registered agent at such address is the United States Corporation Company.

THIRD: The nature of the business or purposes of the Corporation to be conducted or promoted is to engage in any lawful act or activity for which a corporation may be organized under the General Corporation Law of the State of Delaware (the "**General Corporation Law**").

FOURTH: The total number of shares of all classes of stock with the Corporation shall have authority to issues is: (i) twelve million (12,000,000) shares of Common Stock, $0.01 par value per share ("**Common Stock**"), and (ii) five million (5,000,000) shares of Preferred Stock, $0.001 par value per share ("**Preferred Stock**").

The following is a statement of the designations and the powers, privileges and rights, and the qualifications, limitations or restrictions thereof in respect of each class of capital stock of the Corporation.

(1) Common Stock

a. General. The voting, dividend and liquidation rights of the holders of the Common Stock are subject to and qualified by the rights, powers and preferences of the holders of the Preferred Stock set forth herein and as may be designated by resolution of the Board of Directors with respect to any series of Preferred Stock as authorized herein.

b. Voting. The holders of Common Stock are entitled to one vote for each share of Common Stock held at all meetings of stock holders (and written action in lieu of meetings). There shall be no cumulative voting. The number of authorized shares of Common Stock may be increased or decreased (but not below the number of shares thereof then outstanding) by the affirmative vote of the holders of shares of stock of the Corporation representing a majority of the votes represented by all

outstanding shares of stock of the Corporation entitled to vote, irrespective of the provisions of Section 242(b)(2) of the General Corporation Law.

c. Dividend Rights. Subject to the provisions of this certificate of incorporation, the holders of Common Stock shall be entitled to receive dividends at such times and in such amounts as may be determined by the Board of Directors of the Corporation.

d. Liquidation Rights. In the event of any liquidation, dissolution or winding up of the Corporation, whether voluntary or involuntary (sometimes referred to herein as a **"Liquidation"**), after payment or provision for payment of the debts and other liabilities of the Corporation and preferential amounts to which the holders of any outstanding Preferred Stock now or hereafter authorized shall be entitled upon Liquidation, the holders of Common Stock shall be entitled to share ratably in the remaining assets of the Corporation.

(2) Preferred Stock

a. Issuance and Reissuance. Preferred Stock may be issued from time to time in one or more series, each of such series to consist of such number of shares and to have such terms, rights, powers and preferences, and the qualifications and limitations with respect thereto, as stated or expressed herein and in the resolution or resolutions providing for the issue of such series adopted by the Board of Directors of the Corporation as hereinafter provided. Any shares of Preferred Stock which may be redeemed, purchased or acquired by the Corporation may be reissued except as otherwise provided by law of by the terms of any series of Preferred Stock.

b. Blank Check Preferred. Authority is hereby expressly granted to the Board of Directors of the Corporation from time to issue the Preferred Stock in one or more series, and in connection with creation of any such series, by resolution or resolutions providing for the issue of shares thereof, to determine and fix such voting powers, full or limited, or no voting powers, and such designations, preferences and relative participating, optional or other special rights, and qualifications, limitations or restrictions thereof, including, without limitation thereof, dividend rights, special voting rights, conversion rights, redemption privileges and liquidation preferences, as shall be stated and expressed in such resolutions, all to the full extent now or hereafter permitted by the General Corporation Law. Without limiting the generality of the foregoing, and subject to the rights of any series of Preferred Stock then outstanding, the resolutions providing for issuance of any series of Preferred Stock may provide that such series shall be superior or rank equally or be junior to the Preferred Stock of any other series to the extent permitted by law.

FIFTH: The following provisions are inserted for the management of the business and for the conduct of the affairs of the Corporation, and for further definition, limitation and regulation of the powers of the Corporation and of its directors and stockholders:

(1) The number of directors of the Corporation shall be such as from time to time fixed by, or in the manner provided in the By-Laws of the Corporation. Election of directors need not be by ballot unless the By-Laws so provide.

(2) The Board of Directors shall have the power without the assent or vote of the stockholders to make, alter, amend, change, add to or repeal the By-Laws of the Corporation; to fix and vary the amount to be reserved for any reserved for any proper purpose; to authorize and cause to be executed mortgages and liens upon all or any port of the property of the Corporation; to determine the use and disposition of any surplus or net profits; and to fix the times for the declaration and payment of dividends.

(3) The directors in their discretion may submit any contract or act for approval or ratification at any annual meeting of stockholders called for the purpose of considered any such act or contract, and any contract or act that shall be approved or ratified by the vote of the holders of a majority of the stock of the Corporation which is represented in person or by proxy at such meeting and entitled to vote thereat (provided that any lawful quorum of stockholders be there represented in person or by proxy) shall be valid and as binding upon the Corporation and upon all the stockholders as though it had been approved or ratified by every stockholder of the Corporation, whether or not the contract or act would otherwise be open to legal attach because of directors' interest, or for any other reason.

(4) In addition to the powers and authorities hereinbefore or by statute expressly conferred upon them, the directors are hereby empowered to exercise all such powers and do all such acts and things as may be exercised or done by the Corporation; subject, nevertheless, to the provisions of the statues of Delaware, of this certificate, and to any By-Laws from time to time made by the stockholders; provided, however, that no By-Laws so made shall invalidate any prior act of directors which would have been valid if such By-Law had not been made.

SIXTH: The Corporation shall, to the full extent permitted by Section 145 of the General Corporation Law, as amended from time to time indemnify all persons whom it may indemnify pursuant thereto.

SEVENTH: Whenever a compromise or arrangement is proposed between this Corporation and its creditors or any class of them and/or between this Corporation and its stockholders or any class of them, any court of equitable jurisdiction within the State of Delaware may, on the application in a summary way of this Corporation or of any creditor or stockholder thereof or on the application of any receiver or receivers appointed for this Corporation under Section 291 of Title 8 of the Delaware Code or on the application of trustees in dissolution or of any receiver or receivers appointed for this Corporation under Section 279 of Title 8 of the Delaware Code order a meeting of the creditors or class of creditors, and/or of the stockholders or class of stockholders of this Corporation, as the case may be, to be summoned in such manner as the said court directs. If a majority in number representing three fourths in value of the creditors or class of creditors, and/or of the stockholders or class of stockholders of this Corporation, as the case may be, agree to any compromise or arrangement and to any reorganization of this Corporation as consequence of such compromise or arrangement, the said compromise or arrangement and the said reorganization shall, if sanctioned by the court to which the said application has been made, be binding on all the creditors or class of creditors, and/or on all the stockholders or class of stockholders, of this Corporation, as the case may be, and also on this corporation.

EIGHTH: The Corporation reserves the right to amend, alter, change or repeal any provisions contained in this certificate of incorporation in the manner now or hereafter prescribed by law, and all rights and powers conferred herein to stockholders, directors and officers are subject to this reserved power.

NINTH: A director of the Corporation shall not be personally liable to the Corporation or its shareholders for monetary damages for breach of fiduciary duty as a director to the fullest extent permitted by the General Corporation Law, as the same exists or may hereafter be amended, except for liability (i) for any breach of the director's duty of loyalty to the Corporation or its stockholders; (ii) for acts or omission not in good faith of which involve intentional misconduct or a knowing violation of law; (iii) under Section 174 of the General Corporation Law or (iv) for any transaction from which the director derived an improper personal benefit. Any repeal or modification of this paragraph by the stockholders of the Corporation shall not adversely affect any right or protection of a director of the Corporation at the time of such repeal or modification.

* * *

3. The foregoing amendment and restatement was approved by the holders of requisite number of shares of Sensis Corporation in accordance with Section 228 of the General Corporation Law.

4. The foregoing amendment and restatement, which restates and integrates and further amends the provisions of the Corporation's Certificate of Incorporation, had been duly adopted in accordance with Sections 242 and 245 of the General Corporation Law.

IN WITNESS WHEREOF, this Amended and Restated Certificate of Incorporation has been executed by a duly authorized officer of the Corporation on this 17 day of July, 2007.

By: _____
Name: Judson J. Gostin
Title: President, Chief Executive Officer

State of Delaware
Secretary of State
Division of Corporations
Delivered 06:50 PM 07/23/2007
FILED 06:47 PM 07/23/2007
SRV 070843484 - 2066226 FILE

CERTIFICATE OF DESIGNATIONS
OF
SERIES A PREFERRED STOCK
OF
SENSIS CORPORATION

It is hereby certified that:

1. The name of the corporation (the "Corporation") is Sensis Corporation.

2. The Amended and Restated Certificate of Incorporation of the Corporation authorizes the issuance of 5,000,000 shares of Preferred Stock, par value $0.001 per share, and expressly vests in the Board of Directors of the Corporation the authority provided therein to issue any or all of said shares in one or more series and by resolution or resolutions, the designation, number, full or limited voting power, or the denial of voting powers, preferences and relative, participating, optional and other special rights and the qualifications, limitations, restrictions, and other distinguishing characteristics of each series to be issued.

3. The Board of Directors of the Corporation, pursuant to authority expressly vested in it as aforesaid, has adopted the following, creating a Series A issue of Preferred Stock:

Section 1. Designation and Amount. There shall be a series of Preferred Stock designated as "Series A Preferred Stock" and referred to herein as "Series A Preferred Stock." The par value per each share of Series A Preferred Stock is $0.001. The authorized number of shares of Series A Preferred Stock is 1,200,000.

Section 2. Dividends and Distributions.

a. Holders of shares of Series A Preferred Stock will be entitled to receive dividends when, as and if declared by the Board of Directors at a rate equal to 2% per quarter of the Issue Price (as defined below) per share (the "Dividend Accrual Rate"), accruing quarterly (and rounded up to the nearest whole cent) on the first day of March, June, September, December of each year, commencing September 1, 2007 (each a "Dividend Payment Date"). Notwithstanding the action of the Board of Directors with respect to a declaration and payment of dividends in accordance with this Section 2, dividends shall accrue and cumulate on the shares of Series A Preferred Stock from the date of issuance of such shares. The aggregate amount of dividends accrued in accordance with this Section shall be referred to as the "Accumulated Dividends". The dividends accrued under this Section shall be effected by increasing the Stated Value (as defined below) for each share of Series A Preferred Stock by the amount of the dividend per share of Series A Preferred Stock. Dividends will accrue daily on the basis of a 365-day year, whether or not the Corporation has earnings or surplus, and the dividend payable to the holder of a share of Series A Preferred Stock on the first Dividend Payment Date after the share is issued will be the accrued dividend from the date the share is issued to the applicable Dividend Payment Date.

For the purposes hereof, "Issue Price" shall mean the per share price of Series A Preferred Stock equal to $15,000,000 divided by the number of shares of Series A Preferred Stock issued by the Corporation on the closing date of the Stock Purchase Agreement , dated on or about July 23, 2007, by and among the Corporation and the purchasers of Series A Preferred Stock named therein (the "Stock Purchase Agreement") or at some point thereafter in accordance with the terms contained therein and "Stated Value" shall mean an amount equal to the Issue Price plus all Accumulated Dividends.

b. If any Dividend Payment Date is not a Business Day, the dividend payment due on that Dividend Payment Date will be paid on the Business Day immediately preceding that Dividend Payment Date. As used with regard to the Series A Preferred Stock, the term "Business Day" means a day on which both state and federally chartered banks in New York, New York are required to be open for general banking business. In the event that the Corporation's Board of Directors determines to pay a dividend in cash, each dividend shall be payable to holders of record of the Series A Preferred Stock on a date (a "Record Date") selected by the Board of Directors which is not less than ten nor more than thirty days before the Dividend Payment Date on which the dividend is to be paid. No Record Date will precede the date when the resolution fixing the Record Date is adopted.

c. In the event of a Liquidation Event (defined in Section 4 below), an automatic conversion described in Section 5(c) below or a redemption at the option of the holder described in Section 7 below, the Corporation shall, at its sole discretion, settle the amount of then Accumulated Dividends (plus any accrued but unpaid dividends on the shares of Series A Preferred Stock) by either (i) issuing that number of fully paid and nonassessable shares of Series A Preferred Stock in accordance with the following sentence or (ii) making a cash payment equal to the amount of Accumulated Dividends. If the Corporation pays dividends in accordance with clause (i) of this Section 2(c), the amount of shares issued shall be determined by dividing (x) the amount of Accumulated Dividends plus any accrued and unpaid dividends with respect to such record holder of shares (rounded to the nearest whole cent) by (y) the Conversion Price. The Corporation shall not issue fractional shares of Series A Preferred Stock, but in lieu of any fractional shares to which holders may otherwise become entitled pursuant to this provision, the Corporation shall deliver to holders an amount in cash equal to the Conversion Price multiplied by the applicable fraction.

d. No dividends (other than those payable solely in the Common Stock of the Corporation) shall be paid on any Common Stock of the Corporation during any fiscal year of the Corporation until dividends on the Series A Preferred Stock in the total amount of the then Accumulated Dividends per share shall have been paid or declared and set apart during that fiscal year and any prior fiscal year in which dividends were declared but remain unpaid. No dividends shall thereafter be paid on any shares of Common Stock unless at the same time a like proportionate dividend for the same dividend period, ratably in proportion to the respective annual dividend rates fixed therefore, shall be paid on or declared and set apart for the shares of all of the Series A Preferred Stock (on an as-if-converted to Common Stock basis) to the amount paid or set aside for each share of Common Stock.

Section 3. Voting Rights. The only voting rights which the holders of shares of Series A Preferred Stock will have will be any voting rights to which they may be entitled under the laws of the State of Delaware, and the following:

a. (i) Except as required by law and in Section 3(b) below, the holder of each share of Series A Preferred Stock shall be entitled to the number of votes equal to the number of shares of Common Stock into which such shares of Series A Preferred Stock could be converted on the record date for the vote or consent of stockholders and, except as otherwise required by law, shall have voting rights and powers equal to the voting rights and powers of the Common Stock. The holder of each share of Series A Preferred Stock shall be entitled to notice of any stockholders' meeting in accordance with the

Bylaws of the Corporation and shall vote with holders of the Common Stock upon any matter submitted to a vote of stockholders, except as to those matters required by law or this Certificate of Designation to be submitted to a class vote and the election of directors other than the election of the Preferred Director. Fractional votes by the holders of Series A Preferred Stock shall not, however, be permitted and any fractional voting rights resulting from the above formula (after aggregating all shares into which shares of Series A Preferred Stock held by each holder could be converted) shall be rounded to the nearest whole number (with one-half being rounded upward).

(ii) The holders of the Series A Preferred Stock, voting as a separate class, have the right to elect one person to serve as a director of the Corporation, to be in addition to the directors elected by the holders of any class or series of stock of the Corporation other than the Series A Preferred Stock voting as a separate class (the "Preferred Director").

(iii) In the event the Corporation (A) breaches any material covenant contained in (1) the Stock Purchase Agreement (2) Section 3(b) hereof or (3) the Stockholder Agreement and does not cure such breach within 30 days of the occurrence thereof, provided, however that no cure period shall be required for a breach which by its nature cannot be cured (B) fails to redeem shares of the Series A Preferred Stock at the option of a holder in accordance with Section 7 below, (C) any material representation or warranty of the Corporation contained in the Stock Purchase Agreement was untrue in any material respect when made and such failure to be true would have an adverse impact on the business, operation or financial performance of the Corporation, (D) defaults under the terms of any agreement pursuant to which the Corporation has occurred any material indebtedness which has not been cured within the applicable cure period or (E) is the subject of a voluntary or involuntary bankruptcy filing (brought either by or against the Corporation), from and after such event the holders of shares of Series A Preferred Stock shall (immediately upon the giving of written notice to the Corporation by the holders of a majority of the then outstanding shares of Series A Preferred Stock), voting together as a single class, be entitled to elect the smallest number of directors that shall constitute a majority of the authorized number of directors of the Corporation, and the holders of the Common Stock shall be entitled to elect the remaining members of the Board of Directors.

(iv) Unless there are sufficient vacancies on the Board of Directors (or sufficient vacancies are created by resignations of directors or otherwise) to permit the holders of the Series A Preferred Stock to elect a director under this Section, the number of directors constituting the entire Board of Directors will automatically increase in order to permit election of that director. The Corporation will take all steps necessary so that the election by the holders of shares of the Series A Preferred Stock under this Section will not increase the number of directors constituting the entire Board above the maximum number permitted by the Corporation's Amended and Restated Certificate of Incorporation or By-Laws.

(v) The holders of shares of the Series A Preferred Stock may exercise their right under Section 3(a)(ii), 3(a)(iii) and Section 3(a)(iv) by acting through either (a) a written consent with respect to the election of such director or directors, (b) at a special meeting of the holders of shares of the Series A Preferred Stock or (c) at an annual meeting of the stockholders of the Corporation held for the purpose of electing directors.

(vi) A director elected in accordance with Section 3(a)(ii) will serve until the next annual meeting of stockholders of the Corporation or until his or her successor is elected and qualified. When the right of the holders of shares of Series A Preferred Stock to elect directors under Section 3(a)(iii) terminates, the term of office of the person elected under that Section by the holders of shares of Series A Preferred Stock will terminate, and the number of directors constituting the entire Board will be reduced to eliminate the effect of any increase made in accordance with Section 3(a)(iii).

b. While at least 66% of the authorized shares of Series A Preferred Stock are outstanding, the Corporation will not, directly or indirectly, without the affirmative vote at a meeting or the written consent of the holders of at least 66% of the outstanding shares of Series A Preferred Stock, (i) amend, alter or repeal any of the provisions of the Amended and Restated Certificate of Incorporation or By Laws of the Corporation, or of this certificate of designation, so as to affect adversely the preferences, special rights or powers of the Series A Preferred Stock, (ii) create any class or series of stock ranking prior to or on a parity with the Series A Preferred Stock as to dividends, liquidation rights or voting rights, or with a Conversion Price (as defined below) below that of the Series A Preferred Stock, (iii) sell all or substantially all of its assets or merge or consolidate with or into any other entity, (iv) redeem, purchase or otherwise acquire (or pay into or set aside for a sinking fund for such purpose) any of the Common Stock; provided, however, that this restriction shall not apply to the repurchase of shares of Common Stock from employees, officers, directors, consultants or other persons performing services for the Corporation, or any subsidiary pursuant to agreements or plans under which the Corporation has the option to repurchase any or all of such shares; (v) declare or pay any distribution to holders of shares of Common Stock, (vi) authorize any of the Corporation's subsidiaries to sell, issue or transfer any class or series of stock of such subsidiary to any third party, (vii) authorize or issue additional shares of Series A Preferred Stock and (viii) issue a number of options in excess of the number authorized under the Corporation's stock incentive plans either in existence as of the date hereof (without any amendment thereto). This Section will not prevent the issuance of any Series A Preferred Stock which has been authorized in Section 1.

Section 4. Liquidation.

a. Upon the liquidation, dissolution or winding-up of the Corporation, whether voluntary or involuntary (a "Liquidation Event"), the holders of shares of Series A Preferred Stock will be entitled at their option to receive out of the assets of the Corporation available for distribution to its stockholders, whether from capital, surplus or earnings, the greater of either (i) before any distribution is made to holders of Junior Shares (as defined below) an amount equal to (x) the Stated Value plus (y) all dividends which have not been paid ("accumulated unpaid dividends") or (ii) ratably, with the holders of shares of Common Stock with the number of shares of Series A Preferred Stock held of record by the holders equal to the number of shares of Common Stock into which those shares of Series A Preferred Stock could be converted at the Conversion Rate (as defined below) in effect at such date (each, a "Liquidation Distribution"). If, upon any liquidation, dissolution or winding-up of the Corporation, the assets of the Corporation, or proceeds of those assets, available for distribution to the holders of shares of Series A Preferred Stock and of the shares of all other classes or series which are on a parity as to distributions on liquidation with the Series A Preferred Stock are not sufficient to pay in full the preferential amount required to be distributed to the holders of the Series A Preferred Stock and of all other classes or series which are on a parity as to distributions on liquidation with the Series A Preferred Stock, then the assets, or the proceeds of those assets, which are available for distribution to the holders of Series A Preferred Stock and of the shares of all other classes or series which are on a parity as to distributions on liquidation with the Series A Preferred Stock will be distributed to the holders of the Series A Preferred Stock and of the shares of all other classes or series which are on a parity as to distributions on liquidation with the Series A Preferred Stock ratably in accordance with the respective amounts of the liquidation preferences of the shares held by each of them. After payment of the full amount of the Liquidation Distribution to any holder of shares of Series A Preferred Stock, such holder of shares of Series A Preferred Stock will not be entitled to any further distribution of assets of the Corporation. For the purposes of this Section, a consolidation or merger of the Corporation with another corporation (other than a merger where the Corporation is the surviving entity and the holders of a majority of the voting power of the Corporation prior to such merger or consolidation hold a majority of the voting power of the surviving entity), and a sale of substantially all of the assets of the Corporation,

shall, unless otherwise elected by the holders of a majority of shares of the Series A Preferred Stock, be considered a liquidation, dissolution or winding-up of the Corporation.

b. This corporation shall give each holder of record of Preferred Stock written notice of a proposed Liquidation Event (to the extent such Liquidation Event is voluntary) not later than twenty (20) days prior to the stockholders' meeting called to approve such transaction, or twenty (20) days prior to the closing of such transaction, whichever is earlier, and shall also notify such holders in writing of the final approval of such transaction. The first of such notices shall describe the material terms and conditions of the impending transaction and the provisions of this Section 4, and this corporation shall thereafter give such holders prompt notice of any material changes. The transaction shall in no event take place sooner than twenty (20) days after this corporation has given the first notice provided for herein or sooner than ten (10) days after this corporation has given notice of any material changes provided for herein; provided, however, that subject to compliance with the Delaware General Corporation Law such periods may be shortened or waived upon the written consent of the holders of Preferred Stock that represent at least a majority of the voting power of all then outstanding shares of such Preferred Stock (voting together as a single class).

Section 5. Conversion Into Common Stock.

a. Each holder of shares of Series A Preferred Stock will have the right at any time, at such holder's option, to convert all or any of the shares of Series A Preferred Stock held of record by the holder into the number of fully paid and non-assessable shares of Common Stock (calculated as to each conversion to the nearest 1/100th of a share) calculated by multiplying the number of shares of Series A Preferred Stock to be converted by one (1) (the "Conversion Rate", as the same may be adjusted as provided herein).

b. (i) In order to exercise the conversion privilege, the holder of each share of Series A Preferred Stock to be converted must surrender the certificate representing that share to the conversion agent for the Series A Preferred Stock appointed by the Corporation (which may be the Corporation itself), with a notice of election to convert duly completed and signed, at the principal office of the conversion agent. If the shares issuable on conversion are to be issued in a name other than the name in which the Series A Preferred Stock is registered, each share surrendered for conversion must be accompanied by an instrument of transfer, in form satisfactory to the Corporation, duly executed by the holder or the holder's duly authorized attorney and by funds in an amount sufficient to pay any transfer or similar tax which is required to be paid in connection with the transfer or evidence that that tax has been paid.

(ii) As promptly as practicable after the surrender by a holder of certificates representing shares of Series A Preferred Stock in accordance with this Section 5(b), the Corporation will issue and will deliver to the holder at the office of the conversion agent, or on the holder's written order, a certificate or certificates for the number of full shares of Common Stock issuable upon the conversion of the shares of Series A Preferred Stock. Any fractional interest in respect of a share of Common Stock arising upon a conversion will be settled as provided in Section 5(d).

(iii) Each conversion will be deemed to have been effected immediately prior to the close of business on the date on which all the conditions specified in Section 5(b)(i) have been satisfied, and the person in whose name a certificate for shares of Common Stock is to be issued upon a conversion will be deemed to have become the holder of record of the shares of Common Stock represented by that certificate at that time. All shares of Common Stock delivered upon conversion of Series A Preferred Stock will upon delivery be duly and validly issued and fully paid and nonassessable, free of all liens and charges and not subject to any preemptive rights. Upon the surrender of certificates

representing shares of Series A Preferred Stock for conversion and compliance with all the other requirements of Section 5(b)(i), the shares represented by those certificates will no longer be deemed to be outstanding and all rights of the holder with respect to those shares will immediately terminate, except the right to receive the Common Stock or cash as a result of the conversion.

c. Upon the closing of an initial public offering by the Corporation of shares of Common Stock by at least two nationally recognized managing underwriters whereby the Corporation's Common Stock trades on either the NASDAQ National Market or the New York Stock Exchange and yields proceeds to the Corporation of at least $50 million at a price per share of at least two times the Conversion Price (as defined below) per share of the Series A Preferred Stock (an "IPO"), each share of Series A Preferred Stock shall automatically be converted into the number of fully paid and non-assessable shares of Common Stock calculated by multiplying the one share of Series A Preferred Stock and the Conversion Rate

d. No fractional shares of Common Stock will be issued upon conversion of shares of Series A Preferred Stock. Any fractional interest in a share of Common Stock resulting from conversion of shares of Series A Preferred Stock will be paid in cash (computed to the nearest cent) based on the fair market value of one share of the Corporation's Common Stock on the date of conversion. If more than one share of Series A Preferred Stock is surrendered for conversion at substantially the same time by the same holder, the number of full shares of Common Stock issuable upon the conversion will be computed on the basis of all the shares of Series A Preferred Stock surrendered at that time by that holder.

e. If, prior to the closing of an IPO, the Corporation shall (i) pay a dividend or make a distribution on the Common Stock in shares of Common Stock, (ii) subdivide its outstanding shares of Common Stock into a larger number of shares of Common Stock, (iii) combine its outstanding shares of Common Stock into a smaller number of shares of Common Stock or (iv) increase or decrease the number of shares of Common Stock outstanding by reclassification of its Common Stock, then the Conversion Rate immediately after the happening of such event shall be adjusted so that, after giving effect to such adjustment, a holder of each share of Series A Preferred Stock shall be entitled to receive the number of shares of Common Stock upon conversion of such share of Series A Preferred Stock that such holder would have owned or would have been entitled to receive had such share of Series A Preferred Stock been converted immediately prior to the happening of the events described above (or, in the case of a dividend or distribution of Common Stock, immediately prior to the record date therefor). An adjustment made pursuant to this Section 5(e) shall become effective immediately after the distribution date, retroactive to the record date therefor in the case of a dividend or distribution in shares of Common Stock, and shall become effective immediately after the effective date in the case of a subdivision, combination or reclassification.

f. In the event that, prior to the closing of an IPO, the Corporation shall issue shares of Common Stock for a consideration per share that is less than the Conversion Price in effect as of the issuance date of such shares, then the Conversion Rate immediately after the happening of such event shall be adjusted so that the number of shares of Common Stock issuable upon the conversion of each share of Series A Preferred Stock immediately after such issuance date shall be determined by multiplying the number of shares of Common Stock issuable upon conversion of each share of Series A Preferred Stock immediately prior to such issuance date by a fraction, the numerator of which shall be the number of shares of Common Stock outstanding immediately preceding the issuance of such shares plus the number of additional shares of Common Stock to be issued in such transaction, and the denominator of which shall be the number of shares of Common Stock outstanding immediately preceding the date for the issuance of such shares plus the total number of shares of Common Stock which the aggregate consideration expected to be received by the Corporation upon the issuance of such shares (as determined in good faith by the Board of Directors, whose determination shall be evidenced by a board resolution, a

copy of which will be sent to Holders upon request) would purchase at the Conversion Price in effect as of the date of such issuance; and, subject to Section 5(j), in the event of any such adjustment, the Conversion Price shall be adjusted to a number determined by dividing the Conversion Price immediately prior to such date of issuance by the aforementioned fraction. Notwithstanding the foregoing, in the event that the Corporation shall issue shares of Common Stock for a consideration per share that is less than the Conversion Price as of the issuance date of such shares, upon the first such occurrence only the Conversion Price shall be adjusted to equal the price per share of such additional shares of Common Stock issued. No adjustment shall be made pursuant to this Section as a result of any issuance of Common Stock (i) in connection with the exercise of warrants, (ii) to officers, directors or employees of the Corporation pursuant to customary stock incentive plans either in existence as of the date hereof (without any amendment thereto) or new stock incentive plans or amendments to existing stock incentive plans, which are approved by the Corporation's Board of Directors including the Preferred Director, or (iii) in connection with acquisitions of assets or businesses other than from affiliates of the Corporation either in existence as of the date hereof or approved by the Corporations' Board of Directors including the Preferred Director.

g. In the event that, prior to the closing of an IPO, the Corporation shall issue to all holders of Common Stock (i) rights, options or warrants to acquire (provided, however, that no adjustment shall be made under Section 5(f) or this Section 5(g) upon the exercise of such rights, options or warrants), or (ii) securities convertible, exchangeable or exercisable into (provided, however, that no adjustment shall be made under Section 5(f) or this Section 5(g) upon the conversion or exchange of such securities (other than issuances specified in clauses (i) or (ii) which are made as the result of anti-dilution adjustments in such securities)), Common Stock entitling the holders thereof to subscribe for or purchase shares of Common Stock at a price per share that is less than the Conversion Price in effect immediately prior to such issuance, then the Conversion Rate immediately after the happening of such event shall be adjusted so that the number of shares of Common Stock issuable upon the conversion each share of Series A Preferred Stock immediately after such issuance shall be determined by multiplying the number of shares of Common Stock issuable upon conversion of each share of Series A Preferred Stock immediately prior to such issuance by a fraction, the numerator of which shall be the number of shares of Common Stock outstanding immediately prior to the issuance of such rights, options, warrants or securities plus the number of additional shares of Common Stock offered for subscription or purchase or into which such securities are convertible or exchangeable, and the denominator of which shall be the number of shares of Common Stock outstanding immediately prior to the issuance of such rights, options, warrants or securities plus the total number of shares of Common Stock which the aggregate consideration expected to be received by the Corporation upon the exercise, conversion or exchange of such rights, options, warrants or securities (as determined in good faith by the Board of Directors, whose determination shall be evidenced by a Board resolution, a copy of which will be sent to holders upon request) would purchase at the Conversion Price then in effect; and, subject to Section 5(j), in the event of any such adjustment, the Conversion Price shall be adjusted to a number determined by dividing the Conversion Price immediately prior to such date of issuance by the aforementioned fraction. Such adjustment shall be made, and shall only become effective, whenever such rights, options, warrants or securities are issued. No adjustment shall be made pursuant to this Section 5(g) as a result of any issuance of rights, options or warrants (A) to officers, directors or employees of the Corporation pursuant to customary stock incentive plans either in existence as of the date hereof (without any amendment thereto) or new stock incentive plans or amendments to existing stock incentive plans, which are approved by the Corporation's Board of Directors including the Preferred Director or (B) in connection with acquisitions of assets or businesses other than from affiliates of the Corporation either in existence as of the date hereof or approved by the Corporations' Board of Directors including the Preferred Director.

h. Upon the expiration of any rights, options, warrants or conversion or exchange privileges which resulted in adjustments pursuant to this Section 5, if any thereof shall not have been

exercised, the number of shares of Common Stock issuable upon the conversion of each share of Series A Preferred Stock shall be readjusted pursuant to the applicable clause of this Section 5 as if (i) the only shares of Common Stock issuable upon exercise of such rights, options, warrants, conversion or exchange privileges were the shares of Common Stock, if any, actually issued upon the exercise of such rights, options, warrants or conversion or exchange privileges and (ii) shares of Common Stock actually issued, if any, were issuable for the consideration actually received by the Corporation upon such exercise plus the aggregate consideration, if any, actually received by the Corporation for the issuance, sale or grant of all such rights, options, warrants or conversion or exchange privileges whether or not exercised and the Conversion Price shall be readjusted inversely; provided, however, that no such readjustment (except by reason of an intervening adjustment under Section 5(e) shall have the effect of decreasing the number of shares of Common Stock issuable upon the conversion of each share of Series A Preferred Stock or increasing the Conversion Price by an amount in excess of the amount of the adjustment initially made in respect of the issuance, sale or grant of such rights, options, warrants or conversion or exchange privileges.

i. For purposes of any computation respecting consideration received pursuant to this Section 5, the following shall apply: (i) in the case of the issuance of additional Common Stock for cash, the consideration shall be the amount of such cash, provided that in no case shall any deduction be made for any commissions, discounts or other expenses incurred by the Company for any underwriting of the issue or otherwise in connection therewith; and (ii) in the case of the issuance of securities convertible into or exchangeable or exercisable for Common Stock, the aggregate consideration received therefor shall be deemed to be the consideration received by the Company for the issuance of such securities plus the additional minimum consideration, if any, to be received by the Corporation upon the conversion, exchange or exercise thereof (exclusive of the securities so converted, exchanged or exercised) (the consideration in each case to be determined in the same manner as provided in clause (i) of this Section 5(i)).

j. The adjustments required by the preceding sections of this Section 5 shall be made whenever and as often as any specified event requiring an adjustment shall occur, except that no adjustment of the Conversion Price or the Conversion Rate that would otherwise be required shall be made unless and until such adjustment either by itself or with other adjustments not previously made increases or decreases by at least 1% the Conversion Price or the number of shares of Common Stock issuable upon the conversion of the shares of Series A Preferred Stock immediately prior to the making of such adjustment. Any adjustment representing a change of less than such minimum amount shall be carried forward and made as soon as such adjustment, together with other adjustments required by this Section 5 and not previously made, would result in a minimum adjustment. For the purpose of any adjustment, any specified event shall be deemed to have occurred at the close of business on the date of its occurrence.

k. Whenever the Conversion Rate and the Conversion Price is adjusted, the Corporation will promptly send each holder of record of Series A Preferred Stock a notice of the adjustment of the Conversion Rate and Conversion Price setting forth the adjusted Conversion Rate and Conversion Price and the date on which the adjustment becomes effective and containing a brief description of the events which caused the adjustment.

l. In any case in which this Section 5 provides that an adjustment will become effective immediately after a record date for an event, the Corporation may defer until the occurrence of the event (A) issuing to the holder of any share of Series A Preferred Stock converted after the record date and before the occurrence of the event the additional shares of Common Stock issuable upon the conversion by reason of the adjustment over and above the Common Stock issuable upon the conversion

before giving effect to the adjustment and (B) paying to the holder any cash in lieu of any fractional share pursuant to Section 5(d).

m. The Corporation will pay any documentary stamp or similar issue or transfer taxes payable in respect of the issue or delivery of shares of Common Stock on conversion of Series A Preferred Stock; provided, however, that the Corporation will not be required to pay any tax which may be payable in respect of any transfer involved in the issue or delivery of shares of Common Stock in a name other than that of the holder of record of the Series A Preferred Stock to be converted and no such issue or delivery will be made unless and until the person requesting the issue or delivery has paid to the Corporation the amount of any such tax or has established, to the satisfaction of the Corporation, that the tax has been paid.

Section 6. Status. Upon any conversion or redemption of shares of Series A Preferred Stock, the shares of Series A Preferred Stock which are converted or redeemed will have the status of authorized and unissued shares of preferred stock, and the number of shares of preferred stock which the Corporation will have authority to issue will not be decreased by the conversion or redemption of shares of Series A Preferred Stock, but the number of shares of Series A Preferred Stock which the Corporation will have authority to issue will be reduced so that the shares of Series A Preferred Stock which were converted or redeemed may not be re-issued.

Section 7. Redemption at the Option of the Holder.

a. Each holder of Series A Preferred Stock will have the right at any time after three year anniversary of the closing date of the Stock Purchase Agreement to require the Corporation to redeem any or all the shares of Series A Preferred Stock owned of record by the holder, at a redemption price per share equal to 1.5 times the Issue Price for that share (the "Redemption Price").

b. In order to exercise a right to require the Corporation to redeem a holder's shares Series A Preferred Stock, the holder must deliver a request for redemption, accompanied by the certificates representing the shares to be redeemed, to the Corporation (the date of such request, the "Redemption Request Date"). If a request for redemption is given with regard to shares of Series A Preferred Stock promptly, but in any event within thirty (30) business days after the request for redemption is given to the Corporation (the "Redemption Payment Date"), the Corporation will pay the holder making such request, cash equal to the Redemption Price of the shares.

c. (i) If a request for redemption accompanied by the certificates representing the shares to be redeemed is delivered to the Corporation, on the date the request for redemption is given, dividends will cease to accrue with regard to the shares of Series A Preferred Stock to be redeemed, and at the close of business on that date the holders of those shares will cease to be stockholders with respect to those shares, will have no interest in or claims against the Corporation by virtue of the shares and will have no voting or other rights with respect to the shares, except the right to receive cash as a result of the redemption, and from and after the close of business on the date the request for redemption is given the shares to be redeemed will no longer be outstanding.

(ii) The dividend with respect to a share of Series A Preferred Stock which is the subject of a request for redemption delivered on a day which falls between the close of business on a dividend payment Record Date and the opening of business on the corresponding Dividend Payment Date will be payable on the Dividend Payment Date to the holder of record of the share of Series A Preferred Stock on the dividend payment Record Date notwithstanding the redemption of the share of Series A Preferred Stock after the dividend payment Record Date and prior to the Dividend Payment Date.

d. If the Corporation fails to pay to the holders of Series A Preferred Stock cash equal to the Redemption Price of the shares in accordance with this Section 7 on the Redemption Payment Date, such cash amount that is unpaid shall be converted into and exchanged for, the sole discretion of the holders and upon such holder's written instruction, a promissory note in the principal amount of such unpaid balance, bearing an interest rate of 3.0% compounded quarterly from the Redemption Payment Date. The Corporation shall, within five (5) business days following such written instruction, issue the promissory note in favor of such holder or holders referenced above.

Section 8. Ranking. The shares of Series A Preferred Stock will, with respect to the payment of dividends and the distribution of assets on liquidation, dissolution or winding-up of the Corporation, unless otherwise provided in the Corporation's Amended and Restated Certificate of Incorporation or a Certificate of Designations, Rights and Preferences relating to a subsequently issued series of preference stock of the Corporation, rank (i) senior to any other class or series of preferred stock issued by the Corporation and designated as senior to the Series A Preferred Stock, (ii) *pari passu* with any other class or series of preferred stock issued by the Corporation and designated as *pari passu* to the Series A Preferred Stock, and (iii) prior any other class or series of preferred stock issued by the Corporation and designated as junior to the Series A Preferred Stock and to the Common Stock (the shares referred to in subsection (iii) shall be referred to herein as "Junior Shares").

Section 9. Miscellaneous.

a. Except as otherwise expressly provided in this resolution, whenever a notice or other communication is required or permitted to be given to holders of shares of Series A Preferred Stock, the notice or other communication will be deemed properly given if deposited in the United States mail, postage prepaid, addressed to the persons shown on the books of the Corporation as the holders of the shares at the addresses as they appear in the books of the Corporation, as of a record date or dates determined in accordance with the Corporation's Certificate of Incorporation and By-laws, these resolutions and applicable law, as in effect from time to time.

b. The holders of the Series A Preferred Stock will not have any preemptive right to subscribe for or purchase any shares or any other securities which may be issued by the Corporation.

c. Except as may otherwise be required by law, shares of Series A Preferred Stock will not have any designations, preferences, limitations or relative rights, other than those specifically set forth in this resolution and in the Certificate of Incorporation.

d. The headings of the various subdivisions of this resolution are for convenience only and will not affect the meaning or interpretation of any of the provisions of this resolution.

e. The preferences, special rights or powers of the Series A Preferred Stock may be waived, and any of the provisions of the Series A Preferred Stock may be amended, by the affirmative vote at a meeting or the written consent of holders of record of at least 66% of the outstanding shares of Series A Preferred Stock.

* * *

4. The statements contained in the foregoing, creating and designating said Series A Preferred Stock and fixing the numbers, powers, preferences and relative, optional, participating, and other special rights and the qualifications, limitation, restrictions and other distinguishing characteristics

thereof shall, upon the effective date of said series, be deemed to be included and be part of the Amended and Restated Certificate of Incorporation of the Corporation pursuant to Sections 104 and 151 of the General Corporation Law of the State of Delaware.

[SIGNATURE PAGE FOLLOWS]

IN WITNESS WHEREOF, this Certificate of Designations is executed on behalf of the Corporation by its authorized officer as of this 23rd day of July, 2007.

SENSIS CORPORATION

By: Judson J. Gostin
Name: Judson J. Gostin
Title: President & CEO

State of Delaware
Secretary of State
Division of Corporations
Delivered 02:27 PM 06/05/2008
FILED 02:21 PM 06/05/2008
SRV 080666240 - 2066226 FILE

AMENDMENT TO THE AMENDED AND RESTATED CERTIFICATE OF INCORPORATION OF SENSIS CORPORATION

(Pursuant to Sections 242 of the General Corporation Law of the State of Delaware)

Sensis Corporation, a corporation organized and existing under the and by virtue of the provisions of the General Corporation Law of the State of Delaware,

DOES HEREBY CERTIFY:

1. That the name of this corporation is Sensis Corporation and that the Certificate of Incorporation was originally filed with the Secretary of State of the State of Delaware on July 10, 1985 under the name Sensis Corporation, and such Certificate was subsequently amended on November 18, 1987 and on July 17, 2007.

2. The Amended and Restated Certificate of Incorporation of Sensis Corporation, is hereby amended by deleting paragraph SIXTH and now to read as follows:

SIXTH: INTENTIONALLY OMITTED.

3. The foregoing amendment was approved by the holders of requisite number of shares of Sensis Corporation in accordance with Section 228 of the General Corporation Law.

4. The foregoing amendment, which amends the provisions of the Corporation's Amended and Restated Certificate of Incorporation, had been duly adopted in accordance with Sections 242 of the General Corporation Law.

IN WITNESS WHEREOF, this Amendment to the Amended and Restated Certificate of Incorporation has been executed by a duly authorized officer of the Corporation on this 17th day of April, 2008.

By: _____
Name: Judson Gostin
Title: President and CEO

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1. Executive Summary

1.1 Overview

Sensis is pleased to respond to the Port Authority's request for proposal for a Surface Management System at JFK. The proposed solution includes the proven Aerobahn Platform, new departure metering functionality and techniques tailored to the Port Authority's needs, a mature Aerobahn hosting and service infrastructure with a long track record of high availability, and professional on and off-site staffing for sustainable success.

Expansion of the Surface Management program at JFK is one of the key initiatives that will shape the future of air traffic management. With three major airports and four contiguous surrounding airspaces, efficient management of the New York Metroplex is of paramount importance to the National Airspace System (NAS). Improvements to the NAS and NextGen solutions must include a focus on the airport surface as it is no longer simply a point of origination or destination, but an increasingly critical area of control. While government and industry groups in the U.S. and around the world are striving to better understand and improve surface collaboration, the Port Authority and JFK stakeholders have taken action and are leading by example. Sensis is proud to already be a part of the success at JFK, and is prepared to meet and surpass the Port Authority's expanded surface management objectives.

The unique challenges of the New York Metroplex, specifically at JFK, are some of the most difficult in the world and will require a blend of proven technologies, experience, and industry leading thinking in order to be adequately addressed. Successful implementation of the Port Authority's Surface Management program will require:

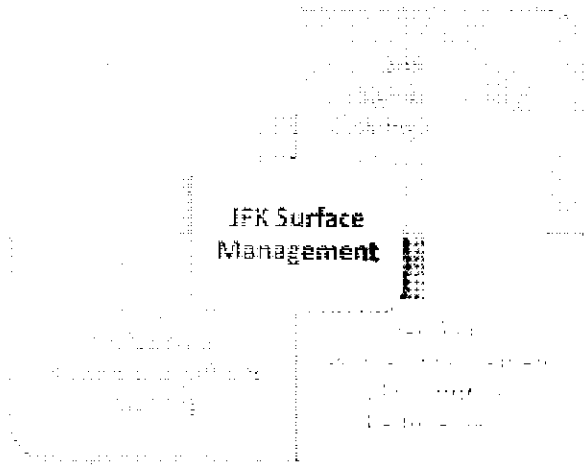
- A Surface Management System (SMS) that is reliable, state-of the-art, and market tested (the progress the Port Authority has achieved thus far is impressive and the stakes are too high to risk unproven technologies);
- The departure metering functionality and operational management must provide additional value that builds on the success achieved thus far;
- The SMS must continue to deliver benefits for all stakeholders at JFK, and system-wide, to ensure continued participation of key stakeholders;
- The team providing the solution must be recognized for their expertise in both surface management and air traffic systems, and be capable of delivering an integrated operational solution within the requested timeline.

Sensis' proposed solution will build on the foundation of Aerobahn's reliability and incorporate additional functionality that improves On-Time performance, improves the passenger experience, reduces taxi time and associated emissions, increases runway utilization, and increases the likelihood of adoption among stakeholders at JFK.

1.2 The Sensis Solution

At the heart of Sensis' solution is Aerobahn, the world's leading Surface Management System currently in use at JFK and 16 other top airports worldwide. Aerobahn has been in development for over 10 years, has thousands of users, millions of hours of use, and has defined what an SMS is. It provides real-time situational awareness, metrics, predictions, and alerts, and has extensive data reporting and analytic capabilities. Supporting the easily accessible web interface is an advanced data processing engine capable of integrating flight information and surveillance from a huge array of operational systems to then derive higher level data events, statistics, and predictions.

Figure 1 Components of Sensis' Proposed SMS Service



A pioneer in surface management, Sensis has long been committed to listening and responding to customer needs and advancing the state of surface management. As a result, Aerobahn's sophisticated capabilities are immediately ready to meet many of the Port Authorities needs and set it far apart from every other product on the market. A few of Aerobahn's key differentiating benefits are:

- **Region of Interest Processing (ROI)**
  Aerobahn divides the airport surface into over a thousand polygons to track all aircraft entries, exits, and occupancies. The employed region occupancy logic leverages Sensis' unique familiarity with surface surveillance like ASDE-X and incorporates years of improvements and anomaly handling techniques for the most accurate measurements available. ROI processing provides the Port Authority with capability to better monitor metering positions and harvest data for improved runway and taxiway utilization (i.e. pavement management)
- **Data Integration and Correlation**
  Aerobahn's huge deployment base requires it to interface with a diverse set of customers and IT systems, including direct interfaces to 6 major airlines in the U.S. already. It has highly optimized data correlation algorithms that can

correlate, prioritize, and disambiguate overlapping and conflicting data sources. This is an area of particular significance for JFK due to the number of carriers, terminal operators, and data sources. The benefit to the Port and their aviation partners is improved data accuracy for departure management, schedule conformance, flight call sign correlation, and ultimately, confidence of the SMS users.

- **Dynamic Rules Engine**
  Aerobahn is the only surface management system that truly exposes the value of flight information, events, and predictions by enabling nearly any operational situation to be automatically identified and acted upon. Through a user friendly interface, flexible rules can be constructed that highlight, alert, aggregate, or record important flights for reporting. Dynamic Rules allows users to focus their attention on resolving potential problems rather than discovering them. When combined with Aerobahn's ability to notify users via visual, audible, e-mail or text alerts, users experience increased productivity.
- **Comprehensive Playback**
  Aerobahn's playback capabilities are not an afterthought or add-on, they are at the very core of its architecture. All real-time data provided through the numerous real-time tools can be played back to review not only the surface operation, but the exact information that was being presented to users through Aerobahn at the time. Comprehensive playback allows the Port to conduct post event analysis and evaluation of situations and operational performance.
- **Integrated Chat System**
  Aerobahn's integrated chat system provides multiple chat rooms for public or more restrictive chat conversations. Additionally, all conversations are logged and auditable by authorized personnel. When used in a departure metering environment, the integrated chat feature allows users to communicate in same system used to provide recommended push back times. The drop and drag functionality allows flight specific references to be incorporated in chat conversations.
- **Advanced Analytics and Reporting**
  Aerobahn provides a large set of preconfigured reports, raw data tables, and built in analytics capabilities, including advanced pivot tables and filtering. Additionally, when combined with Dynamic Rules and Watch Lists, reports can be run to aggregate statistics for an incredibly diverse set of operational situations. Furthermore, the existing database created over the past 2 years provides increased value to the Port Authority.

To meet the Port Authority's requested SMS requirements, Sensis will build on its 6th generation Aerobahn product and provide the following new features and capabilities:

- **Integrated Departure Metering and Sequencing**
  The Sensis solution is more than just Departure Metering. A fully integrated set

of departure metering and sequencing capabilities will be added to Aerobahn, providing:

- Departure Sequencing to increase Runway utilization
- Departure slot rationing in order to maintain a configurable target queue length and equitable distribution of departure times
- User tools to disseminate and adjust assigned departure slots and flight specific call-for-taxi times
- Automated system to request and assign metering points when needed
- Optimized departure sequencing – a final pass of minor adjustments to flight call-for-taxi times in order to improve the overall airport throughput and account for constraints like wake vortex separation and departure fix balancing
- Recommended off block times based on dynamic taxi time predictions to help operators better adhere to their departure slots

Element of Success	Detect the Difference
NYSERDA sponsored development of Departure Management Algorithms	Under contract to the New York State Energy Research and Development Authority, Sensis has developed a prototype JFK Departure Manager (DMAN). Included in DMAN is an integrated a departure metering and sequencing feature to reduce taxi-out time, fuel burn, & emissions while increasing runway capacity and reducing overall departure delays

- **Dynamic Flight Predictions**
  The Aerobahn Predictive Engine will be adapted to provide flight specific forecasted taxi paths and times at JFK. This includes estimated off block, wheels up, wheels down, and in block times, as well as taxi routes and region entry times along the entire predicted taxi path. The Predictive Engine directly address the Port's desire to improve demand and capacity predictions for JFK.
- **Aerobahn Service at LGA and EWR**
  In order to provide situational awareness and operational decision support across the NY Metroplex, Sensis will provide the Port Authority with Aerobahn Service at LaGuardia and Newark airports. The additional information provided via Aerobahn provides an opportunity to better monitor performance of the other two airports in the metroplex relative to JFK to ensure a balanced approach to management of the Metroplex. Aerobahn displays of the three primary airports can also be provided to the FAA, including virtual departure queues, so that a true picture of airport demand is available. This concept will provide a foundation for further developments of Collaborative Decision Making.

Element of Success	Detect the Difference
Comprehensive View of the New York Metroplex	The Port will have real-time access to surface and terminal airspace conditions at the three key airports in the Metroplex. With the expanded situational awareness, the Port Authority can stay apprised of each airports current and historical throughput, departure queue lengths, and de-icing operations. Aerobahn can be used to improve operational decision making and ensure balanced and objective execution.

- **Integrated ATC Radio and Weather Data**
  Sensis will integrate ATC radio communications and weather information into real-time tools and playback in order to support a more complete situational understanding. The recorded voice data will enhance Sensis Departure Management operations and provide the Port with improved event analysis capability.
- **Expansion and Customization of the Aerobahn Dynamic Rules**
  Sensis will enhance the Aerobahn Dynamic Rule Engine to support the identification of forecasted demand imbalances and specific departure metering conditions like potential non-compliance. Additionally, Sensis and its partners will work with the Port Authority to customize rules and workspaces to meet their operational needs and increase user productivity.
- **Improved, Geographically Diverse Data Service Infrastructure**
  Sensis will expand its proven Aerobahn data service infrastructure to provide even greater reliability in support of its increased usage and reliance at JFK. Users can be assured that all controllable causes of system outages have been reinforced to minimize service disruption and meet the Port's Service Level requirements. Although Sensis has designed the infrastructure to support the required .9999 service levels, Sensis will ensure that fallback procedures are in place to mitigate any negative impact of a service outage caused by surveillance or any related system.
- **Emissions Tracking**
  Aerobahn will be enhanced with an integrated emissions tracking capability to provide critical information about the additional benefits of departure metering and ensure objective reporting for the local communities.
- **Increased User Capacity**
  The current Aerobahn system at JFK will be extended and enhanced to support 400 simultaneous users and 3200 registered accounts. All users will be able to securely access the Aerobahn web-based interface. The increased capacity will allow more stakeholders to contribute and receive the benefits of an enhanced SMS.

When fully integrated, the Port Authority and other stakeholders at JFK will have access to the most sophisticated and powerful surface management system in the world.

Element of Success	Detect the Difference
Leading Edge Technology	Sensis has invested over $7.0 Million in the development of Aerobahn. The current Product Road map includes development of over 35 new product features scheduled for delivery within the next three years. Continued development ensures the Port Authority will have access to leading edge technology well into the future.

Sensis is also the industry leader in SMS Service Delivery:

- As part of the provided service, Sensis will conduct annual User Group meetings to provide updated information on new features and capture of recommended functionality
- Annual Upgrades of the Aerobahn software will keep the Port equipped with World-Class capabilities
- Sensis' industry leading "Gold Standard" Customer Service and Support is available 24 hours per day, 7 days per week and 365 days per year.

Aerobahn is inarguably the most mature SMS available today and aligns extremely well with the requested functionality. However, the Port Authority's current success and forward looking plans are at the forefront of innovation and will still require significant development from any potential supplier. Sensis is best positioned to not only meet the Port Authority's ultimate goals, but do so on the shortest timeline with the least amount of risk. Sensis has an incredibly strong track record of delivering on its promises, particularly as they relate to aggressive, cutting edge Aerobahn SMS deployments. One of Sensis most recent successes was in a competitive procurement with the Department of Aviation at Hartsfield-Jackson Atlanta International Airport (ATL). In similar circumstances to JFK, Sensis leveraged its Aerobahn platform for an ATL SMS system on top of which it developed significant, and truly innovative, predictive capabilities. The result was that Sensis delivered the most sophisticated SMS on the market at time, and did so ahead of schedule.

Element of Success	Detect the Difference
Sensis has Award-Winning and Onsite SMS Support and Training to Maximize JFK SMS Operational Success	Sensis supports day-to-day JFK operations through on-site 24/7 operational support, as well as award-winning help utilities, training and Aerobahn user groups. The Aerobahn user group meetings support cross-fertilization of the Port Authority with other long-time Aerobahn users for best-of-breed ways to use the Aerobahn software to support improved airport operations. This high-quality operational support is critical because we understand that the Surface Management System capability is only as good as the operational personnel who understand and use the capabilities.

During the runway construction project of 2010, the Port demonstrated the leadership required to break through the barriers that impede collaboration among stakeholders and achieve meaningful results for the national airspace, the traveling public, and surrounding communities at JFK. It is Sensis' commitment, and within our capability to deliver a solution that capitalizes on the success achieved thus far and to deliver an industry-leading system that achieves the Port Authority's goals and maintains their leadership within the industry.

1.3 The Sensis Team

To ensure operational success, Sensis has teamed with Robinson Aviation, the leading provider of Managed Air Traffic Control tower services at over 93 locations, and ANSA, renowned experts in the areas of air traffic control, optimization, and system analysis. Robinson Aviation's experience includes FAA certified Operations, Ramp Tower Management, and management of Departure Metering functions at Seattle and Fort Lauderdale. With the Aerobahn platform to augment their experience, Robinson will professionally deliver a new level of automation and quality to the meter operation at JFK. The Sensis Team brings together a comprehensive set of operationally-proven industry airport and airspace experts, with a proven track-record in areas relevant to the proposed SMS development and deployment.

Organization	Why Chosen
Sensis	Global provider of advanced ATM, airline, and airport decision support tools; and Aerobahn, the World's leading Surface Management System; Developer of decision support tools for predicting taxi-times and departure-release planning tools, with extensive contacts with airport stakeholders; Integrator of surface optimization algorithms into NASA's fast-time simulation platform; Expertise in airport surface operations analysis for safety, efficiency, and environmental impact with patented algorithms; Developer of algorithms, software, and architecture for airport conflict detection and resolution for NASA; Developer of fast-time national, regional, and airport surface traffic simulation platforms; Extensive user of fast-time simulations in conducting NextGen analyses for NASA, FAA, and JPDO; Validation and Verification (V&V) expert and fast-time simulation integrator for NASA's Mixed Integer Linear Programming (MILP) based Traffic Flow Management (TFM) Optimization Solution; Subject matter experts in NAS demand generation and ATM assessment;

Sensis, a New York-based company with over $170M in 2010 annual revenues, is proud to design and deploy solutions that address critical issues facing the aviation industry. Sensis has a 26-year history in sensor and system development. The workforce of approximately 600 employees services a global base of more than 60 customers located in more than 35 countries across six continents. Its customers include 54 of the world's 100 largest airports. One of Sensis' industry-leading products, Aerobahn, has been providing benefits to Customers in a Service framework for over ten years. In development since 1999, Aerobahn is a mature Surface Management System platform in commercial use at 17 airports worldwide since 2004 supporting day-to-day collaboration between airport authorities, airlines, and the Air Navigation Service Providers (ANSP) such as the FAA. The real-time collaboration and post-operational planning improvements that Aerobahn provides have been cited multiple times as the source of major throughput and efficiency increases at major US airports.

The Port Authority will also benefit from capabilities delivered by Sensis' world-class NextGen research and operations analysis team who have been studying JFK airport and associated terminal airspace operations for over 10 years. The Sensis team understands New York and JFK's unique demands and constraints that include not just airport issues like the high demand-to-capacity airport loadings combined with high-frequency ground delay programs (GDP) and other Traffic Management Initiatives, but also the airspace constraints like the multi-airport departure fix merges, the small size of the New York (ZNY) airspace and elongated shape of surrounding airspace sectors that lead to the need for highly coordinated efforts between the various FAA stakeholders.

Sensis is uniquely suited to provide industry-leading capabilities to the Port Authority and its stakeholders through its experience and expertise in:

- FAA systems engineering including development of portions of the FAA's TMA and TFMS systems and participation in FAA's CDM Surface Management Working Group
- Strategic, pre-tactical and tactical Traffic Flow Management expertise including the innovative development of FAA TFM rationing and scheduling algorithms
- Pre-tactical and tactical Departure Management systems including FAA-funded Departure Flow Management (DFM) tools and processes
- Fuel and emissions impact assessment of aviation
- Development of Flight Operator Surface Application (FOSA) interface for the Collaborative Departure Queue Management tests being conducted by the FAA in Memphis.

- Provider to the FAA of ASDE-X surface surveillance systems at 35 top US airports

RVA
Robinson Aviation (RVA), Inc.

An aviation services company specializing in air traffic control operations; communications engineering, installation, & maintenance; navigation and landing system engineering, installation & maintenance; aviation safety and CNS/ATM studies, and transportation security studies and planning. In business since 1986, Robinson currently operates 93 air traffic control towers under the FAA Contract Tower (FCT) Program and two (2) Ramp Control; Administers the FAA Air Traffic Selection and Training (AT-SAT) examination, a pre-hire controller aptitude test, for the FAA. Utilizes ISO-Certified Quality Management System with Safety Management Systems. Supports DOD provides turnkey engineering and installation services for air traffic control equipment and facilities. Completed air traffic projects in Ghana, Ukraine, Azerbaijan, Armenia, Georgia, Moldova; aviation security studies in Uzbekistan; an air space management study in Indonesia, aviation safety oversight studies in Vietnam, Bulgaria and seven (7) West African Economic and Monetary Union (UEMOA) countries.

Robinson Aviation (RVA), Inc. is an aviation services company that specializes in air traffic control operations; communications engineering, installation, & maintenance; navigation and landing system engineering, installation & maintenance; aviation safety and CNS/ATM studies, and transportation security studies and planning.

RVA has over eight (8) years of continuous ramp tower service under two contracts; this service includes departure metering and utilizes ASDE-X Technology by Sensis. The Port of Seattle selected RVA to operate the Seattle Tacoma International Airport (SeaTac) Ramp Control Tower (Seattle Ramp Tower (SRT)) in January 2006. In June 2007, Fort Lauderdale/Hollywood International Airport (FLL) selected RVA to operate their ramp tower. At SeaTac, RVA has provided services to 1,500,000 operations since contract startup with an average per year of 337,554. At FLL, we have provided services to over 1,000,000 operations since contract startup with an average of 290,222 per year. Options have been exercised on both contracts and RVA has won a second competitive term on SeaTac and it has recently been expanded to include a Gate/Hardstand Utilization Data Collection Project.

Heading up Robinson Aviation's on-site staff will be former FAA JFK Air Traffic Control Tower Assistant Manager - Dave Pagagua. Mr. Pagagua will ensure that all staff are properly trained on the unique aspects of the New York airspace and the corresponding impact on operations at JFK. Furthermore, he will ensure proper integration of technology and operations to produce maximum benefit for the Port Authority.

Air Network Simulation & Analysis Inc.	Extensive research expertise in the areas of control, optimization, and system analysis and design, as well as subject matter expertise with real-world knowledge of airport operations and constraints; Principal Investigator of a previous surface optimization NRA that developed a suite of modules to optimize surface operations; Co-investigator for another surface optimization NRA that explored and identified methods for incorporating environmental constraints into surface optimization decisions; Expertise in fast computation methods for solving MILPs; Developer of real-world optimization algorithms and leader/participant in field trials of new technologies. ANSA is a Minority Business Enterprise.

ANSA provides innovative airline and FAA operational improvements including research, development and deployment of Continuous Descent Approach profiles (CDA) and other airline and government NextGen concepts including pre-tactical and tactical aircraft sequencing, scheduling, and runway allocation advisory systems.

Element of Success	Detect the Difference
Sensis has the **Team Required to Mitigate Technical** and Operational Risk	Sensis has best-of-breed NextGen development capabilities. The Sensis team includes Robinson Aviation the leading provider of Manage Tower Services in the United States, and ANSA, a Minority Business Enterprise (MBE), who have critical subject matter expertise on FAA Traffic Flow Management, Departure Flow Management, Surface Management, and Fuel and Emissions Impact Modeling

1.4 Metering Operations

Manual processes to perform Departure Metering services such as those in use at JFK today, will not be sufficient to sustain continued improvement and consistent delivery of benefits. By integrating the Sensis' Departure Management (DMAN) system with the Aerobahn platform, flight-specific call–for-taxi times are algorithmically generated and shared with airlines and terminal operators. The DMAN system accounts for multiple factors including airfield configuration, desired departure queue depth, aircraft type and location on the surface to generate a flight-specific call for taxi time (CFT) that ensures an optimum sequence of aircraft to the departure threshold. Sensis' proposed departure metering and sequencing functionality offers substantial benefits beyond the current JFK metering program. While the current program moves departure delay from the taxiways to the ramp, the Aerobahn metering and sequencing program also reduces delay by delivering aircraft to the departure queue in an optimized sequence, enabling greater throughput at the runway. Improvements to the departure sequence can increase capacity by 1-2 departures per hour and reduce take-off delay by 1-2 minutes per departure. Of the remaining delay, the Aerobahn metering and sequencing program enables flights to take a greater fraction at the gate with engines off, rather than on the taxiways or at the

spot. By metering each departure runway individually, providing flight-specific call-for-taxi times, and recommending gate departure times, Aerobahn maintains a shorter, less variable departure queue without starving the runway, and allows aircraft to wait at the gate longer while still reaching the movement area and the runway as planned. At times when limited gate capacity constrains metering operations, Aerobahn's metering point assignment and monitoring features enable metering points to be used more frequently and effectively than they are today. Furthermore, Aerobahn's integrated monitoring and reporting features enable greater adherence to metering procedures and assure participants that they are being treated fairly.

Technology is only part of a successful solution. Operation of the Metering Coordination Center will require professionally trained personnel, experience and knowledge of the operating conditions at JFK. As it pertains to this procurement, Robinson Aviation brings a wealth of experience conducting metering operations in Seattle and Fort Lauderdale. According to a May 26, 2010, Port of Seattle Memorandum, in a three-year period, since 2006, an estimated annualized savings of over $3 million was realized. In 2008, Port of Seattle, Aviation Managing Director, Mark Reis testified before the Aviation Subcommittee of the Transportation and Infrastructure of the U.S. House of Representatives regarding Airport/Airline Collaboration on Aircraft Emission Reduction, in which he stated:

> *'We estimate that aircraft ramp movements are five percent more efficient and that this efficiency has potentially saved the airlines 800,000 gallons of fuel per year and reduced GHG emissions by 8,500 tons per year.'*

The following two sections describe in greater detail how the Sensis Team can meet the Port Authority's requested project phases.

1.4.1 Phase A Metering Solution

The Sensis Team will provide the Phase A system requirements that will maintain existing service and continuity of functionality at JFK, while adding benefits and incrementally transitioning to the final concept of operations. As opposed to the optimal *Time Based Metering* solution that will be provided in Phase B, in Phase A an automated *Count Based Metering* program will be delivered, staffed, and fully executed by Robinson Aviation using the Aerobahn SMS Service. The *Count Based Metering* system is essentially what is being implemented today at Kennedy, and involves rationing a number of flights to different carriers or terminal operators in time buckets or bins. The Sensis Team's Phase A solution will utilize an enhanced version of the Flight Operator Surface Application (FOSA) interface that was built into Aerobahn for the FAA's Collaborative Departure Queue Management (CDQM) trials in Memphis. Sensis' Phase A proposal provides all of the necessary functionality to keep departure metering running at JFK in January, and does so with field tested components that closely mimic the current metering process in order to limit training and transition pains. While manual processes to perform Departure Metering services such as those in use at JFK today, will

not be sufficient to sustain continued improvement and consistent delivery of benefits, the Sensis Phase A solution utilizes an approach that closely mimics the current metering process in order to limit training and transition pains. However, the Sensis Phase A approach exceeds the current Manual approach in key areas and provides significant additional benefits.

The proposed Phase A solution:

- Incorporates Sensis' latest rationing algorithms to ensure equitable distribution within the buckets;
- Utilizes metering by buckets, which is the currently employed system to minimize the training and transition pain;
- Utilizes the already fielded FOSA departure metering interface, which has received favorable feedback from Delta Airlines, to reduce risk and improve likelihood of quick success;
- Maintains all crucial components of the Port Authority's current departure metering program with the additional benefits of:
    - Operations Scorecard developed and available for daily use
    - Integrated conformance monitoring
    - Integrated situational awareness (metering, communications, and graphical displays are unified and consistent)
    - Improved automated mechanism for requesting and assigning metering points, enabling more frequent and effective use of metering points
    - Integrating Metering Point tracking
    - Metering by runway instead of airport wide
    - Playback and reporting on metering assignments and performance

1.4.2 Phase B Metering Solution

In Phase B, the Sensis Team is proposing transitioning the existing *Count Based Metering* program to a *Time Based Metering* program, adding in runway sequence optimization, and rounding out the supporting software feature set.

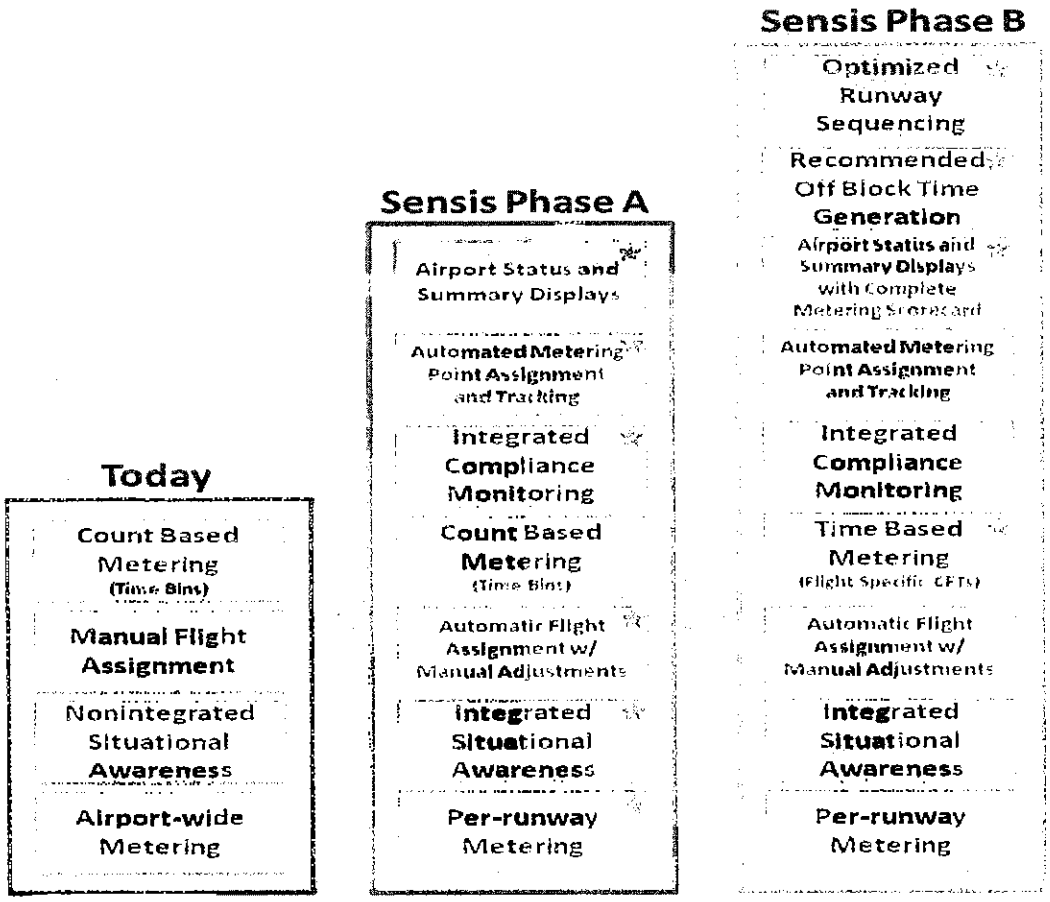
The proposed Phase B solution builds on Phase A and:

- Utilizes time based metering with the assignment of flight specific Call For Taxi Time (CFT) in order to reduce runway queue length variability, provide recommended off block times (ROBTs), and ultimately allow a greater percentage of delays to be taken at the gate

- Leverages Sensis' existing Departure Manager (DMAN) developed with New York State Energy Research and Development (NYSERDA) to ensure a timely and successful delivery
- Augments the metering process with per runway sequence optimizations that incorporate minor sequence adjustments to optimize runway throughput based constraints (e.g., wake vortex class, departure fix balancing).

As depicted in Figure 2, Sensis will build on our successful Aerobahn platform and deploy Metering Operations in a phased approach.

Figure 2 Metering Phased Approach



1.5 The Sensis Advantage

Sensis is uniquely positioned to meet the phased timelines requested by the Port Authority due to the advanced nature of Sensis' product development and track record of successful service delivery.

- Existing MOU's are already complete and data access is assured

- Sensis already has experience supporting the unique airport operational requirements of a wide range of JFK-focused operational personnel including the Port Authority, Airlines, and FAA at the JFK Air traffic Control Tower, Tracon, New York Center, and the National Command Center.
- Sensis is familiar with the coverage and capabilities of the Gate Surveillance system. The award-winning surveillance system supporting the JFK Surface Management Systems was developed by Sensis for the FAA's ASDE-X program. No one is better suited than Sensis to understand how best to integrate and adapt the Gate surveillance system data for use in a surface management system.
- Sensis has been working with the data providers at JFK to ensure accurate schedules and gates. At contract award, the data content of Aerobahn will be validated and accurate.
- Our team is knowledgeable and familiar with the JFK operations and the Port Authority Management Team

Element of Success	Detect the Difference
Operationally-Proven, Mature Aerobahn Platform Minimizes Risk	Sensis is leveraging its Aerobahn SMS Platform, which is an operationally-proven product currently in use 24/7 at 17 airports and has been running for over 6.2 Million User hours at 99.6 % service uptime. Because of its operationally-proven product and development and deployment process, Sensis can uniquely meet the Port Authority requirements for minimized technical, schedule, and budget risk and minimized deployment time.

1.6 Summary

The Port Authority has taken the bold step of building on the success achieved during the Runway 13R-31L construction project of 2010 and leading the development of more formalized departure metering capabilities in one of the most complex operating environments in the world. To ensure success at this critical time, the Port Authority will require proven technology, leading edge thinking, and operational expertise to ensure continued success and progress. The stakes are high and the team must be up to the challenge. Sensis and its partners have the technology, credentials, and experience to deliver on the Port's objectives. Our proposed solution incorporates proven technology to eliminate associated risks of new and untested software while incorporating leading edge thinking in line with NextGen concepts. Our expanded surveillance capabilities at LGA and EWR will provide a comprehensive view of the New York Metroplex and provide a platform for expanded collaboration. When compared to the features and

capabilities in use at JFK as described in Figure 3, our proposed system delivers substantial and remarkable improvements.

Figure 3 A summary of Features and Capabilities compared with those currently in place. When fully integrated, the Port Authority and other stakeholders at JFK will have access to the most sophisticated and powerful surface management system in the world.

Description	Today	Future	Comments
Licenses	75	400	Increase of 325 licenses
Departure management	Manual Process	Integrated	Professional Staffing- Aerobahn Trained
Sensis DMAN Engine	Not adapted to JFK	Integrated	Additional Taxi time reduction, increased runway utilization
Aerobahn Predictive Engine	Not adapted to JFK	Integrated	Provides Taxi Time, and Demand and Capacity Predictions
Metering Hours	8 hours per day	14 hours per day	Additional 6 hours per day of staffing
Dedicated On Site Manager	Not in Place	Sensis Manager	Incremental Person over staffing
ATC Radio Integration	Does not exist	Included	Integrated with playback
Weather Integration	Does not exist	Included	Improved access to information
Emissions Tracking	Does not exist	Included	Available Dynamically
Conformance Monitoring	Does not exist	Custom Functionality	Only available with Sensis
Custom Reports	Robust capability	Expanded and integrated with Departure Metering	Leverages Sensis data superiority
Service level	No SLA	0.9999	Creation of supporting infrastructure
Aerobahn at LGA	Does not exist	10 seats	Movement Area only
Aerobahn at EWR	Private System	10 seats	8 additional seat for Port only

As will be shown in our Technical Proposal, we have qualified and experienced technical experts, a proven Aerobahn SMS and recognized operational experts leading our team for the Port Authority. Our proven program management and quality system standard operating procedures (SOP) will ensure a successful implementation in line with the requested timing. The Aerobahn reporting capabilities used as part of our maintenance management combined with our understanding of the operating environment at JFK ensures our start-up approach and business transition processes result in minimal risk and maximum value to the Port Authority.

Sensis is uniquely qualified to provide the Port Authority, and associated stakeholders at JFK and surrounding Metroplex with a secure, reliable and integrated Surface and Departure Management System that will deliver improved demand and capacity

predictions, maximized airport and airspace capacity, while minimizing adverse effects on users, the public and environment.

ATTACHMENT A
AGREEMENT ON TERMS OF DISCUSSION

The Port Authority's receipt or discussion of any information (including information contained in any proposal, vendor qualification, ideas, models, drawings, or other material communicated or exhibited by us or on our behalf) shall not impose any obligations whatsoever on the Port Authority or entitle us to any compensation therefor (except to the extent specifically provided in such written agreement, if any, as may be entered into between the Port Authority and us). Any such information given to the Port Authority before, with or after this Agreement on Terms of Discussion ("Agreement"), either orally or in writing, is not given in confidence. Such information may be used, or disclosed to others, for any purpose at any time without obligation or compensation and without liability of any kind whatsoever. Any statement which is inconsistent with this Agreement, whether made as part of or in connection with this Agreement, shall be void and of no effect. This Agreement is not intended, however, to grant to the Port Authority rights to any matter, which is the subject of valid existing or potential letters patent. The foregoing applies to any information, whether or not given at the invitation of the Authority.

Notwithstanding the above, and without assuming any legal obligation, the Port Authority will employ reasonable efforts, subject to the provisions of the Port Authority's Freedom of Information Policy and Procedure adopted by the Port Authority's Board of Commissioners on November 20, 2008, which may be found on the Port Authority website at: *http://www.panynj.gov/corporate-information/pdf/Freedom-of-Information-Policy-and-Procedure.pdf*, not to disclose to any competitor of the undersigned, information submitted which are trade secrets or is maintained for the regulation or supervision of commercial enterprise which, if disclosed, would cause substantial injury to the competitive position of the enterprise, and which information is identified by the Proposer as proprietary, which may be disclosed by the undersigned to the Port Authority as part of or in connection with the submission of a proposal.

Sensis Corporation
(Company)

(Signature)

Kathy Selmser - Manager-ATS Contracts
(Title)

8/2/2011
(Date)

ORIGINAL AND PHOTOCOPIES OF THIS PAGE ONLY.

PART I – CONTRACT SPECIFIC TERMS AND CONDITIONS

Sensis

Detect the Difference

August 2, 2011
KAS-11-630d

The Port Authority of NY & NJ
Attn: Bid/RFP Custodian
Procurement Department
1 Madison Avenue, 7th Floor
New York, NY 10010

Subject: Response to Request for Proposals (RFP) for Surface Management System at JFK International Airport

Reference: Sensis Proposal dated August 8, 2011

Dear Sir or Madam,

Sensis confirms that by signing the Letter of Transmittal, we make the certifications set forth in the Attachment B: General Contract Provisions, "Contractor's Integrity Provisions," Clause 32.

Sincerely,

Kathy Selmser
Manager, ATS Contracts
Sensis Corporation

5717 Enterprise Parkway, East Syracuse, NY 13057 Phone: 315-445-0550 Fax: 315-446-2209
www.sensis.com

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1. Documentation of Proposer Prerequisites

1.1 Overview

Only Proposers who can demonstrate that they can comply with the following prerequisites should submit proposals, as only such proposals from such Proposers will be considered:

If the proposal is submitted by a common law joint venture, a joint venture that has not been established as a distinct legal entity, each participant of the joint venture shall be held jointly and severally liable and must individually execute and perform all acts required by this proposal. Documents signed by a common law joint venture, in connection with this proposal, shall include the names of all participants of the joint venture followed by the words "acting jointly and severally". All joint venture proposers must provide documentation of their legal status.

By furnishing this solicitation document to Proposers, the Port Authority has not made a determination that the Proposers have met the prerequisites or have otherwise been deemed qualified to perform the services. In addition, a determination that a Proposer has met the prerequisites is no assurance it will be deemed qualified in connection with other proposal requirements included herein.

In the event a Proposal is submitted by a joint venture, the foregoing prerequisites will be considered with respect to such a proposal as follows:

With respect to paragraphs 1 and 2 above, the prerequisites will be considered satisfied if the joint venture itself, or any of the participants individually, can meet the requirements.

1.1.1 Sensis Team Overview

Through partnerships with Robinson Aviation (RVA), Inc and Air Network Simulation and Analysis, Inc., Sensis has created a team that readily meets or exceeds the prerequisites and requirements of this RFP. As described below, this team contains the experience and expertise surpassing that which any other team can expect to assemble.

1.1.1.1 Sensis

Sensis has been delivering Surface Surveillance and Surface Management Systems for over a decade with systems installed and operating worldwide. With installations including Surface and Airspace coverage for ATC separation and efficiency of traffic flow, as well as operational efficiency applications for airline and airport operators, Sensis is well positioned to provide an integrated Surface Management System for JFK. Implementing additional functionality into the existing Aerobahn system at JFK and beginning operational control of the metering program are the least risk and lowest cost options for the Port Authority due to the work already being carried out by Sensis.

1.1.1.2 Robinson

With their extensive experience in staffing and operating Air Traffic Control and Ramp Control facilities, Robinson Aviation provides the required skill necessary to manage daily Departure Metering at JFK. Robinson Aviation (RVA), Inc. is an aviation services company that specializes in air traffic control operations; communications engineering, installation, & maintenance; navigation and landing system engineering, installation & maintenance; aviation safety and CNS/ATM studies, and transportation security studies and planning. In business since 1986, they currently operate 93 air traffic control towers under the FAA Contract Tower Program. RVA, Inc. employs over 500 air traffic controllers, engineers and technicians that are dedicated to satisfying our customers' requirements.

1.1.1.3 ANSA

ANSA brings to the team extensive research expertise in the areas of control, optimization, and system analysis and design, as well as subject matter expertise with real-world knowledge of airport operations and constraints. They are the Principal Investigator of a previous surface optimization NRA that developed a suite of modules to optimize surface operations, as well as Co-investigator for another surface optimization NRA that explored and identified methods for incorporating environmental constraints into surface optimization decisions. With expertise in fast computation methods for solving MILPs, they are developers of real-world optimization algorithms and leader/participant in field trials of new technologies who have critical subject matter expertise on FAA Traffic Flow Management, Departure Flow Management, Surface Management, and Fuel and Emissions Impact Modeling

Sensis, ANSA and Robinson provide a formidable team that will surpass the expectations and requirements of the contract. In this team the Port Authority will find the professionalism, experience and quality of service that it has come to expect.

1.2 Experience: Surface and Airspace Efficiency

1. *The Proposer shall have at least three (3) years of continuous experience immediately prior to the date of the submission of its proposal in the development, installation, management, testing and operation of a system that is specifically tailored to the function of improving overall surface and airspace system efficiency and predictability while enhancing safety, and shall be actually engaged in providing these capabilities to commercial entity. The Proposer may fulfill this prerequisite if it can demonstrate that the persons or entities owning and controlling the Proposer have a cumulative total of at least the same number of years and type of direct continuous experience immediately prior to the submission of this proposal as is required of the Proposer, or have owned and controlled entities which meet the requirement. The proposer will provide a letter on company letter head outlining the development, installation, management, testing and operation of a system designed to*

accomplish the above system (surface and airspace) objective. This letter should be signed by an officer of the Proposer and notarized by a Notary Public.

1.2.1 SMS Experience

Sensis has been in the surface management business since 2003 when the first Aerobahn installation, including a complete surveillance system went operational. Since that time Sensis' SMS have been adopted at fourteen airports in the US and worldwide, including JFK for the Port Authority since August, 2009. Through each installation and subsequent service contract Sensis has become the leading qualified provider of SMS in the World.

Among the airports under contract for Sensis Aerobahn SMS is Atlanta Hartsfield-Jackson International, the busiest airport in the world. A system for an airport of this magnitude entails numerous complexities that require a unique, competent company and a robust, capable system. The many stakeholders that rely on Aerobahn output for operational information include the Atlanta Department of Aviation, FAA ATCT, TRACON and Center, ramp tower companies and numerous airline entities, i.e. ramp and gate controllers, OCC personnel and ATC coordination personnel. Aerobahn is used daily in the operations for each entity, many times as the exclusive source of information, and has become an integral source of data for decision making and problem mitigation.

The system at ATL contains the most extensive suite of tools, functionality and capability of any SMS fielded in the world. Along with real-time situational awareness, complete data basing and reporting, condition-based rules and alerting, operational timeline tracking, and various airport operations reporting metrics the system contains the first fielded predictive engine. Users have the ability to view the predicted routing of each flight, gather metrics, create rules based on the predictions and create reports of the tracks taken. Initiatives have begun with airline personnel to track the flow and capacity constraints placed on the airfield and gates due to traffic volumes throughout the day and actively manage flights based on tactical information available. The FAA has tested and been successful using the flight data available in Aerobahn and rules created on specific flight information in a program to manage arrival flows to the ATL airport.

Sensis has extensive experience in providing SMS as shown in Figure 1 below. Also, please see Appendix - Notarized Experience Certification Letter.

Figure 1 Sensis SMS Experience

Customer	Year	Airport	Project	Significant Accomplishment/Results
Internal IR&D	1999	None	Surface Surveillance Database and Web Display	Framework for Aerobahn - Surface Surveillance data stored, retrieved, and correlated - Event Processing - Geo Processing - Real-time display on a web browser
NASA	2001	DTW	DROMS (Dynamic Runway Occupancy Measurement System)	Region Processing Proved that Multilateration can be used to measure runway occupancy
NWA/FAA	2002 - 2003	DTW	SensorBahn and ATIDS (Airport Target Identification System)	Launch customer FAA study found tremendous quantitative benefits (See above)
NWA/FAA	2003	DTW	Sensorbahn	Version 1.0 Released – Commercial product baseline
Multiple	2004	Multiple	Aerobahn Service	Version 2.0 Released - Mode 3 Altitudes - Operations Snapshot Dashboard - Rebranding to Aerobahn
ADP (Paris)	2004	CDG and ORY	Aerobahn Product	First Turn-key system deployed
NWA	2005	MSP	Aerobahn Service	NWA deploys Aerobahn at MSP after emerging from bankruptcy and seeing the results in DTW NWA experiences significant improvement in De-Icing and irregular operations
ASA **(Australia)**	2006	MEL, SYD, BNE	Aerobahn Service coupled with a surface safety system	Won a competitive procurement for a combined safety and surface management system (An option for Perth was added in 2008)

Customer	Year	Airport	Project	Significant Accomplishment/Results
Multiple	2007	Multiple	Aerobahn Service	Version 3.0 Released - Improvements in Flight Association Logic - Data block Repositioning - Multiple Dynamic Queue Monitors - Back/OAG Database Integration - User Alerting Thresholds
CAL	2008	IAH, EWR	Aerobahn Service	Aerobahn Service Launch Much improved airport ramp flow and taxi reduction especially during night and irregular operations
Port of Seattle	2008	SEA	Aviation Flight and Fleet Data Server	Sensis won a competitive procurement to provide an automated xml data feed for the Port of Seattle's Billing and Metrics systems This project eliminated the need for self-reported billing by the carriers
DAL	2008	JFK	Aerobahn Service	Aerobahn Service Delta claims significant reduction in Taxi Time
FAA	2008	JFK	Aerobahn Service	The FAA subscribes to seats of Aerobahn at the JFK Air traffic control tower (JFK ATCT), New York Terminal Radar Approach Control, (N90), New York Air Route Traffic Control Center (ZNY), and the Air Traffic Control System Control Center (ATCSCC)
Multiple	2009	Multiple	Aerobahn Service	Version 4.0 Released - Tools enabled in a flexible docking framework - AIDX Interface Support - Enhanced Data Security
PANYNJ	2009	JFK	Aerobahn Service	The Port Authority of New York New Jersey subscribes to Aerobahn Service and provides seats to most of the tenants First case of the airlines, airport, and the FAA using a common surface management tool Preliminary results show a significant improvement in taxi time
HKG	2009	CAD – Hong Kong	Aerobahn Product	Aerobahn Hong Kong accepted by CAD Hong Kong
ATL	2009	City of Atlanta DOA	Aerobahn Service	Sensis won a competitive tender to provide a surface management service to the world's busiest airport Integrated Vehicle Tracking with aircraft

Customer	Year	Airport	Project	Significant Accomplishment/Results
Multiple	**2010**	Multiple	Aerobahn Service	Version 5.0 Release - High Resolution TaxiView Mapping - Improved data tag manipulation - OpsView Pivot Tables
City/ County of Denver	2010	Denver	Aerobahn Service	Aerobahn selected by the City/County of Denver to provide Aerobahn Service for all of the stakeholders at Denver
Multiple	2010	Multiple	Aerobahn Service	Version 6.0 Release - Dynamic Rules - Predictive Suite
US Airways	2011	PHL & CLT	Aerobahn Service Demonstration	Sensis demonstrated how Aerobahn can save taxi time and allow the organization to improve irregular operations management.
US Airways	2011	CLT	Departure Sequencing	Enabled a Departure Sequencing Control capability using Dynamic Rules.(no software development) US Airways was able to hold aircraft at gates without starving the runways, manage incoming arrivals, and achieve significant cost, taxi time, and fuel savings
US Airways	2011	CLT, PHL, PHX, DCA	Aerobahn Service	US Airways and Sensis have a letter of intent agreement in place for Aerobahn Service at their major hubs and focus cities. Contract to be finalized in Q3 OF 2011.

Sensis has partnered with Robinson Aviation to bring in the experience necessary to efficiently and effectively manage the operational aspects of the Port Authority's metering program. The relevant experience that Robinson brings is described in the following two sections.

1.2.2 Air Traffic Control Tower Operation

Employing over 500 Air Traffic Controllers, RVA currently provides the Air Traffic Controllers and management personnel needed to operate 93 Airport Traffic Control Towers. From time to time new towers are added to the contract by FAA. During the transition of a tower into the program, RVA considers traffic trends, environmental conditions, and operational complexities at the airport and develops staffing plans and schedules to meet peak traffic demands, while ensuring efficiency and safety. ATC operations are conducted in accordance with the regulations and procedures issued and

used by the FAA. In addition, we have an ISO 9001:2008 certified Quality Assurance Program that has produced exceptional results on FAA quality assurance evaluations through their Facility Safety Assessment System (FSAS) audit and outstanding customer satisfaction reports.

1.2.3 Ramp Tower Services

The most recent addition to RVA's professional aviation services is Ramp Tower Management and Operations. Building on their experience in air traffic control and aviation, the Ramp Tower specialists provide air traffic management in the airport non-movement areas. Each airport is unique and the services are tailored accordingly to include the utilization of the airport resource management system (RMS), which provides gate management and other services. Standard services include traffic sequencing, separation and pushback. The airports enjoy enhanced ground movement safety, better optimization of ramp space and a more structured operating environment. The airlines benefit through reduced risk by operating in a safer environment and more predictable on and off gate times. Professional Ramp Tower Services are a win/win for the airports and airlines.

1.3 Experience: Airport Environment

2. In the same time period stated above, the Proposer shall demonstrate firm experience in the provision of similar services with similar scope to the requirements of this Agreement, in at least one (1) airport environment.

The Sensis team has a vast range of experience in a variety of airport environments. Along with the ATL service described above, Sensis' SMS has been installed and providing service to users at JFK International airport since August 2009. During the service since installation Sensis maintains communication with the various stakeholders to support in extracting the maximum benefit from Aerobahn as well as gain insight into changes and additions that will provide future benefit. The airport environment at JFK is very complex and Sensis has been analyzing and improving data gathering during the life of system there. This has positioned Sensis as the only SMS provider with an intimate understanding of the various data sources and the ability to maximize use of said data for stakeholder benefit.

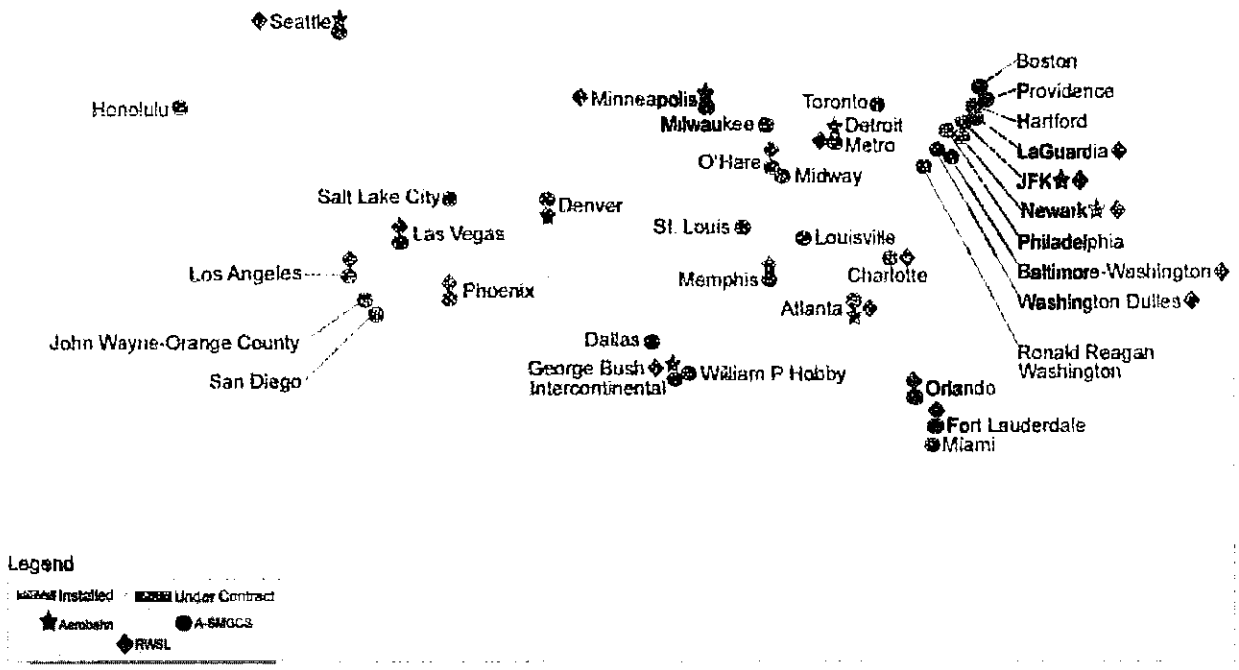
From the standpoint of work in the airport environment, for the ATL system mentioned in the section above, Sensis personnel and subcontractors have installed a 30 remote unit Multilateration with wireless mesh network backhaul at the Atlanta Hartsfield-Jackson International Airport. In addition to ATL, Sensis' experienced Field Engineering and Optimization teams have installed, implemented and optimized four other complete stand-alone Multilateration SMS, which include a full surveillance system in addition to the SMS, at MSP, DTW, IAH and EWR. Sensis managed the installation, implementation and optimization of the system with numerous subcontractors, the ATL

DOA, the FAA and many airline entities to successfully begin service ahead of scheduled service start date. Extensive Airport Operations Area (AOA) access was required by Sensis personnel and its subcontractors.

Sensis experience in the airport environment includes the installation of 35 ASDE-X systems at the nation's largest airports, 9 complete Advanced Surface Movement Guidance Systems (A-SMGCS) installations at international airports, 17 installations of Multilateration systems at airports worldwide and 9 current installations (3 completed) of the FAA's Runways Status Lights program. Based on this depth of experience on multifarious airport environments it is clear that the requirements of a contract of this nature are well within the competencies of Sensis.

Figure 2 represents the North American installations of Sensis systems.

Figure 2 Sensis North American Installations



1.4 Reference Documents

All Proposers must include documentation (including references with points of contact), which meets the above prerequisites.

Sensis provides references as shown in Appendix – Attachment D – Proposer Reference Form and the attached Reference Reports for Aerobahn, Surface MLAT, A-SMGCS and Runway Status Lights. Also included are references for Robinson Aviation (RVA), Inc.

1.5 Financial Information

1.5.1 Financial Statement Documentation

Sensis provides financial statements as requested in Appendix – Financial Statement Documentation. In addition, please refer to the attached letter from Sensis Corporation's Chief Financial Officer (CFO).

1.5.2 Statement of Work on Hand

As a private company, Sensis cannot divulge the requested level of detail concerning our contracts. Sensis has included a substantial list of reference contracts with customer information and encourages the Port Authority to contact these references for information concerning performance and customer satisfaction.

In addition, please refer to the Business Risk section of this proposal, which provides a clear description of our ability to accept this additional business and perform to the required standards.

1.5.3 Proposer Banking Information

Bank Information -	RBS Citizens Bank NA Robert Barnhard 28 State Street, 11th Floor Boston, MA 02109 (617) 994-7389
Federal Employer Identification Number -	22-2629993
Dun and Bradstreet Number -	151375359

Sensis

Detect the Difference

August 3, 2011

The Port Authority of NY & NJ
Attn: Bid/RFP Custodian
Procurement Department
1 Madison Avenue, 7th Floor
New York, NY 10010

Subject: Response to Request for Proposals (RFP) for Surface Management System at JFK International Airport

Reference: Sensis Proposal dated August 8, 2011

Dear Sir or Madam,

As required by the RFP for Surface Management System at JFK International Airport, Part I – Contract Specific Terms and Conditions, 3. Proposer Prerequisites, Sensis confirms it meets the requirements below, and as required, has provided supporting information in Section "E – Documentation of Proposer Prerequisites" and its related Appendices:

1. *The Proposer shall have at least three (3) years of continuous experience immediately prior to the date of the submission of its proposal in the development, installation, management, testing and operation of a system that is specifically tailored to the function of improving overall surface and airspace system efficiency and predictability while enhancing safety, and shall be actually engaged in providing these capabilities to commercial entity. The Proposer may fulfill this prerequisite if it can demonstrate that the persons or entities owning and controlling the Proposer have a cumulative total of at least the same number of years and type of direct continuous experience immediately prior to the submission of this proposal as is required of the Proposer, or have owned and controlled entities which meet the requirement. The proposer will provide a letter on company letter head outlining the development, installation, management, testing and operation of a system designed to accomplish the above system (surface and airspace) objective. This letter should be signed by an officer of the Proposer and notarized by a Notary Public.*

Sincerely,

Kenneth Kaminski
Vice President & General Manager, Air Traffic Systems
Sensis Corporation

5717 Enterprise Parkway, East Syracuse, NY 13057 Phone: 315 445-0550 Fax: 315-446-2209
www.sensis.com

Sensis

Detect the Difference

On August 3, 2011, before me personally came Kenneth Kaminski known to me to be Vice President & General Manager, Air Traffic Systems of Sensis Corporation and executed the attached instrument.

Kathleen M. Kitt

Kathleen Kitt, Notary Public

My Commission Expires: June 28, 2015.

KATHLEEN M. KITT
NOTARY PUBLIC-STATE OF NEW YORK
No. 01KI6027012
Qualified In Madison County
My Commission Expires June 28, 2015

5717 Enterprise Parkway, East Syracuse, NY 13057 Phone: 315-445-5076 Fax: 315-446-2209
www.sensis.com

ATTACHMENT D- PROPOSER REFERENCE FORM

Name of Proposer: Sensis Corporation

1.

Address:	Federal Aviation Administration (FAA) 800 Independence Avenue, SW Washington, DC 20591
Contact Name and Title:	Tom Prevost – Surface Project Manager – FAA
Phone and Fax Numbers of Contact:	(202) 267-3363
Contract date(s):	10/1/2009 – present
Description of work:	Sensis was awarded an Indefinite Delivery Indefinite Quantity (IDIQ) contract by Volpe to deliver automation solutions including Aerobahn, MDS surveillance and related services. Sensis was also awarded a Task Order for delivery of the Aerobahn service at Memphis under this contract.

2.

Address:	City of Atlanta Department of Aviation P.O. Box 20509 Atlanta, GA 20509
Contact Name and Title:	Paul Meyer – Director of Operations, Hartsfield-Jackson Atlanta International Airport
Phone and Fax Numbers of Contact:	(404) 530-6620
Contract date(s):	8/3/2010 – present
Description of work:	Sensis Aerobahn combines airside operational information, such as flight schedules, with the exact location and identification of aircraft and vehicles on the surface of the airport for a realtime, comprehensive view of surface operations. Through the DOA, each airline at Hartsfield-Jackson and the FAA has access to the web-based Aerobahn service with the ability to customize Aerobahn with their operational data. Further, each individual user will be able to customize Aerobahn's screens and tools to best match his or her job requirements. This will result in airlines having the information most needed to better manage daily operations. The DOA uses Aerobahn to automatically measure gate use and occupancy in addition to managing airfield operations.

3.

Address:	Continental Airlines SOCC Flight Operations Division 12th Floor HQSSC 1600 Smith Street Houston, TX 77002
Contact Name and Title:	Les Parson – Managing Director Air Traffic Systems/SOCC –

	Continental Airlines
Phone and Fax Numbers of Contact:	(713) 324-5164
Contract date(s):	Newark International Airport: 11/1/2008 – present George Bush Intercontinental Airport (Houston): 7/1/2008 - present
Description of work:	Newark International Airport: At Newark, where Continental offers more than 400 daily departures to 155 non-stop destinations world-wide, Aerobahn enhances Continental's ability to more efficiently manage traffic flows on the Airport surface in both routine and irregular operations, which is expected to result in an overall reduction of taxi out delays. George Bush Intercontinental Airport (Houston): Continental Airlines is installing Sensis Aerobahn® at George Bush Intercontinental Airport (Houston) to enable more efficient management of aircraft traffic flows, particularly during periods of abnormal delay. In addition to the Houston Ramp Controllers, Aerobahn will be used by Continental's System Operations Coordination Center (SOCC) located at the corporate offices in Houston, Texas. The SOCC Center will use Aerobahn to make more informed decisions about airline resources, improving the overall operation of the airline and, as a result, the performance of the National Airspace System (NAS).

4.

Address:	Aviation Development Council World Plaza 141-07 20th Avenue Whitestone, NY 11357
Contact Name and Title:	Bill Huisman – Executive Director – Aviation Development Council
Phone and Fax Numbers of Contact:	(718) 746-0212
Contract date(s):	11/10/08 – present
Description of work:	Under contract to the Aviation Development Council (ADC), Sensis Corporation provides its Aerobahn® Service, a web-based airport management tool, to the Port Authority of New York & New Jersey (PANYNJ) for use at John F. Kennedy International Airport (JFK). Aerobahn combines airside operational information with aircraft position data from the airport's surface surveillance system for a real-time, highly accurate view of surface operations. This capability is in line with the RTCA Task Force 5 report recommendation regarding shared surface data, a step toward the mid-term NextGen.

	Sensis Aerobahn provides the PANYNJ and its stakeholders with greater awareness of aircraft traffic flow on the airport surface, including the gate areas, resulting in a reduction in delays and emissions and increased passenger satisfaction.

5.

Address:	Delta Air Lines, Inc. Operations Control Center, Dept. 083 P.O. Box 20706 Atlanta, GA 30320-6001
Contact Name and Title:	Lorne Cass – Director, Air Traffic Management Industry Affairs – Delta Air Lines, Inc.
Phone and Fax Numbers of Contact:	(612) 727-0200
Contract date(s):	Minneapolis-St. Paul International Airport: 12/16/2005 - present Detroit Wayne County Metropolitan Airport: 4/1/2005 - present
Description of work:	Sensis Corporation was awarded contract by Northwest Airlines (now Delta Air Lines) to provide Aerobahn Service at Minneapolis-St. Paul International Airport (MSP), and continue the service at Detroit Wayne County Metropolitan Airport (DTW). Aerobahn is a powerful toolbox that increases visibility into critical airside operations. At DTW, the Aerobahn Traffic Monitor is the primary tool used by Northwest Airlines ramp controllers to manage traffic into and out of the ramp area. It is also used extensively by ground operations staff responsible for managing winter deicing events. Approximately 70% of Northwest Airlines passengers transfer through DTW, the 10th busiest airport in North America in terms of movements. At MSP, in addition to Northwest Airlines personnel in the local control center, performance analysts, strategic planners and dispatchers at the airline's Systems Operations Center use the displays to monitor operations at both airports. With Aerobahn, Northwest Airlines can view, monitor and quantifiably measure operations in real-time, playback operational events for post-event analysis, decrease routine voice communications, more efficiently manage pushbacks and movement in the ramp area, and reduce taxi times.

6.

Address:	John F. Kennedy International Airport General Aviation Terminal, Building 145 New York, NY 71430
Contact Name and Title:	John K. Selden – Manager, Aeronautical Services Airport

	Operations Division – The Port Authority of NY & NJ
Phone and Fax Numbers of Contact:	(718) 244- 3771
Contract date(s):	11/10/08 – present
Description of work:	Under contract to the Aviation Development Council (ADC), Sensis Corporation provides its Aerobahn® Service, a web-based airport management tool, to the Port Authority of New York & New Jersey (PANYNJ) for use at John F. Kennedy International Airport (JFK). Aerobahn combines airside operational information with aircraft position data from the airport's surface surveillance system for a real-time, highly accurate view of surface operations. This capability is in line with the RTCA Task Force 5 report recommendation regarding shared surface data, a step toward the mid-term NextGen. Sensis Aerobahn provides the PANYNJ and its stakeholders with greater awareness of aircraft traffic flow on the airport surface, including the gate areas, resulting in a reduction in delays and emissions and increased passenger satisfaction.

ATTACHMENT D- PROPOSER REFERENCE FORM

Name of Proposer: Robinson Aviation (RVA), Inc.

1.

Address:	Federal Aviation Administration (FAA) 600 Independence Avenue, S.W. Washington, DC 20591
Contact Name and Title:	Donald Richardson, AJA-46, Contracting Officer
Phone and Fax Numbers of Contact:	(202) 385-8415
Contract date(s):	February 1, 2010, to present
Contract cost:	Original Base Contract Amount: $128,926,851 Final Contract Amount: $131,730,435
Description of work:	Federal Aviation Administration (FAA) Contract Tower Program – Area 2 RVA contracted with the FAA to operate Visual Flight Rules (VFR) Airport Traffic Control Towers (ATCT) at various locations in the Southeast and Southwest sectors of the United States, as prime contractor. This contract is in Area II of the FAA Contract Tower (FCT) program and includes the operation of 53 ATCT's at diverse locations. Under the terms of the contract, RVA provides ATC services in accordance with the procedures specified in Federal Aviation Regulations (FAR) Part 65, Subpart B (excluding paragraph 65.46), and in the documents, directives, and regulations contained in FAA Orders 3120.4, Air Traffic Technical Training; 7010.1, Air Traffic Evaluation Procedures; 7110.65, Air Traffic Control; 7210.3, Facility Operation and Administration; 7210.56, Air Traffic Quality Assurance; and 7220.1, Certification and Rating Procedures. RVA has continually been selected to provide these services through a competitive process since our initial start in September 1994. Names of Key personnel responsible for supplying the contract's services: Bill Peacock, Executive Vice President

2.

Address:	Port of Seattle 17801 Pacific Highway South Seattle, WA 98158
Contact Name and Title:	Dave Crowner, Contracting Officer
Phone and Fax Numbers of Contact:	(206) 439-7759
Contract date(s):	January 1, 2011, to present

Contract cost:	$ 2,827,293
Description of work:	Port of Seattle - Seattle-Tacoma International Airport Ramp Tower Services We have just completed the fifth year providing Ramp Control Service for the Port of Seattle at the Seattle-Tacoma International Airport (SEATAC), as prime contractor. The SEATAC Ramp Tower provides ramp control services to over 120 gates. The services include maintaining close coordination with Gate Control personnel and the FAA ATCT to ensure Ramp Tower operations support and complement the FAA's flow of aircraft on the airport; monitoring assigned radio frequencies; providing concise instructions to aircrews to assigned gates or parking areas; providing pushback approval and instructions; providing non-movement area advisories; providing taxi route instructions; directing aircraft to designated holding areas; and providing updated information that may be relayed from the company or appropriate authority. After serving as the incumbent contractor from January 2006 through December 2010, RVA was again selected as the contractor through a competitive process to continue to perform the Ramp Tower services at SEATAC. Names of Key personnel responsible for supplying the contract's services: Bill Peacock, Executive Vice President

3.

Address:	Broward County Aviation Department 100 Aviation Boulevard Ft. Lauderdale, FL 33315
Contact Name and Title:	John Pokryfke, Contracting Officer
Phone and Fax Numbers of Contact:	(954) 359-1214
Contract date(s):	June 1, 2007, to June 2012
Contract cost:	$4,649,600
Description of work:	Airport Ramp Control Services at Fort-Lauderdale/Hollywood International Airport in Broward County, Florida The Broward County Aviation Department (BCAD) contracted with RVA to operate the ramp tower at Fort Lauderdale/Hollywood Int'l Airport (FLL), as prime contractor. The services include maintaining close coordination with Gate Control personnel and the FAA ATCT to ensure ramp tower operations support and complement the

	FAA's flow of aircraft on the airport; monitoring assigned radio frequencies; providing concise instructions to guide aircrews to assigned gates or parking areas; providing pushback approval and instructions; providing taxi route instructions; directing aircraft to designated holding areas; and providing updated information that may be relayed from the company or appropriate authority. At FLL, we work with BCAD, airlines representatives, and FAA to create procedures for pushback, taxi routes, hold spots and transfer point through consensus and assured buy-in prior to implementation. We work closely with the BCAD and airlines with access to the RMS system to ensure gate assignments and changes are shared and aircraft are directed to the appropriate gates, and when no gate is available, to an approved holding area. Further, RVA relays information from the pilot to the company as appropriate; monitors taxiing aircraft visually and utilizes Flight Explorer and RMS system for the sequence of arriving aircraft and gate assignment; provides instructions to aircraft that are not visible based on the pilot's reports and reports from other aircraft; maintains an awareness of aircraft maneuvering on the ramp area; issues advisories to aircraft in non-visible areas; on a real-time basis, anticipates and plans so as to avoid bottlenecks in traffic flows; scans for certain vehicular movements that may impede aircraft movements on the ramp area; remains alert to emergency conditions/events and prioritize aircraft and emergency vehicle movements to prevent delays of emergency vehicles responding to emergency situations; and to the extent feasible, provides observed weather conditions that may interrupt aircraft movements. Ramp Tower personnel maintain the status of all Notices to Airman (NOTAM) that affect the status of ramp areas and other egress/ingress to ramps/taxiways and relay NOTAM information to pilots that are in areas related to the NOTAM. FLL has 295,496 annual operations and 11,322,888 enplaned passengers. RVA controls 33 gates on the north side of the airport. We operate sixteen hours per day, seven days per week with one operational manager and five ramp tower controllers. One year after taking over the ramp tower operations at FLL, the Station Manager for Southwest Airline-FLL, Tennina M. McAnany, wrote, in a letter to our tower manager:

	"Just a quick note to express our profound appreciation and thanks to you and your staff for the fantastic job that your Team is doing with Ramp Control at the Ft. Lauderdale/Hollywood Int'l Airport...., I will merely say that since the inception of Ground Control in FLL, there has been much less "chatter" and frustration displayed from our Southwest Employees, including our Flight Ops and Dispatch offices, regarding Ramp Congestion delays. As a Station Manager for Southwest, this realization alone leaves me much to be grateful for. On the other hand, as a shareholder of Southwest Airlines as well as the person directly responsible for our Customer's (both Internal and External) experience, I know for a fact that since the inception of Ground Control-FLL, your performance has helped us to operate with less frustration and most importantly, more efficiently. I don't have to tell you that in this day and age of $130+ per barrel oil costs, every second saved counts. FLL has on average, approximately 850+ aircraft movements per day, and to choreograph this level of movement is no small task. That being said, it is one that you and your staff safely execute with precision each day. Much like a ballet, it is a well-orchestrated event. Thank you for all that you and your staff do to help Southwest Airlines achieve our goals as a Company."

References for Aerobahn

Australia A-SMGCS

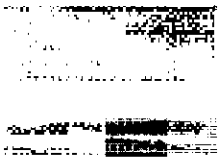
Contract Description **Airservices Australia (Airservices) has contracted with Sensis Corporation to deploy an Advanced – Surface Movement Guidance and Control System (A-SMGCS) at four airports: Sydney, Melbourne, Brisbane and Perth. As part of the A-SMGCS deployment, Airservices will also be using Sensis VeeLo NextGen™ units for tracking and identification of vehicles on the airport surface and Sensis Aerobahn® airport management tool for the efficient management of ground operations.**

Customer Name:	Airservices Australia	Contact Email:	scott.lowry@airservicesaustralia.com
Contact Name:	Scott Lowry	Contact Phone	+61 3 9339 2521
Contact Address:	Airservices Australia Technology and Asset Services Tower Road, Melbourne Airport VIC 3043 Australia		

Brisbane Aerobahn	**In Process**
Perth Aerobahn	**Under Contract**
Sydney Aerobahn	**Operational**
Melbourne Aerobahn	**Operational**

Hong Kong International Airport A-SMGCS

Contract Description **After a successful 9 RU Sensis MDS trial system, Sensis was awarded a contract to upgrade system in Hong Kong to a full A-SMGCS. The Hong Kong International Airport (HKIA) A-SMGCS utilizes a 19 RU MDS system for coverage of the airport surface up to and including the gates, and includes Safety Logic, Aerobahn for efficient management of ground operations, CWPs and a Remote Monitoring System (RMS). In addition, the HKIA A-SMGCS interfaces with these external systems: Secondary Surveillance Radars (SSRs); Surface Movement Radar (SMR); QNH for meteorological data; Flight Data Processing System (FDPS); Master Clock; Airfield Ground Lighting (AGL); Parking Bay.**



Customer Name:	Civil Aviation Department (CAD) Hong Kong	Contact Email:	wyleung@cad.gov.hk
Contact Name:	W.Y. Leung J.P.	Contact Phone	+852.2591.5000
Contact Address:	10/F, Commercial Building Airport Freight Forwarding Centre 2 Chun Wan Road Hong Kong International Airport, Hong Kong		

Hong Kong Aerobahn	**Operational**

References for Aerobahn

Charles de Gaulle MDS

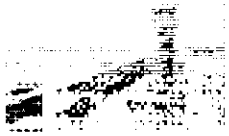
Contract Description **At CDG and Orly, Sensis provides MDS surface surveillance of the runways, taxiways and gates as well as automatic labeling of aircraft for improved situational awareness, enabling the airport to monitor traffic flows and throughput prior to safely implementing procedural changes. Aerobahn complements the multilateration system by enabling Service de la Navigation Aerienne (SNA), the French civil aviation authority for the greater Paris region, to view, monitor, and quantifiably measure airport operations.**

Customer Name:	**Aéroports de Paris**	Contact Email:	jean-marc.receveau@adp.fr
Contact Name:	Jean-Marc Receveau	Contact Phone	+01 49 75 72 04
Contact Address:	Subdivision Radar-Traitement DTI/SDSO **Antenne Aéroports région parisienne** Orly Sud 103 - 94396 Orly Aerogare CEDEX		

Paris - Charles de Gaulle - Aerobahn **Operational**

Orly MDS

Contract Description **At CDG and Orly, Sensis provides MDS surface surveillance of the runways, taxiways and gates as well as automatic labeling of aircraft for improved situational awareness, enabling the airport to monitor traffic flows and throughput prior to safely implementing procedural changes. Aerobahn complements the multilateration system by enabling Service de la Navigation Aerienne (SNA), the French civil aviation authority for the greater Paris region, to view, monitor, and quantifiably measure airport operations.**



Customer Name:	**Aéroports de Paris**	Contact Email:	jean-marc.receveau@adp.fr
Contact Name:	Jean-Marc Receveau	Contact Phone	+01 49 75 72 04
Contact Address:	Subdivision Radar-Traitement DTI/SDSO **Antenne Aéroports région parisienne** Orly Sud 103 - 94396 Orly Aerogare CEDEX		

Paris - Orly - Aerobahn **Operational**

Newark - Aerobahn

Contract Description **At Newark, where Continental offers more than 400 daily departures to 155 non-stop destinations world-wide, Aerobahn enhances Continental's ability to more efficiently manage traffic flows on the Airport surface in both routine and irregular operations, which is expected to result in an overall reduction of taxi out delays.**

References for Aerobahn

Customer Name:	Continental Airlines	Contact Email:	
Contact Name:	Les Parson	Contact Phone	
Contact Address:	Continental Airlines SOCC Flight Operations Division 12th Floor HQSSC 1600 Smith Street Houston, TX 77002		

Newark - Aerobahn **Operational**

Houston George W. Bush - Aerobahn

Contract Description **Continental Airlines is installing Sensis Aerobahn® at George Bush Intercontinental Airport (Houston) to enable more efficient management of aircraft traffic flows, particularly during periods of abnormal delay. In addition to the Houston Ramp Controllers, Aerobahn will be used by Continental's System Operations Coordination Center (SOCC) located at the corporate offices in Houston, Texas. The SOCC Center will use Aerobahn to make more informed decisions about airline resources, improving the overall operation of the airline and, as a result, the performance of the National Airspace System (NAS).**

Customer Name:	Continental Airlines	Contact Email:	
Contact Name:	Les Parson	Contact Phone	
Contact Address:	Continental Airlines SOCC Flight Operations Division 12th Floor HQSSC 1600 Smith Street Houston, TX 77002		

Houston George Bush -Aerobahn (Continental Airlines) **Operational**

JFK - Aerobahn - Port Authority

Contract Description **Under contract to the Aviation Development Council (ADC), Sensis Corporation provides its Aerobahn® Service, a web-based airport management tool, to the Port Authority of New York & New Jersey (PANYNJ) for use at John F. Kennedy International Airport (JFK).**
Aerobahn combines airside operational information with aircraft position data from the airport's surface surveillance system for a real-time, highly accurate view of surface operations. This capability is in line with the RTCA Task Force 5 report recommendation regarding shared surface data, a step toward the mid-term NextGen.
Sensis Aerobahn provides the PANYNJ and its stakeholders with greater awareness of aircraft traffic flow on the airport surface, including the gate areas, resulting in a reduction in delays and emissions and increased passenger satisfaction.

Customer Name:	Aviation Development Council	Contact Email:	
Contact Name:	Bill Huisman	Contact Phone	(718) 746-0212
Contact Address:	Aviation Development Council		

JFK - Aerobahn - Port Authority **Operational**

References for Aerobahn

Delta Airlines - Aerobahn -Detroit and Minneapolis

Contract Description **Sensis Corporation was awarded a five year contract by Delta Air Lines to provide Aerobahn Service at Minneapolis-St. Paul International Airport (MSP), and continue the service at Detroit Wayne County Metropolitan Airport (DTW). Aerobahn is a powerful toolbox that increases visibility into critical airside operations. At DTW, the Aerobahn Traffic Monitor is the primary tool used by Delta ramp controllers to manage traffic into and out of the ramp area. It is also used extensively by ground operations staff responsible for managing winter deicing events. Approximately 70% of Delta passengers transfer through DTW, the 10th busiest airport in North America in terms of movements. At MSP, in addition to the Delta personnel in the local control center, performance analysts, strategic planners and dispatchers at the airline's Systems Operations Center use the displays to monitor operations at both airports. With Aerobahn, Delta Air Lines can view, monitor and quantifiably measure operations in real-time, playback operational events for post-event analysis, decrease routine voice communications, more efficiently manage pushbacks and movement in the ramp area, and reduce taxi times.**

Customer Name:	Delta Air Lines	Contact Email:	timothy.reid@nwa.com
Contact Name:	Lorne Cass	Contact Phone	(612) 727-0202
Contact Address:	Delta Air Lines Dept F7040 7200 34th Ave South Minneapolis, MN 55450-1106		

Detroit - Aerobahn	**Operational**
Minneapolis - Aerobahn	**Operational**

Atlanta Aerobahn

Contract Description **Sensis Aerobahn combines airside operational information, such as flight schedules, with the exact location and identification of aircraft and vehicles on the surface of the airport for a real-time, comprehensive view of surface operations. Through the DOA, each airline at Hartsfield-Jackson and the FAA has access to the web-based Aerobahn service with the ability to customize Aerobahn with their operational data. Further, each individual user will be able to customize Aerobahn's screens and tools to best match his or her job requirements. This will result in airlines having the information most needed to better manage daily operations. The DOA uses Aerobahn to automatically measure gate use and occupancy in addition to managing airfield operations.**

Customer Name:	City of Atlanta Department of Aviation	Contact Email:	paul.meyer@atlanta-airport.com
Contact Name:	Paul S. Meyer, A.A.E	Contact Phone	+1 404 530-6620
Contact Address:	City of Atlanta Department of Aviation P.O. Box 20509 Atlanta, GA 30320		

Atlanta Aerobahn	**Operational**

References for Aerobahn

Port of Seattle

Contract Description **Implementation and delivery of the Aviation Flight & Fleet Data Server and implementation of Gate information on the ASDE-X remote displays at Sea-Tac International Airport.**

Customer Name:	Port of Seattle	Contact Email:	sadler.k@portseattle.org
Contact Name:	Krista Sadler	Contact Phone	+1 206 728-3629
Contact Address:	Port of Seattle Pier 69 2711 Alaskan Way Seattle, WA 98121		

Port of Seattle **Operational**

Memphis Aerobahn

Contract Description **Sensis was contracted by Volpe to create an interface that incorporates the capabilities of the Surface Decision Support System (SDSS) with a FOSA (generic description of an Aerobahn-like system). The FOSA provides a platform and user independent capability for information exchange between the Surface Decision Support System (SDSS) and flight operator information systems.**

Customer Name:	Federal Aviation Administration (FAA)	Contact Email:	Vince.Orlando@dot.gov
Contact Name:	Vince Orlando	Contact Phone	(617) 494-2842
Contact Address:	Volpe NTSC RVT-72 55 Broadway Cambridge, MA 02142		

Memphis Aerobahn **Operational**

References for A-SMGCS

ASDE-X

Contract Description **Sensis was awarded the ASDE-X contract in 2000 by the U.S. Federal Aviation Administration (FAA). Since this time, thirty-two sites that include MDS Multilateration have reached ATC operational status. The Sensis A-SMGCS system has been tested to more than 2000 requirements and has been validated by independent Operational Test and Evaluation experts in the U.S. Since 2000, the system has undergone a series of Pre-Planned Product Improvements (P3I) to increase capability and overall functionality—including legacy radar interfaces, data distribution and 32 conflict detection and alerting scenarios. Sensis provides integrated logistics support and operator and maintenance training, and is required to support the system for more than 20 years and maintain an obsolescence management plan for the equipment.**

Customer Name:	Federal Aviation Administration (FAA)	Contact Email:	robert.valdes@faa.gov
Contact Name:	Robert Valdes	Contact Phone	+1.202.567.6157
Contact Address:	Federal Aviation Administration, ASU-320 800 Independence Ave. S. W. Room 506 Washington, DC 20591		

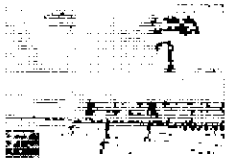
Oklahoma City Training	**Online**
Milwaukee - ASDE-X	**Operational**
Orlando - ASDE-X	**Operational**
Providence - ASDE-X	**Operational**
Houston Hobby - ASDE-X	**Operational**
Lambert-St. Louis - ASDE-X	**Operational**
Louisville – ASDE-X	**Operational**
Seattle - Tacoma - ASDE-X	**Operational**
Atlanta - ASDE-X	**Operational**
Hartford - ASDE-X (Bradley)	**Operational**
Charlotte Douglas - ASDE-X	**Operational**
Chicago O'Hare -ASDE-X	**Operational**
Washington Dulles - ASDE-X	**Operational**
Detroit Metro -ASDE-X	**Operational**
Phoenix - ASDE-X	**Operational**
Dallas - ASDE-X	**Operational**
Los Angeles - ASDE-X	**Operational**

References for A-SMGCS

Ft. Lauderdale - ASDE-X	**Operational**
Newark - ASDE-X	**Operational**
Denver - ASDE-X	**Operational**
Houston George Bush - ASDE-X	**Operational**
Minneapolis - ASDE-X	**Operational**
Chicago Midway - ASDE-X	**Operational**
Miami - ASDE-X	**Operational**
Honolulu - ASDE-X	**Operational**
John Wayne Orange County - ASDE-X	**Operational**
Baltimore-Washington - ASDE-X	**In Process**
Boston - ASDE-X	**Operational**
Washington National - ASDE-X	**Operational**
Philadelphia - ASDE-X	**Operational**
Las Vegas - ASDE-X	**In Process**
Memphis - ASDE-X	**In Process**
LaGuardia - ASDE-X	**Operational**
Salt Lake City - ASDE-X	**Operational**
San Diego - ASDE-X	**Operational**

Australia A-SMGCS

Contract Description **Airservices Australia (Airservices) has contracted with Sensis Corporation to deploy an Advanced – Surface Movement Guidance and Control System (A-SMGCS) at four airports: Sydney, Melbourne, Brisbane and Perth. As part of the A-SMGCS deployment, Airservices will also be using Sensis VeeLo NextGen™ units for tracking and identification of vehicles on the airport surface and Sensis Aerobahn® airport management tool for the efficient management of ground operations.**



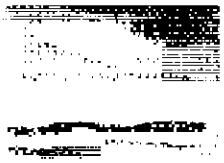
Customer Name:	Airservices Australia	Contact Email:	scott.lowry@airservicesaustralia.com
Contact Name:	Scott Lowry	Contact Phone	+61 3 9339 2521
Contact Address:	Airservices Australia Technology and Asset Services Tower Road, Melbourne Airport VIC 3043 Australia		

Sydney A-SMGCS	**Operational**

References for A-SMGCS

Melbourne A-SMGCS	**Operational**
Brisbane A-SMGCS	**In Process**
Perth A-SMGCS	**Under Contract**

Hong Kong International Airport A-SMGCS

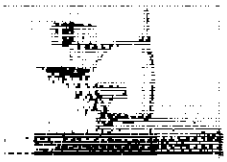


Contract Description **After a successful 9 RU Sensis MDS trial system, Sensis was awarded a contract to upgrade system in Hong Kong to a full A-SMGCS. The Hong Kong International Airport (HKIA) A-SMGCS utilizes a 19 RU MDS system for coverage of the airport surface up to and including the gates, and includes Safety Logic, Aerobahn for efficient management of ground operations, CWPs and a Remote Monitoring System (RMS). In addition, the HKIA A-SMGCS interfaces with these external systems: Secondary Surveillance Radars (SSRs); Surface Movement Radar (SMR); QNH for meteorological data; Flight Data Processing System (FDPS); Master Clock; Airfield Ground Lighting (AGL); Parking Bay.**

Customer Name:	Civil Aviation Department (CAD) Hong Kong	Contact Email:	wyleung@cad.gov.hk
Contact Name:	W.Y. Leung J.P.	Contact Phone	+852.2591.5000
Contact Address:	10/F, Commercial Building Airport Freight Forwarding Centre 2 Chun Wan Road Hong Kong International Airport, Hong Kong		

Hong Kong A-SMGCS	**Operational**

Indira Gandhi International Airport A-SMGCS



Contract Description **Sensis has provided India's first Level II A-SMGCS system for complete airport coverage and all weather surveillance at the Indira Gandhi International (IGI) Airport in New Delhi. Sensis A-SMGCS fuses multiple surveillance sources to provide one-second update rate multilateration, X-band radar with state of the art radar data processor, and an ADS-B vehicle tracking system. This data is integrated by the system's Multi-Sensor Data Processor (MSDP) which leverages the strengths of each individual sensor for the most accurate indication of target location. The MSDP also incorporates advanced Safety Logic algorithms to provide robust conflict detection and alerting functionality to support the Air Traffic Controllers. At IGI, Sensis A-SMGCS is also providing taxi route conformance monitoring to ensure that aircraft are conforming to their assigned route. Air Traffic Controllers receive an alert when an aircraft deviates from its assigned route.**

Customer Name:	Airport Authority of India	Contact Email:	mansoor_ahmad@hotmail.com
Contact Name:	Mansoor Ahmad	Contact Phone	+91 (11) 256 54 370
Contact Address:	CNS(P), Airports Authority of India		

Indira Gandhi International Airport - A-SMGCS	**Operational**

References for A-SMGCS

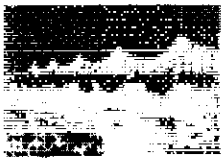
King Fahad International Airport A-SMGCS and WAM/ADS-B

Contract Description **Sensis will deploy Advanced – Surface Movement Guidance and Control Systems (A-SMGCS) and Wide Area Multilateration (WAM) systems for King Abdulaziz International Airport (Jeddah) and King Fahad International Airport (Dammam) in the Kingdom of Saudi Arabia. Both airports will enhance safety by using A-SMGCS to view aircraft and vehicles on the ground. The multilateration subsystem of the A-SMGCS systems will be expanded to provide the airports with WAM for safe and efficient separation of aircraft in the terminal approach coverage area. Additionally, the airports will use Sensis VeeLo NextGen™ vehicle locator units for tracking and identification of vehicles on the airport surface.**
Sensis was awarded both contracts as part of competitive procurements.

Customer Name:	General Authority of Civil Aviation (GACA)	Contact Email:	zalamri@yahoo.com
Contact Name:	Zaki Al Amri	Contact Phone	966 (2) 671 7717 X228
Contact Address:	GACA/Air Navigation Services Bani Malik St. Old Airport Jeddah, Kingdom of Saudi Arabia 21444		

King Fahad A-SMGCS **In Process**

King Abdulaziz International Airport A-SMGCS and WAM/ADS-B



Contract Description **Sensis will deploy Advanced – Surface Movement Guidance and Control Systems (A-SMGCS) and Wide Area Multilateration (WAM) systems for King Abdulaziz International Airport (Jeddah) and King Fahad International Airport (Dammam) in the Kingdom of Saudi Arabia. Both airports will enhance safety by using A-SMGCS to view aircraft and vehicles on the ground. The multilateration subsystem of the A-SMGCS systems will be expanded to provide the airports with WAM for safe and efficient separation of aircraft in the terminal approach coverage area. Additionally, the airports will use Sensis VeeLo NextGen™ vehicle locator units for tracking and identification of vehicles on the airport surface.**
Sensis was awarded both contracts as part of competitive procurements.

Customer Name:	General Authority of Civil Aviation (GACA)	Contact Email:	zalamri@yahoo.com
Contact Name:	Zaki Al Amri	Contact Phone	966 (2) 671 7717 X228
Contact Address:	GACA/Air Navigation Services Bani Malik St. Old Airport Jeddah, Kingdom of Saudi Arabia 21444		

King Abdulaziz A-SMGCS **In Process**

References for A-SMGCS

Ben Gurion A-SMGCS

Contract Description **The Israel Airports Authority (IAA) selected Sensis Corporation Advanced – Surface Movement Guidance and Control System (A-SMGCS) for Ben Gurion International Airport as part of a competitive procurement. The Level II A-SMGCS will fuse a number of surveillance technologies into a comprehensive view of the airport's runways and taxiways for enhanced safety at Israel's capital airport. A Level II A-SMGCS features the improved surveillance of a Level I A-SMGCS plus safety alerts to the controller for the prevention of runway incursions.**

The Sensis A-SMGCS fuses surveillance data from Sensis multilateration, Sensis Surface Movement Radar (SMRi), and Sensis VeeLo NextGen™ vehicle locators to provide comprehensive location and identification of all aircraft and vehicles on the airport's runways and taxiways. Further, the surveillance data is integrated with Sensis Safety Logic conflict detection and alerting algorithms to give controllers advanced visual and audible warning of potential runway incursion situations. All information is displayed to the controller on Sensis Controller Working Positions. The system records all events, including controller voice commands, for future playback. Sensis' modular approach to A-SMGCS enables hardware, such as additional multilateration ground stations, and software, such as airport automation tools, to be added to accommodate additional interfaces, new runways/taxiways or other needs as the airport grows.

Customer Name:	Israel Airport Authority	Contact Email:	yairg@iaa.gov.il
Contact Name:	Yair Gannot	Contact Phone	+1 972-3-9752520
Contact Address:	Israel Airports Authority Director - Aviation Safety Division Ben Gurion Airport P.O. Box 7 Israel 70100		

Ben Gurion A-SMGCS **Under Contract**

References for Surface MLAT

Vienna International Airport MDS

Contract Description **The 21 RU Sensis MDS system provides cooperative surveillance coverage for aircraft on the runways, taxiways and into the gate areas. Sensis received follow-on work to upgrade the system and install SMRI on the new ATC Tower. Sensis was awarded the contract after winning a competitive procurement.**

Customer Name:	Austro Control	Contact Email:	christian.schelflinger@austrocontrol.at
Contact Name:	Christian Schelflinger	Contact Phone	+43 (51703) 3050
Contact Address:	ATS/Operational Planning Schnirchgasse 11A-1030 Wien Austria		

Vienna Mlat **Operational**

Brussels MDS

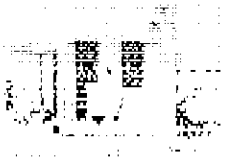
Contract Description **The 16 RU Sensis MDS system provides cooperative surveillance coverage for aircraft on the runways, taxiways and into the gate areas. Sensis was awarded the contract after winning a competitive procurement.**

Customer Name:	Belgo Control	Contact Email:	Manuel_de_Klerk@belgocontrol.be
Contact Name:	Manuel de Klerk	Contact Phone	+32.2.206.2228
Contact Address:			

Brussels MDS **Operational**

Charles de Gaulle MDS

Contract Description **At CDG and Orly, Sensis provides MDS surface surveillance of the runways, taxiways and gates as well as automatic labeling of aircraft for improved situational awareness, enabling the airport to monitor traffic flows and throughput prior to safely implementing procedural changes. Aerobahn complements the multilateration system by enabling Service de la Navigation Aerienne (SNA), the French civil aviation authority for the greater Paris region, to view, monitor, and quantifiably measure airport operations.**



Customer Name:	**Aéroports de Paris**	Contact Email:	jean-marc.receveau@adp.fr
Contact Name:	Jean-Marc Receveau	Contact Phone	+01 49 75 72 04
Contact Address:	Subdivision Radar-Traitement DTI/SDSO **Antenne Aéroports région parisienne** Orly Sud 103 - 94396 Orly Aerogare CEDEX		

Paris - Charles de Gaulle - MDS **Operational**

References for Surface MLAT

Orly MDS

Contract Description **At CDG and Orly, Sensis provides MDS surface surveillance of the runways, taxiways and gates as well as automatic labeling of aircraft for improved situational awareness, enabling the airport to monitor traffic flows and throughput prior to safely implementing procedural changes. Aerobahn complements the multilateration system by enabling Service de la Navigation Aerienne (SNA), the French civil aviation authority for the greater Paris region, to view, monitor, and quantifiably measure airport operations.**

Customer Name:	**Aéroports de Paris**	Contact Email:	jean-marc.receveau@adp.fr
Contact Name:	Jean-Marc Receveau	Contact Phone	+01 49 75 72 04
Contact Address:	Subdivision Radar-Traitement DTI/SDSO **Antenne Aéroports région parisienne** Orly Sud 103 - 94396 Orly Aerogare CEDEX		

Paris - Orly - MDS **Operational**

Frankfurt International Airport MDS

Contract Description **Sensis' first international installation of MDS technology provides coverage of runways, taxiways and gate areas. The system was expanded in 2003 from 19 to 22 RUs to provide coverage of approaching aircraft. Sensis MDS is used both as a surface surveillance system and a precision approach monitor. Sensis was awarded the contract after winning an open procurement.**

Customer Name:	Thales ATM GmbH	Contact Email:	r.posern@fraport.de
Contact Name:	Roy Posern	Contact Phone	+49 69 690.21658
Contact Address:	Information and Telecommunications, Airside Engineering, IUK-AF1 60547 Frankfurt am Main Germany		

Frankfurt MDS **Operational**

Haneda MDS

Contract Description **MDS system**

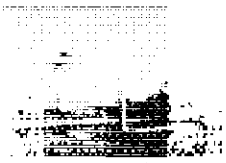
Customer Name:	Melco	Contact Email:	
Contact Name:	Takayuki Niiyama	Contact Phone	+1.714.236-6227
Contact Address:	Mitsubishi Electric and Electronics USA, Inc. International Purchasing Division (Cypress) 5665 Plaza Drive, Cypress, CA 90630-0007		

Haneda MDS **Operational**

References for Surface MLAT

Amsterdam Schiphol MDS

Contract Description **The 21 RU Sensis MDS system provides cooperative surveillance coverage for aircraft on approach, on the runways, taxiways and into the gate areas. Sensis was awarded the contract after winning a competitive procurement.**

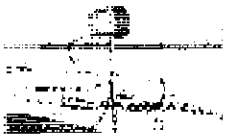


Customer Name:	LVNL Air Traffic Control The Netherlands	Contact Email:	e.c.vink@lvnl.nl
Contact Name:	E.C. Vink	Contact Phone	+31 20 406 2236
Contact Address:			

Amsterdam Schiphol - MDS **Operational**

Stockholm Arlanda MDS

Contract Description **Sensis MDS was integrated into the airport's existing SMGCS. This improves overall system reliability and safety by providing heightened surveillance accuracy and automated labeling of aircraft and vehicles in the gates and movement area. Sensis was awarded the contract after winning a competitive procurement.**



Customer Name:	Luftfartsverket (LFV)	Contact Email:	anders.j.andersson@lfv.se
Contact Name:	Anders Andersson	Contact Phone	+46 (708) 892 819
Contact Address:	Luftfartsverket Air Navigation Services ANS System & Infrastructure **601 79 Norrköping**		

Stockholm Arlanda **Operational**

Zurich MDS

Contract Description **The 14 RU Sensis MDS system provides cooperative surveillance coverage for aircraft on the runways, taxiways and into the gate areas. Sensis was awarded the contract after winning a competitive procurement.**

Customer Name:	Sky Guide	Contact Email:	
Contact Name:	**Bård Guttelvik** (Park Air)	Contact Phone	
Contact Address:	Park Air Systems AS Bromsveien 17 SNI Senteret P.O. Box 145, N-3191 Horten Norway		

Zurich **Operational**

References for Surface MLAT

Customer Name:	Sky Guide	Contact Email:	daniel.stamm@skyguide.ch
Contact Name:	Daniel Stamm	Contact Phone	+41 43 816 84 21
Contact Address:			

Zurich **Operational**

Geneva MDS

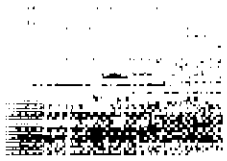
Contract Description **The 10 RU Sensis MDS system provides cooperative surveillance coverage for aircraft on the runways, taxiways and into the gate areas. Sensis was awarded the contract after winning a competitive procurement.**

Customer Name:	Sky Guide	Contact Email:	daniel.stamm@skyguide.ch
Contact Name:	Daniel Stamm	Contact Phone	+41 43 816 84 21
Contact Address:			

Geneva **Operational**

Suvarnabhumi (Bangkok) MDS

Contract Description **Sensis has installed a 10 RU system at the new airport in Bangkok to provide coverage on the runways, taxiways and into the gate areas. Sensis was awarded the contract after winning a competitive procurement.**



Customer Name:	AEROTHAI	Contact Email:	bhumisat@aerothai.or.th
Contact Name:	Bhumisathit Jampathom	Contact Phone	+66 2285-0092
Contact Address:			

Bangkok (Suvarnabhumi) MDS **Operational**

Dubai International Airport MDS

Contract Description **Sensis' multilateration (MDS) and vehicle tracking (Veelo) systems are being integrated into the airport's Advanced Surface Movement Guidance Control System (A-SMGCS). The Sensis MDS (Multistatic Dependent Surveillance) will provide high accuracy, high update rate multilateration surveillance for all transponder-equipped aircraft at the airport and is proven to provide spatial isolation of multiple aircraft at the same range. Sensis was awarded the contract after winning a competitive procurement.**

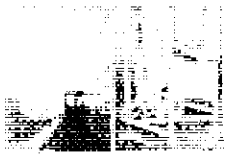
Customer Name:	Park Air	Contact Email:	colinh@dca.gov.ae
Contact Name:	Colin Hewson	Contact Phone	
Contact Address:			

Dubai International Airport **Delivered**

References for Surface MLAT

London Heathrow MDS

Contract Description **The 17 Remote Unit (RU) Sensis MDS system provides cooperative surveillance coverage on all runways, taxiways and gate areas. The system underwent an expansion and upgrade to accommodate the growth at the airport; seven RUs were added. Sensis was awarded the contract as part of a competitive procurement.**



Customer Name:	National Air Traffic Services (NATS) -UK	Contact Email:	alistair.j.clark@nats.co.uk
Contact Name:	Alistair Clark	Contact Phone	+44 20 8750 3668
Contact Address:	National Air Traffic Services 1st Floor Heathrow House 785 Bath Road Cranford Middlesex, TW5 9AT		

London Heathrow **Operational**

London Gatwick MDS

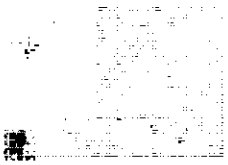
Contract Description **The 15 Remote Unit (RU) MDS surface surveillance system is providing accurate location and identification for enhanced safety and efficiency of aircraft operating in runway, taxiway and stand areas of the airport. Gatwick is the busiest single runway airport in the world and the second largest airport in the UK. Sensis was awarded the contract as part of a competitive procurement.**

Customer Name:	National Air Traffic Services (NATS) -UK	Contact Email:	alistair.j.clark@nats.co.uk
Contact Name:	Alistair Clark	Contact Phone	+44 20 8750 3668
Contact Address:	National Air Traffic Services 1st Floor Heathrow House 785 Bath Road Cranford Middlesex, TW5 9AT		

London Gatwick **Operational**

Montreal Pierre Elliott Trudeau International Airport MDS

Contract Description **Sensis MDS complements the surface radar technology currently in place at Montreal International Airport. By identifying the aircraft and vehicles through transponder-based multilateration, Sensis MDS helps provide NAV CANADA controllers and airport personnel with a more complete picture at one of Canada's busiest airports.**



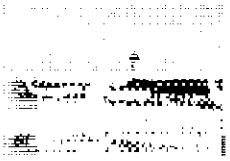
References for Surface MLAT

Customer Name:	NAV CANADA	Contact Email:	McCarthP@navcanada.ca
Contact Name:	Paul McCarthy	Contact Phone	+1 (613) 248-6949
Contact Address:	NAV CANADA Contracting & Procurement Services 280 Hunt Club Road Room A109 Ottawa, Ontario K1V 1C1 Canada		

Montreal MDS **Operational**

London Stansted MDS

Contract Description **The 17 Remote Unit (RU) MDS surface surveillance system will provide accurate location and identification for enhanced safety and efficiency of aircraft operating in runway, taxiway and stand areas of the airport. Stansted is the third busiest airport in the UK, and the third largest airport serving the London area. Sensis was awarded the contract as part of a competitive procurement.**

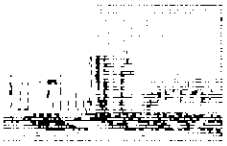


Customer Name:	National Air Traffic Services (NATS) -UK	Contact Email:	alistair.j.clark@nats.co.uk
Contact Name:	Alistair Clark	Contact Phone	+44 20 8750 3668
Contact Address:	National Air Traffic Services 1st Floor Heathrow House 785 Bath Road Cranford Middlesex, TW5 9AT		

London Stansted **Operational**

Lisbon Airport MDS

Contract Description **Sensis MDS enables controllers to have a highly accurate, frequently updated view of the Lisbon Airport surface and allow them to more efficiently manage traffic on the ground. The solution also provides Lisbon with some approach and departure coverage out to five nautical miles from the runways. Sensis was awarded the contract after winning a competitive procurement.**



Customer Name:	NAV Portugal	Contact Email:	
Contact Name:	Mr. Andre Main	Contact Phone	
Contact Address:			

Lisbon Airport **Operational**

Narita MDS

Contract Description **RUS.**

References for Surface MLAT

Customer Name:	Melco	Contact Email:	
Contact Name:	Takayuki Niiyama	Contact Phone	+1.714.236-6227
Contact Address:	Mitsubishi Electric and Electronics USA, Inc. International Purchasing Division (Cypress) 5665 Plaza Drive, Cypress, CA 90630-0007		

Narita MDS **Operational**

Frankfurt International Airport Upgrade

Contract Description **Frankfurt Airport (FRA) was the industry's first airport to select multilateration for surface surveillance, awarding Sensis a contract back in 1999. Since then, the Sensis system has been expanded or altered several times to meet FRA's changing geographic and traffic requirements In March 2011 Fraport AG - the owner and manager of FRA - selected Sensis to expand and upgrade its multilateration surface system to accommodate capacity expansion and growth of operational areas at FRA. Fraport chose to replace all existing Sensis multilateration sensors in use at the airport with the latest-generation sensor for precise surveillance of all aircraft and transponder-equipped vehicles operating on the airport surface.**

Customer Name:	FRAPORT	Contact Email:	r.posern@fraport.de
Contact Name:	Roy Posern	Contact Phone	+49 69 690.21658
Contact Address:	Information and Telecommunications, Airside Engineering, IUK-AF1 60547 Frankfurt am Main Germany		

Frankfurt International Airport Upgrade **In Process**

References for RWSL

Runway Status Lights

Contract Description **The Federal Aviation Administration has contracted Sensis to install Runway Status Lights (RWSL) at 22 airports across the United States.**
RWSL is a system of red lights embedded in the pavement of runways that automatically warns pilots if it is unsafe to cross or enter a runway and "take-off hold lights" that indicate if a runway is unsafe for departure.
RWSL operates by automatically illuminating red lights if the airport's Airport Surface Detection Equipment, Model X (ASDE-X) detects traffic on or approaching the same runway.
Sensis was awarded the contract after a competitive procurement.

Customer Name:	Federal Aviation Administration (FAA)	Contact Email:	robert.valdes@faa.gov
Contact Name:	Robert Valdes	Contact Phone	+1.202.567.6157
Contact Address:	Federal Aviation Administration, ASU-320 800 Independence Ave. S. W. Room 506 Washington, DC 20591		

Orlando - RWSL	**In Process**
Baltimore-Washington - RWSL	**In Process**
Detroit Metro - RWSL	**In Process**
Phoenix - RWSL	**In Process**
Charlotte Douglas - RWSL	**In Process**
Houston George Bush - RWSL	**In Process**
Ft. Lauderdale - RWSL	**Operational**
Seattle - Tacoma - RWSL	**In Process**
Atlanta - RWSL	**In Process**
Washington Dulles - RWSL	**In Process**
LaGuardia - RWSL	**In Process**
Las Vegas - RWSL	**In Process**
Newark - RWSL	**In Process**
Philadelphia - RWSL	**In Process**
Chicago O'Hare - RWSL	**In Process**
Minneapolis - RWSL	**In Process**
JFK - RWSL	**In Process**

References for RWSL

Dallas - RWSL	**In Process**
San Diego - RWSL	**In Process**
Los Angeles - RWSL	**In Process**
Boston - RWSL	**In Process**
Denver - RWSL	**In Process**

Sensis

Detect the Difference

July 6, 2011

The Port Authority of NY & NJ
Attn: Bid/RFP Custodian
Procurement Department
1 Madison Avenue, 7th Floor
New York, NY 10010

Subject: Response to RFP for Proposals for Surface Management System at JFK International Airport

Reference: E – Documentation of Proposer Prerequisites – Financial Information

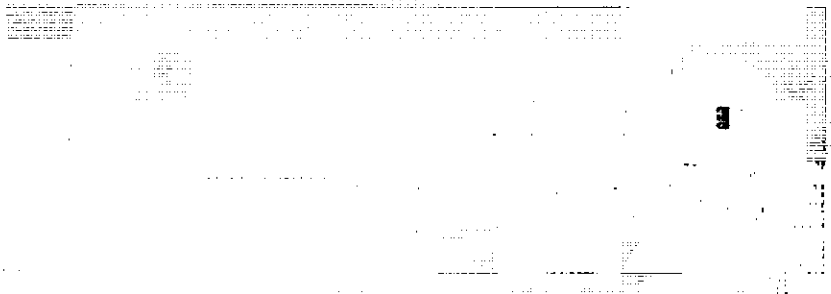
Dear Sir or Madam,

The reader of the attached financial statements should be aware that on 29 June 2011, Sensis and Saab AB of Sweden signed a definitive agreement for the sale of Sensis to Saab. Sensis will operate as a wholly owned U.S Subsidiary of the Saab Group. Saab is nearly a $4B publically traded company, and will provide Sensis Corporation with the financial strength to perform, without risk, on very high value Aviation and Defense projects. The deal is expected to close in early August of 2011.

Sincerely,

Larry Harris
Senior Vice President & Chief Financial Officer (CFO)
Sensis Corporation

5717 Enterprise Parkway, East Syracuse, NY 13057 Phone: 315-445-0550 Fax: 315-446-2209
www.sensis.com



Investor Relations Contact:

[illegible]

Sands Corporation

Phone: [illegible]

email: [illegible]

Media Inquiries:

[illegible]

[illegible]

Analyst Inquiries:

[illegible]

2002
Michael Sinsabaugh
Mark Bachner
Kenneth Cook
Timothy DeVaul
David Nels
Linda Becker
Lawrence Surace
Jeffrey Legge
Laura Livingston
Melanie Bowers
James Phillips
Justin Firenze
Sheri Parsons
Michael Masters
Patrick Kilfoile
James Pulverenti
Jeremy Rossman
Sally Wypych
Heidi Hinckley
Faruk Mehkic
John Corcoran
Nicole Chatman
Christopher Annal
Shannon Clouse
Andrew Keckler
Allen Reese
Michelle Palmer
Gregory Thisse
Joshua Burak
Thomas Westpfal
Elizabeth Larson
Ricky Smith
Jesse DeFeyter
David Kovarik
Carol Lisi
Albert Burgin
Jose Mera

2001
Robert Buck
Stephen Sauriol
AnnMarie Youmans
†*Mark Sabatino
Kenneth Samuelson
Keith Fenton
James Teator
Mark Abramski
Diane Reed
Bruce Docherty
Brian Fairman
David Gallaro
Scott Everhart
Dominic Morganti
Linda Johnson
Don House
Patrick Henson
Kimberly Hoxie
John Laub
Annette Lira
Jeremy Scicchitano
Jeffrey Renk
Rodney Collins
Stephen Radder
Phillip Koppers

2000
Hung Le
Sarah Fitzgerald
Stephen Horn
Brian Desai
John Nahor
*David Olster
William Athey
Stephen Winslow
Michael Simon
Zion DeRegis
Andrea Masten
Linda Muraca
Frank Matus
Stephen McMahon
Marchelle Milsap
Richard Downing
Kevin McGarry
Stanley Yancy
John Rougas
Joseph Byrne
Suad Busuladzic
Trieu Phan
Sany Joseph
Alex Fairbank
Robert Pakan
Kim Wandersee

1999
Kenneth Tollstam
Richard Cauchon
Michael Taylor
Scott Remillard

1998
Robert Deutschman
Nancy Coldren
Kevin Hatch
Kenneth Pomerenk
Nina Lott
Jonathan Stoberl
Margaret Heffron
Simon Hurley
Jack Waldman
Jeffrey Bell
James Marsch
William Pomerenk
Edward deLutio

1997
Daniel Panachyda
Dennis Yaeger
Raymond Leggiero
Kevin McEntee
Jean Chao
Adlai Wheeless
Melody Cornman
Edwin Dyer
Craig McGowan
Jean Southwick
Christopher Smith
Mark Campitello
Charles Brown
William Donahue
Jeanette Elwood
Michael Donabella
Lynn Dabrowski
Kenneth DiFlorio
Rene DiFlorio
LuWen Yamamoto
Sally Kwasigroch
David Rinehart
Jeffrey Biedermann
*Antonio Lo Brutto
John Nykaza
Glenn Hall
Michael Conte
*Michael Gerry
Cindy Wilson
Michael Smith
Donna Pond
Lawrence Nguyen
Anthony DaSilva
Frederic Stettler

1996
Kathleen Reid
Joseph Crandall
Ronald Turner
Brett Coburn
Nicole Bell
Roseann Smith
Paul Blust

1995
*Jenifer Herman
John Carioti
Michael Gangemi

1994
David Miller
David Sargrad
Lisa Bordonaro
Jason Desai

1993
Barry Viggiano
David Bordonaro
*Arthur Almeida
Michael Farneth
Craig Gostin
Steve Chapin
Jason Anderson
Thomas Polovick
Donna Wilson
Geoff Lloyd
Jessica Ryan
Stephen Wilson

1992
Nicholas Gullotta
Larry Harris
Michelle Hoffman
Christopher Keeney
David Michel
Gregory Berkebile
Robert Corriero
Anna Avsitidisky
Barbara Garden

1991
Avi Barsheshat

1990
Paul Bertalan
Curtis Stover
Edward Valovage

1989
Dana Dudarchik
Salvatore Yurman
Todd Lampersberger
*William Hullings
Kelly Beardsley
Susan Gallagher
William Halpin
Margaret Dudarchik

1988
Matthew Massiano
David Becker

1987
Arthur Morris
*Timothy Waldron
Jeffrey Thompson

1986
†*Daniel Fitch
Marc Viggiano

1985
Jud Gostin
†Richard Kinsey
†Ernest Rockwood
†James Perry
Roz Gostin

†Sensis Senior Fellows
*Recipients of the Senior Fellows Award, instituted in 2002

Sensis Employees continued

Sean Davidson
Patrick Fitzgerald
Stacy Haley
Daniel Magee
David Talaga
Valentino Felipe
George Adams
Matthew Bellinger
Justin Thornton
Ann Albanese
Benjamin Shawley
Michael Skrzypek
Mark Groman
Mark Steigerwald
Robert Eaton
Jennifer Krause
Jason Oppedisano
Kevin Chen
Matthew Francescotti
David Wang
Michael Ashbridge
Christopher Holverson
Jeffrey Markley
Pamela Follett
Stevenson
Lee Gratz
Daryl Hartman
Edward Bondgren
Patricia Hartmann
Kelly Woods
Peter Hunt
David Rappaport

2006

Stephen Lesh
Steve Trigonis
Nataliya Orosz
Nicole Dzuba
Jared Titus
Darin DeRoberts
Frederick Koennecke
Huong Dang
Seung Kim
Robert Matus
Robert Triggs
Michael Anzalone
John Tymkiw
Ray Ulinski
Gregory Wormer
David Parrett
Leslie Dodson
Nichole Wenderlich
Margo Brink
Gary Hall
Stephen Roman
Frederick Wieland
Christopher Melfi
Darrell Nandal
Michael Connery
Andrew Tompkins
Ann Hamby
Martha Winslow
Oleh Iwachiw
Michael Davey
Kathleen Selmser
Troy Toffolo
Angela Dunkel
Glenn Gabriele
Howard King
Jeffrey Warner
Michael Owen
Sharon Peterson
Craig Lancaster
Robert Brown
Srdjan Lukic
Thomas Uva
Scott Watterud
Kathryn LaFay
Sandra Schilling
Dwight Jemison
Grace Giarusso
Carl Bauder
Fanti Le
Barbara Ponzi
Michael Borden
Christopher Collins
Rachelle DeFurio
James Heroux

2005

John Greene
Michael Barcak
Horen Kuecuekyan
William Bodily
Ricardo Mediavilla
John Sokolovic
James Haswell
Thomas Troast
Debby Farrelly
Timothy Bosworth
Debbie Stack
Johanna Phillips
Sam Deeb
Hans Hagen
Irene Dugan
Kevin Lee
Retha Whewell
Lisa Whitt
Lorraine Aird
James Bass
Kurt Schultz
Jonathan Plishka
Carl DeWire
Jennifer Hass
Jonathan DeVoe
Dave Phillips
Andrew Bak
Sharon Repass
David Closs
Paul Hoffmann
Abyee Abraham
Marcel Trommel
Marlene Ayling
Matthew Blake
Benjamin Boisvert
Gregory Carr
*George Couluris
Paul Davis
Diego Escala
Cathy Grimes
Lora Hoetger
Kun-Lung Hsiao
Sheng-Chen Huang
George Hunter
Joseph King
Michael LeClair
Mark Peters
James Phillips
Kris Ramamoorthy
David Schleicher
Phillipe Stassart
Douglas Sweet
Erin Gambucci
Donna Weniger-Kimmet
SatSat Fox
Cory Przybyla
Timothy Sutton
Steve Perretta
Michael Bowers
Michael Royer
David Brzostek
Keith Tebby
Shawn Dubowyk
Patrick McCormick
Douglas Rabe
Mark Runnels
Ling Tang
Brian Yaichuk
Colleen MacKay
Phillip Neumiller
Andrea Beaudet
Joseph Governali

2004

Steve Benson
Alan Durston
Ken Kaminski
Adam Krygowski
Nathan Mittler
Alan Rolnick
Pete Ruzicka
Greg Testa
Paul Fioramonti
Niluk Ferdinando
Bob Campitello
Jay Johnson
Luke Nicolette
Mark Prosser
Daniel Bray
Matthew Trexler
Joe Waclawski
Ron Blair
Dana Hall
Dave Janczyk
Alma Jotic
John Marziale
Jerry Monroe
Anne Murphy
Lorraine Stone
Eugene Bojarski
Brian Manion
Jeff Ward
Thomas Reidy
John Kresse
Robert Taft
Robert White
Haoyun Wu
Thomas Jones
Cheryl Willner
Dan Aird
Anthony Barnum
Mike Burke
Larisa Parks
Mark Swenson
Stephen Caldwell
Ben Levy
Scott Wameling
Jon Truelson
John Pelo
Steven DeHart
Christopher Kelly
Ken Rogers
Debra Collins
Robert Savicki
Michael Brame
Sharon Hall
Karen Wilson
Nitin Kapoor
Jeremy Kaznocha
Larry Beck
Nathan Rose
Scott Alexander
Joseph Tari
Christian Shepard
G. Robert DiCaprio
Andrew Hepp
Matthew Synborski
Larry Campanelli
James Doyle
Michael Schiavone
Peg Smallman

2003

Timothy Voorheis
Erik Palmer
Thomas Azallion
Jeffrey Stockwin
Ryan Haynes
†*Elyahu Peri
Chad Nichols
Kathleen Phillips
John Kelly
Christopher Schierer
Frank Skowron
*Brian Edward
Joseph Burko
Timothy Chermak
Dawn House-Bundy
Thomas Johnson
Katherine Rossler
Laurie Caraher
Todd Pittman
Alfred Marshall
William Womble
Colleen Fadden
Alonzo Etheredge
Mark Underwood
David Wilson
Wen-Hei Yang
Sharon Sale
Andrew Biss
Mark Wilson

Sensis Employees

2009

Kyle Aures
Tim Hall
Steve Howe
Gaurav Nagle
Dave Houghton
Craig LaVere
Mike Sanderson
Linda Wander
Sebastian Abraham
Mike Bird
Fei Zheng
Larry Nelson
Greg Davey
Chris Dickens
Nick Dimitrijevski
Harris Frank
Tim Horan
.ıua Vanderpool
LaTroy Graham
Michele Nellenback
Pam Spier
Kory Sponaugle
Ray Young
Judy Ford
Vince Preuss
Yogesh Sharma
Peter Yu
Keith Merritt
Jerry Rushak
Randy Capin
Jennifer Kolozsvary
Pat DiNovo
Jan Garcia
Bill Shampine
John Burns
Pete Dionne
Pete Fischer
Tim Nolan
Mark Romano
·go Scofield
. Coleman
Dan McGuire
David Sturges
John Morgan
Leslie Johnson
John Keil
Jim Augustus
Stephen Conklin
Mike Kohler
Bob Leclere
Jim Razza
Taylor Bullis
Bill Caswell
Paul Gullotta
David Klementowski
Doug Trojan
Curt Wheeler
Subie Ghosh
Doug Karlik
Steve Stroiney
Kevin Barnett
Sami Habayeb
Todd Stevener
James Yoviene
Jeff Cann
Craig Hillabush
Joanne Seamans-Mursak
Joanne Wagner
Rebecca Judkins
Aaron Mauer
Mark Sample
Erick Talley
Andrew Trapani
Beth Via
Charlene Williams
Alonso Zubillaga
Nicholas Sadowski
Yen Tran
Sam Carroll
Tony Demitraszek
Dan London
Pat Lawless
Faris Sousou
Gary Bridge
Bradford Morse
Jamie Whitford
Tim Filkins
Courtney Floyd
Anthony Scalzo
Lindsey Ahern
Joel Placito
Monika Santucci
James Rhone
Huina Gao
Michelle Arcuri
Jeremy Francis
Ron Gagnon
Maximilian Lopez
Suzanne Anderson
Jamie Arnold
Howard Downing
Jaime Strain-Bennett
Spiro Bocvarov
John Dolan
Paul Ciciriello
Hrut Patel
Scott Stone
Ron Finke
Melinda Lewis
Greg Farnham
Michelle Dong
Shawn LaRiviere
Dave Liberty
Suresh Sitharaman
Dennis Tharp
Stojan Trajkov
Richard Chandler
Phil Cobb
Pat Lewis
Chris Lindsey
Matt Von Bargen
Joe Downing
Steve Lamkins

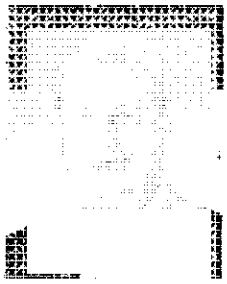
2008

Brian Berlin
Kyle Fritz
Joseph Jaworski
Kenneth Kellerman
Kenneth Wright
Phillip Beamer
Kathleen Kitt
David Perkins
Howard Ross
Kevin Liepke
Christopher Wergin
Jeffrey Birdsall
Christopher Hubbard
Michael Lees
Nikolas Batruch
Miriam Israelowitz
Jeffrey Sidoni
Michael Wakefield
Collen Knickerbocker
James Smith
Ravi Bhargava
Theodore Houck
Mathew Maury
Vincent Ferrelli
Thomas Michlovitch
Alan Scalzo
Ryan Belanger
Laura Golden
Adam MacKenzie
Zenon Werbowsky
Sophia George
Neil Smith
John Scivetti
Kathleen Sloan
Stephen Eron
Andrew Ford
Stephen McEntee
Hilary Taylor
Phyllis Gustafson
John Strouth
Max Barragan
Matthew Chabot
Donald Smith
Allen Wells
Caleb Law
Russell Freeman
Kevin Peirson
Theresa Plonka
James Giannetto
Gordon Owens
Randall Pittman
Thomas Bray
Linda Krupka
Jennifer Robertson
Joseph Verginio
John Mancino
Jason Ladd
Sebastian Timar
Michael Carpenter
Steven Bigness
Daniel Henry
Nicholas Meyer
Joseph Pagcaliwagan
Naji Younes
John Clate
Shobhan Eerabathini
Robert Gardiner
Judith Dudley
Jamie Petty
Amy Bare
Nedim Catal
William Burak
Scott Johnson
Cathleen Ready
Christiaan VanCeylon
Christopher Gregoire
Randall Krytusa
Kim Testa
Daniel Ivanick
John Solpietro
Adelena Bagdasarova
Aditya Saraf
Samuel Skidmore
Dianna Nguyen
David Smorol
Robert Conrad
David Hodge
David Kazlman
Christopher Johnson
David Richardson
John Cerrone
James Gardner
Douglas Nolan
James Reid
Emanouela Canzano
Matthew Feldman
Kevin Lefebvre
Michael Raulli
Ian Weber
Peter Mangerian
Victor Riley
David Shomar
Wendi Evans
Anand Kanabar
Harry Lee
Frank Paglia
Jeffrey Cole
Mevzad Ljuca
Brian Mahan
Albert Olin
Diane Gorman
Anand Kanabar
Regina Frost
Matthew McKeon
David Scrano
Erik Smith
Stuart Williams
Michael Alt
Michael Gleason

2007

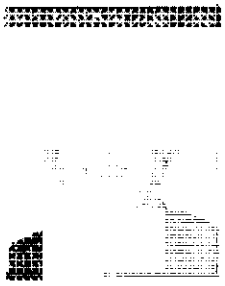
William Bigness
Daniel Estock
Casey Fish
Kenneth Maum
Alexander Ranaldi
Gregory Bintz
Joseph Durfee
Ralph Flatau
Hong Martel
Douglas Fenster
Joseph Weist
Robert Bolton

Board of Directors



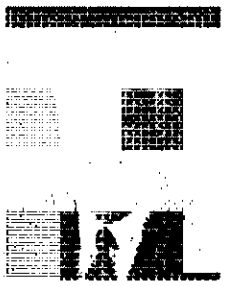
Captain William Cotton

Captain Cotton, President, Cotton Aviation Enterprises, is the "Father of Free Flight," an air traffic management operating concept that will increase safety, capacity and operating efficiency. Captain Cotton's career also includes 33 years as a pilot with United Airlines, the last 15 of those as the airline's chief technical pilot in charge of improvements to air traffic control and cockpit avionics systems.



The Honorable Susan M. Coughlin

The Honorable Susan M. Coughlin, President and Founder, Air Safety Management Associates, is a former Vice Chairman and Member of the National Transportation Safety Board and is widely recognized as an industry expert on transportation safety issues.

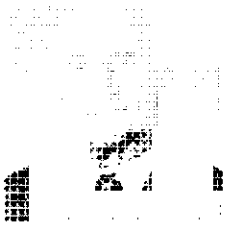


Jud Gostin

Mr. Gostin, Chairman, President and Chief Executive Officer, Sensis Corporation, was the system architect of the U.S. Marine Corps' primary long-range air surveillance radar, AN/TPS-59. Mr. Gostin is also credited with developing methods – widely used throughout the radar industry – to adapt antennas so that they can operate while being subjected to hostile electronic interference.

General Alfred Gray

General (Ret.) Alfred Gray, Chairman, Board of Regents and Senior Fellow, Potomac Institute for Policy Studies, served as the 29th Commandant of the U.S. Marine Corps and a member of the Joint Chiefs of Staff during his 41-year career with the Corps.



General Merrill McPeak

General (Ret.) Merrill McPeak, President, McPeak and Associates, has extensive business experience following a more than 35-year career that included serving as Chief of Staff of the U.S. Air Force and membership on the Joint Chiefs of Staff.

The Honorable Sean O'Keefe

The Honorable Sean O'Keefe, Vice President of the General Electric Company, former Chancellor of Louisana State University, Administrator of the National Aeronautics and Space Administration (NASA), Secretary of the Navy, Comptroller and Chief Financial Officer (CFO) of the Defense Department, has more than 30 years of finance, business and aerospace experience in government, industry and academia.

Peter Salas

Mr. Salas is the Founder and President of Dolphin Asset Management Corporation and its related companies. Formerly, he was Director of Small Cap Research and Co-Manager of the Small Company Fund at J.P. Morgan Investment Management. Mr. Salas has extensive private equity and public small company expertise.

The fair value for these options was estimated at the date of grant using a Black-Scholes option pricing model with the following weighted-average assumptions for 2009 and 2008: risk-free interest rates of 3.24% and 4.92%, respectively, dividend yields of 0%, and expected life of the option of 6.7 and 5.5 years, respectively. In determining the volatility of the Company's common stock, a market approach was utilized in the current year whereby a reasonably comparable group of publicly traded companies were identified and their common stock's long-term price volatility was utilized as a benchmark. The long-term measure of volatility selected for the Company's common stock was 50% for 2009 and 2008.

13. Employee Benefits

The Company sponsors a defined contribution plan that covers substantially all employees. The plan is qualified under Section 401(k) of the Internal Revenue Code (IRC) and provides for employee contributions up to certain IRC limitations. Presently, the Company matches 50% of the employee contribution not to exceed 8% of an employee's salary; such contributions amounted to approximately $1,675,000 and $1,490,000 in 2009 and 2008, respectively.

If the Company achieves certain revenue and pre-tax profit goals that are established at the beginning of each fiscal year, the Company will distribute an award to each employee in the form of cash or the Company's common stock, at the election of the employee, subject to certain restrictions. The amount of the total award will be equal to at least 10% but not more than 20% of the Company's pre-tax profit. Distribution of the Company's common stock under plan may not cause more than a 5% dilution of the ownership of the Company. The fair value of the Company's common stock is determined by outside valuation and approved each year by the Board of Directors. For the year ended June 30, 2009, the Company did not achieve its respective goals and did not grant any employee awards resulting in no expense. For the year ended June 30, 2008, the Company expensed $637,000 and recorded an associated current liability for awards under the plan.

14. Contingencies

The Company is subject to legal proceedings, which arise in the ordinary course of business. These matters are currently in various stages of litigation and the Company intends to defend such claims vigorously. In the opinion of management, the ultimate liability, if any, with respect to these actions will not materially affect the consolidated financial position, consolidated results of operations, or consolidated cash flows of the Company.

In May 2007, the Company initiated legal action against three of its former engineers ("defendant employees") and the companies ("defendant companies") with whom they are now associated (collectively "defendants"). The Company asserted claims for trade secret misappropriation, breach of contract and conversion. In addition to the Company's claim, the defendant employees have initiated a counterclaim against the Company seeking indemnification for legal expenses incurred in the legal action brought against them. The defendant employees' claim that, pursuant to the Company's By-laws and Delaware General Corporation Law, legal expenses incurred to defend the claim brought against them are recoverable under certain provisions of Delaware law that exonerate employees from legal costs they may incur to defend claims that relate to their employment with the Company.

ng fiscal 2008, the Company amended its initial legal action against the endants to exclude the former defendant employees and continued the action against the defendant companies. To date, the defendant companies have not pled any counterclaims presented by the Company; however, in the absence of any specifics regarding the counterclaims, it is not possible to assess the likelihood of a favorable outcome for the Company.

Management believed that judgment against the Company for the indemnification of legal expenses incurred by the defendant employees, initiated in their counterclaim, appeared very likely. Based upon the probable likelihood and reasonable estimate of expenses relative to the outcome of the counterclaim, ranging from $937,000 to $1,087,000, the Company established a reserve as of June 30, 2008 in the amount of $937,000 to cover potential legal expenses and fees on fees that may be awarded with this claim. In August 2009, the Company settled the aforementioned counterclaim by the defendant employees for approximately $837,000, paid in cash. The Company recorded the difference between the amount recorded in accrued liabilities totaling $950,000 as of June 30, 2009 and the post balance sheet date settlement amount in other income within the consolidated statement of income for the year-ended June 30, 2009.

Management believes its claims for trade secret misappropriation, breach of contract and conversion, in its initial legal claim, remain sound and well supported. Management will vigorously defend against any counterclaims offered by the defendant companies.

15. Concentrations of Risk

Revenues from three customers aggregated 64% and 55% of total contract revenues, and 69% and 55% of billed accounts receivable, for fiscal 2009 and 2008, respectively. The revenues and billed accounts receivable from these customers, for the years ended as of June 30, are as follows:

	Revenues		Billed Accounts Receivable	
	2009	2008	2009	2008
Customer 1	$ 58,952,287	$ 48,906,712	$ 16,136,899	$ 6,336,328
Customer 2	31,670,071	13,071,971	2,571,850	1,152,294
Customer 3	10,041,959	8,412,130	1,555,665	1,426,897

16. Subsequent Events

In May 2009, the FASB issued SFAS No. 165, Subsequent Events (SFAS 165). SFAS 165 requires disclosure of the date through which an entity has evaluated subsequent events and whether that represents the date the financial statements were issued or were available to be issued. SFAS 165 is effective for annual financial periods ending after June 15, 2009. The Company has adopted SFAS 165 and in preparing the consolidated financial statements, the Company has reviewed, as determined necessary by Management, events that have occurred after June 30, 2009, up until the issuance of the consolidated financial statements, which occurred on September 25, 2009. The Company has appropriately disclosed those events within the footnotes to the consolidated financial statements.

Statement Notes continued

Voting Rights

The holders of the Series A Preferred Stock have voting rights. The holder of each share of Series A Preferred Stock shall be entitled to the number of votes equal to the number of shares of Common Stock into which such shares of Series A Preferred Stock could be converted on the record date for the vote or consent of stockholders. While at least 66% of the authorized shares of Series A Preferred Stock are outstanding, the Corporation will not, directly or indirectly, without the vote at a meeting or the written consent of the holders of at least 66% of the outstanding shares of Series A Preferred Stock, (i) amend, alter, or repeal any of the provisions of the Amended and Restated Certificate of Incorporation, (ii) create any class of stock ranking prior to or on a parity with the Series A Preferred Stock, (iii) sell all or substantially all of its assets or merge or consolidate with or into another entity, (iv) redeem, purchase, or otherwise acquire shares of Common Stock, (v) declare or pay any distributions to holders of shares of Common Stock, (vi) authorize any of the Company's subsidiaries to sell, issue, or transfer any class or series of stock to a third party, (vii) authorize or issue additional shares of Series A Preferred Stock, and (viii) issue a number of options in excess of the number authorized in the Company's stock incentive plan.

As long as shares of Series A Preferred Stock are outstanding, the holders of the Series A Preferred Stock shall be entitled to elect one director of the Company at each annual meeting of the stockholders.

Liquidation

In the event of any voluntary or involuntary liquidation, dissolution, or winding-up of the Company, the holders of the Series A Preferred Stock then outstanding will be entitled to payment, prior to holders of all other classes of Common Stock, an amount equal to the preferred fixed preference, as defined. Amounts remaining after payment to the holders of Series A Redeemable Preferred Stock, if any, will be distributed ratably to the holders of the Common Stock.

Redemption

Under the terms of the Series A Preferred Stock Agreement, the Company may be required to redeem the Series A Preferred Stock for cash at any time after the third year anniversary of the closing date of the stock purchase at the Redemption Price per share equal to 1.5 times the Issuance Price of $12.66 for that same share plus any accrued dividends. The Company has determined the Series A shares includes redemption features that have the potential to be outside the control of the Company, and accordingly, the Company has classified the Series A Preferred Stock outside of stockholders' equity in accordance with Emerging Issues Task Force Topic D-98, Classification and Measurement of Redeemable Securities. In accordance with EITF Topic, the Company will accrete the carrying value of the preferred stock to the redemption value on a straight line basis. The Company has accreted $2,500,000 to the stated value of the preferred stock in each of the fiscal years ended June 30, 2009 and 2008.

Management is currently negotiating with the Series A Preferred stockholders to extend the anniversary of the closing date of the stock purchase requiring the Company to redeem any or all the shares of Series A Preferred Stock of record owned by the holder until July 2012.

10. Treasury Shares

During fiscal years ended June 30, 2009 and 2008, the Company purchased for cash 5,826 and 4,245 shares, respectively, of common stock at aggregate prices of approximately $73,000 and $52,000, respectively. These purchases were recorded as treasury stock for the fiscal years ended June 30, 2009 and 2008, respectively.

11. Warrants

The Company issued 16,165 warrants in calendar year 2004 that remain outstanding as of June 30, 2009 and 2008, and are exercisable at the earlier of 60 months from the issuance date or an initial public offering. The exercise price for the warrants is $10 per share for the Company's common stock. The warrants contain a cashless exercise provision whereby the holder may pay the exercise price associated with any exercise by having the Company withhold a number of shares otherwise issuable upon such exercise having a fair market value equal to the applicable aggregate exercise price.

In fiscal year 2009, the warrants were amended with the exercise date being extended by 5 years and the termination date being extended 7 years, with each holder signing a new warrant agreement. The Company calculated the warrant expense using the Black-Scholes option pricing model in order to derive the grant-date-fair-value of the warrants as of the new warrant agreement date that was recorded in fiscal year 2009 within operating expenses and general and administrative expenses in the consolidated statement of income totaling $58,208.

12. Stock Options

The Company has adopted various stock option plans, with the approval of its stockholders, for officers, directors, employees and consultants of the Company that provide for the award of up to 1,450,000 shares of the Company's common stock. The term of each stock option is fixed by the Board of Directors, but no stock option can be exercised more than ten years after the option is granted. All stock options have generally been granted at amounts equal to the fair value of the Company's common stock at the date of grant. Other pertinent information related to the plan is as follows:

	2009	2008
Number of shares under option		
Beginning of year	482,488	521,561
Granted	45,000	35,000
Exercised	(111,807)	(29,939)
Forfeited	(85,981)	(44,134)
End of year	329,700	482,488
Options exercisable, end of year	282,200	433,138
Weighted average price per option		
Granted during the year	$ 15.11	$ 12.00
Exercised during the year	2.76	2.81
Outstanding at end of year	10.31	7.18
Weighted average intrinsic value per option		
Granted during the year	$ -	$ -
Exercised during the year	9.68	9.19
Outstanding at end of year	5.19	4.82
Forfeited during the year	8.65	6.91

The aggregate intrinsic value of options exercised during the year was $1,082,000 and $275,000 at June 30, 2009 and 2008, respectively. The aggregate intrinsic value of exercisable options was $1,569,000 and $2,321,000, as June 30, 2009 and 2008, respectively. The aggregate intrinsic value of options outstanding at June 30, 2009 and 2008 was $1,710,000 and $2,329,000, respectively.

The following information summarizes information about stock options outstanding at June 30, 2009:

	Outstanding Options			Exercisable Options	
Range of Exercisable Prices	Number Outstanding	Weighted Average Remaining Contractual Life	Weighted Average Exercise Price	Number Exercisable	Weighted Average Exercise Price
$.01 - $15.50	329,700	5.43	$ 10.31	282,200	$ 9.94

Fiscal year ending June 30:	
2010	$ 1,349,895
2011	1,349,895
2012	1,349,895
2013	1,349,895
2014	1,349,895
Thereafter	41,738,183
Net minimum lease payments	48,487,658
Less amount representing interest	(43,636,364)
Present value of minimum lease payments	4,851,294
Less current portion of capital lease	-
Long-term portion of capital lease obligation	$ 4,851,294

7. Operating Leases

The Company leases an operating facility and certain office equipment under operating leases which expire at various dates through 2020. Rent expense for operating leases totaled $1,537,460 and $1,160,713 for the years ended June 30, 2009 and 2008, respectively. Future minimum lease payments due under all noncancelable operating lease commitments greater than one year are as follows:

2010	**$ 2,074,824**
2011	**463,421**
2012	**309,128**
2013	**179,218**
2014	**101,666**
Thereafter	**406,601**

8. Income Taxes

:ome tax expense (benefit) consist of the following:

	Current	Deferred	Total
Year ended June 30, 2009:			
Federal	$ 1,773,019	$ (310,542)	$ 1,462,477
State	161,061	(18,267)	142,794
Foreign	257,018	-	257,018
	2,191,098	(328,809)	1,862,289
Year ended June 30, 2008:			
Federal	2,445,229	(1,262,510)	1,182,719
State	(31,135)	(179,709)	(210,844)
Foreign	10,000	-	10,000
	2,424,094	(1,442,219)	981,875

Income tax expense differed from the amounts computed by applying the U.S. federal income tax rate of 34% to pretax income for the year ended June 30, 2009 and 2008 as a result of state income taxes, net of federal income tax benefit, permanent differences and tax credits.

Deferred tax assets (liabilities) are comprised of the following at June 30:

	2009	2008
Bad debt reserve	$ 3,600	$ 3,600
Allowances for inventory and warranty	910,751	839,179
Capitalized inventory	45,340	96,647
Benefit accruals	565,248	666,788
Amortization	158,003	170,794
Accrued loss provision	459,929	584,273
Stock options granted	356,882	232,703
Other accrued liabilities	395,761	314,947
Tax credits and carryovers	291,547	359,002
Valuation allowance	(194,047)	(261,502)
Gross deferred tax assets	2,993,014	3,006,431
Depreciation	(350,562)	(399,581)
Gross deferred tax liabilities	(350,562)	(399,581)
Net deferred tax asset	$ 2,642,452	$ 2,606,850

The deferred taxes are classified in the consolidated balance sheets as follows:

	2009	2008
Current deferred taxes, net	$ 2,263,630	$ 2,388,434
Long-term deferred taxes, net	378,822	218,416
Net deferred tax asset	$ 2,642,452	$ 2,606,850

In assessing the realizability of deferred tax assets, management considers whether it is more likely than not that some portion or all of the deferred tax assets will not be realized. The ultimate realization of deferred tax assets is dependent upon the generation of future taxable income and the taxable income in the two previous tax years to which tax loss carryback can be applied. Management considers the scheduled reversal of deferred tax liabilities, projected future taxable income, and taxable income in the carryback period and tax planning strategies in making this assessment. Based upon the level of projected future taxable income over the periods in which the deferred tax assets are deductible and tax planning strategies, a valuation allowance of $194,047 and $261,502 at June 30, 2009 and 2008, respectively, is included in deferred tax assets above. The net deferred tax assets represent a level where management believes it is more likely than not that the Company will realize the benefits of those deductible differences. The decrease in valuation allowance in 2009 is directly related to the adjustment to state investment tax credit carry forwards. The amount of the deferred tax asset considered realizable could be reduced if estimates of future taxable income during the carryforward period are reduced.

9. Preferred Stock

In July 2007, the Company amended and restated its Certificate of Incorporation to authorize the issuance of 5,000,000 shares of Preferred Stock, of which 1,200,000 shares are designated as Series A Preferred Stock with a par value of $0.001. On July 27, 2007, the Company issued 1,184,328 shares of Series A Preferred Stock for $15,000,000. The Company is contractually obligated to issue an additional 13,333 shares based upon the terms in the equity agreement outlined in the section titled "subsequent share issuance." The rights, preferences, and privileges relating to the Series A Preferred Stock are as follows:

Rank

The Series A Preferred Stock shall, with respect to the right to receive dividends and distributions of assets and rights upon liquidation, will rank (i) senior to any other class or series of preferred stock issued by the Company and designated as senior to the Series A Preferred Stock, (ii) pari passu with any other class or series of preferred stock issued by the Company and designated as pari passu to the Series A Preferred Stock, and (iii) prior to any other class or series of preferred stock issued by the Company and designated as junior to the Series A Preferred Stock and to the Common Stock.

Dividends

Holders of shares of Series A Preferred Stock will be entitled to receive dividends at an annual rate of 8%, compounded quarterly, of the issue price, when, as and if declared by the Board of Directors, accruing quarterly, commencing on July 27, 2007. Notwithstanding the action of the Board of Directors with respect to declaration and payment of dividends, dividends shall accrue and accumulate on the shares of Series A Preferred Stock from the date of issuance of such shares. Dividends accrued on the Series A Preferred Stock were $2,477,125 and $1,155,864 at June 30, 2009 and 2008, respectively.

Conversion

The Series A Preferred Stock is convertible into shares of Class A Common Stock at any time at such holder's option, at a preferred conversion rate of 1 to 1, as defined in the Certificate of Incorporation.

Statement Notes continued

	2009			2008
	Short-term	Long-term	Total	
Note payable - line of credit (a)	$ 5,941,096	$ -	$ 5,941,096	$ 4,168,543
Notes payable (a)	1,356,037	3,631,017	4,987,054	1,575,000
Capital leases (b)	1,578,526	892,540	2,471,066	3,854,943
Built to suit - Collamer facility (c)	-	4,851,294	4,851,294	4,840,031
	2,934,563	9,374,851	12,309,414	10,269,974
Total Debt	$ 8,875,659	$ 9,374,851	$ 18,250,510	$ 14,438,517

(a) Debt

The Company has three facilities that it utilizes in support of operations. A $14,000,000 Revolving Line of Credit commitment used for working capital (including $2,000,000 for domestic Letters of Credit), a $25,000,000 Export-Import Bank Line of Credit commitment used exclusively for international Letters of Credit and Performance Guarantees and a Term Note Payable for capital expenditures. The term note payable matures on September 1, 2013. In April 2009, Management renewed the Revolving Line of Credit commitment with its commercial bank, which now expires in July 2010. In February 2009, Management renewed the Export-Import Line of Credit commitment with its commercial bank, which now expires in July 2010.

The Revolving Line of Credit is subject to a borrowing base calculation that limits available borrowings based upon formulaic calculations related to accounts receivable, unbilled accounts receivable balances, extended letters of credit and current borrowings. Total available borrowings at June 30, 2009 under the Revolving Line of Credit, after the borrowing base calculation, were approximately $12,504,000. The Company had approximately $5,941,000 and $4,169,000 of working capital borrowings as of June 30, 2009 and 2008, respectively. Outstanding borrowings under the line of credit are collateralized principally by all corporate assets. Interest under the line of credit is computed at the LIBOR rate plus a rate ranging from 2.75% to 4.25%, with the applicable rate set at a predetermined schedule based on the ratio of funded debt to EBITDA. The interest rate was 3.57% as of June 30, 2009. The Company is subject to annual renewal fees and a monthly unused Revolving Line of Credit commitment fee.

Additionally, the Company has a $5,000,000 term note payable for capital expenditures. The Company has approximately $4,250,000 and $1,575,000 outstanding on the term note payable at June 30, 2009 and 2008, respectively. During fiscal year 2009, the Company paid down the remaining $1,575,000 balance of the note payable that was utilized as part of the financing for an acquisition in 2005 and refinanced the term note payable for capital expenditure use. The Company pays $83,333 per month plus variable interest of the LIBOR rate plus a rate ranging from 2.75% to 4.25%, with the applicable rate set at a predetermined schedule based on the ratio of funded debt to EBITDA. The interest rate was 3.57% as of June 30, 2009.

In August 2008, the Company entered into an interest rate swap agreement associated with the above $5,000,000 term note payable to manage its exposure of market risk from changes in interest rates by locking in a fixed rate of 3.92% for the entire term of the loan and minimize significant unplanned fluctuations in earnings and cash flows caused by interest rate volatility. The interest rate swap has a notional amount of approximately $4,250,000 as of June 30, 2009 and expires in August 2013. The Company has described the accounting treatment of the interest rate swap agreement Note 1.

The Company entered into a separate note payable agreement with a third party in relation to a software purchase during fiscal year 2009. The amount financed and outstanding as of June 30, 2009 totaled approximately $737,000 and the Company is required to make eight quarterly payments of $99,360 beginning in fiscal year 2010. The interest rate is fixed at 6.84% for the life of the note payable, which matures in June 2011. There are no covenants associated with the note payable. The software purchase was presented as a non-cash item in the consolidated statements of cashflows.

The Company had approximately $20,231,000 and $22,000,000 of standby letters of credit issued as of June 30, 2009 and 2008, respectively.

The Revolving Line of Credit, Export-Import Line of Credit and Term Note Payable agreements provide that the Company must meet certain financial ratio covenants relating to total funded debt, fixed charge coverage, tangible net worth and certain capital expenditure limits. The Company was in compliance with all covenants as of June 30, 2009 and 2008.

The combined future principal payments of the notes payable are as follows:

Fiscal year ending June 30:	
2010	$ 1,356,037
2011	1,381,017
2012	1,000,000
2013	1,000,000
2014	250,000
Total principal payments	4,987,054
Less current installments	(1,356,037)
Long-term notes payable	$ 3,631,017

(b) Capital Leases

Capital lease assets, which are included in equipment, are stated at cost, and totaled $15,056,883 as of June 30, 2009 and 2008, net of accumulated amortization of $11,469,539 and $11,201,940 in fiscal 2009 and 2008, respectively.

Future minimum lease payments under these capital leases are as follows:

Fiscal year ending June 30:	
2010	$ 1,695,160
2011	607,935
2012	330,939
Net minimum lease payments	2,634,034
Less amount representing interest	(162,968)
Present value of minimum lease payments	2,471,066
Less current portion of capital lease obligations	(1,578,526)
Long-term capital lease obligations	$ 892,540

(c) Built-to-Suit – Collamer Facility

The Company entered into an arrangement to lease a built-to-suit facility. Based on the criteria set forth in EITF 97-10, The Effect of Lessee Involvement in Asset Construction, the Company capitalized the cost of construction totaling $8,795,929 as of June 30, 2009 and 2008.

The annual lease payments of the building are $1,349,895 for the first ten years of the lease, and $1,439,888 in years eleven through twenty. The Company has the right to renew the lease term, and assuming the Company would renew the lease for years 21 through 35, the payments are as follows: $1,583,820 in years 21 through 25, $1,887,340 in years 26 through 30 and $1,916,760 in years 31 through 35.

The future financing payments are as follows:

temporary equity) are not within the scope of this FSP; however, convertible preferred shares that are mandatorily redeemable financial instruments and are classified as liabilities under SFAS No. 150, Accounting for Certain Financial Instruments with Characteristics of both Liabilities and Equity, shall be considered convertible debt instruments for purposes of determining whether those instruments are within the scope of this FSP. FSP APB 14-1 is effective for financial statements issued for fiscal years beginning after December 15, 2008 (fiscal year 2010). The Company is currently evaluating the impact, if any, of adopting FSP APB 14-1 on its consolidated financial statements.

In June 2009, the FASB issued SFAS No. 168, The FASB Accounting Standards Codification and the Hierarchy of Generally Accepted Accounting Principles – a replacement of SFAS No. 162, The Hierarchy of Generally Accepted Accounting Principles (SFAS 168). The FASB Accounting Standards Codification (Codification) will become the source of authoritative U.S. generally accepted accounting principles recognized by the FASB to be applied by nongovernmental entities. On the effective date of this Statement, the Codification will supersede all then-existing non-Securities and Exchange Commission (SEC) accounting and reporting standards. All other non-grandfathered non-SEC accounting literature not included in the Codification will become nonauthoritative. Following SFAS 168, the FASB will not issue new standards in the form of Statements, FASB Staff Positions, or Emerging Issues Task Force Abstracts. Instead it will issue Accounting Standards Updates. This will change how authoritative literature is referenced in the financial statements from the effective date of this Statement. SFAS 168 is effective for financial statements issued for annual periods ending after September 15, 2009 (fiscal year 2010). The Company does not believe this Statement will have a material impact on the consolidated financial statements.

2. Contract Billing Status

The following summarizes the components of accounts receivable under contracts:

	2009	2008
Accounts receivable	$30,366,156	$ 16,284,570
Unbilled receivables	24,943,328	24,092,406
Reserves	(10,000)	(10,000)
	$55,299,484	$ 40,366,976

Billings in excess of costs and unbilled receivables are incorporated in the consolidated balance sheets as follows:

	2009	2008
Unbilled receivables	$ 24,943,328	$ 24,092,406
(Billings in excess of costs)	(10,204,314)	(4,786,319)
Unbilled receivables, net	$ 14,739,014	$ 19,306,087

Costs and estimated earnings on uncompleted contracts at June 30 are as follows:

	2009	2008
Costs incurred on uncompleted contracts	$688,137,294	$ 546,496,905
Estimated earnings	91,589,579	76,952,904
	779,726,873	623,449,809
Less: Billings to date	(764,987,859)	(604,143,722)
Unbilled receivables, net	$ 14,739,014	$ 19,306,087

3. Inventory

The components of inventory, net of related reserves, consist of the following at June 30:

	2009	2008
Work in process	$ 309,479	$ 1,119,546
Purchased parts	6,393,890	6,985,178
	$ 6,703,369	$ 8,104,724

The Company recorded reserves for obsolete inventory of approximately $1,566,000 and $1,565,000 at June 30, 2009 and 2008, respectively.

4. Property, Plant and Equipment

Property, plant and equipment at June 30 is summarized as follows:

	2009	2008
Computer and general office equipment	$ 13,920,391	$ 10,869,260
Aerobahn tracking systems	3,263,762	2,456,823
Computer software	8,295,042	5,991,722
Leased equipment	13,664,156	13,664,156
Leasehold improvements	975,928	667,179
Other equipment	255,269	204,772
Building	9,061,794	8,903,878
	49,436,342	42,757,790
Less: Accumulated depreciation	(28,263,108)	(24,368,217)
Property, plant and equipment, net	$ 21,173,234	$ 18,389,573

Depreciation expense was approximately $3,896,000 and $3,199,000 and includes approximately $364,000 and $435,000 related to capitalized software for the years ended June 30, 2009 and 2008, respectively.

For the year ended June 30, 2008, the Company recorded an impairment charge related to a group of assets used in providing Aerobahn services to a customer. The anticipated separately identifiable cash flows from the asset group were less than the carrying value, and an impairment loss of $354,476 was recorded.

5. Goodwill and Identifiable Intangibles

Goodwill and identifiable intangible assets consist of the following at June 30:

	2009		2008	
	Gross Carrying Amount	Accumulated Amortization	Gross Carrying Amount	Accumulated Amortization
Goodwill	$ 2,737,791	-	$ 2,737,791	-
Identifiable intangible assets:				
Completed technology	1,817,172	(1,384,101)	1,817,172	(1,164,226)
Customer relationships	1,964,371	(853,249)	1,964,371	(656,811)
Tradename	120,000	(120,000)	120,000	(120,000)
Total	$ 3,901,543	(2,357,350)	$ 3,901,543	(1,941,037)

Amortization expense was approximately $416,000 and $494,000 in fiscal 2009 and 2008, respectively. The weighted average amortization years remaining for identifiable intangible assets of completed technology and customer relationships are 2.73 years and 5.70 years, respectively.

Provided below is the annual amortization of identifiable intangibles by year:

Fiscal year ending June 30:	
2010	$ 360,705
2011	347,383
2012	314,294
2013	196,437
2014	182,124
Thereafter	143,250
Total amortization of intangibles	$ 1,544,193

6. Debt and Capital Lease Obligations

The components of the Company's debt, financing and capital lease obligations for the year ended June 30, 2009 and 2008 are as follows:

Statement Notes continued

APIC pool as described in SFAS No. 123(R)-3, Transition Election Related to Accounting for the Tax Effects of Share-Based Payment Awards.

Use of Estimates

The preparation of financial statements in conformity with accounting principles generally accepted in the United States of America requires management to make estimates and assumptions that affect the reported amounts of assets and liabilities and disclosures of contingent assets and liabilities at the date of the financial statements and the reported amounts of revenues and expenses during the reporting periods. Due to the size and nature of some of our programs, the estimate of the cost at completion is subject to a number of variables, including assumptions for the schedule and technical issues. Actual results could differ from those estimates.

Prior Year Presentation

Certain prior year amounts have been reclassified to conform to current year presentations. These include reclassifications on the consolidated balance sheets between prepaid and other current assets, other non-current assets, accounts payable and accrued liabilities. These also include a reclassification between operating expenses, general and administrative expenses, research and development, business development, direct contract costs, and current and deferred income tax expense (benefit) within the consolidated statement of income.

Recent Accounting Pronouncements

In September 2006, the FASB issued SFAS No. 157, Fair Value Measurements (SFAS 157) effective for fiscal years beginning after November 15, 2007. SFAS 157 defines fair value, establishes a framework for measuring fair value in generally accepted accounting principles and expands disclosures about fair value measurements. In calendar year 2008, the FASB issued FASB Staff Positions (FSP) FAS 157-1, FAS 157-2, and FAS 157-3. FSP FAS 157-1 amends SFAS 157 to exclude SFAS No. 13, Accounting for Leases, and its related interpretive accounting pronouncements that address leasing transactions, FSP FAS 157-2 delays the effective date of the application of SFAS 157 to fiscal years beginning after November 15, 2008 (fiscal year 2010), for all nonfinancial assets and nonfinancial liabilities that are recognized or disclosed at fair value in the financial statements on a nonrecurring basis, and FSP FAS 157-3 clarifies how the fair value of a financial asset is determined when the market for that financial asset is inactive. The Company adopted SFAS 157 effective July 1, 2008, as it relates to financial assets and financial liabilities. The adoption of SFAS 157 did not have a material effect on the Company's consolidated financial statements. The Company is currently assessing the impact, if any, the adoption of FSP FAS 157-2 will have on its consolidated financial statements.

In February 2007, the FASB issued SFAS No. 159, The Fair Value Option for Financial Assets and Financial Liabilities – including an Amendment of FASB Statement No. 115 (SFAS 159). SFAS 159 permits entities to choose to measure many financial instruments and certain other items at fair value for fiscal years that begin after November 15, 2007. The Company has not elected the fair value option under SFAS 159.

In December 2007, the FASB issued SFAS No. 141(R), Business Combinations [SFAS 141(R)], which replaces SFAS No. 141. SFAS 141(R) changes the accounting for business combinations including the measurement of acquired shares issued in consideration for a business combination, the recognition of contingent consideration, the accounting for contingencies, the recognition of capitalized in-process research and development, the accounting for acquisition-related restructuring cost accruals, the treatment of acquisition-related transaction costs and the recognition of changes in the acquirer's income tax valuation allowance and income tax uncertainties. SFAS 141(R) applies prospectively to business combinations for which the acquisition date is on or after the beginning of the first annual reporting period beginning on or after December 15, 2008 (fiscal year 2010). This Statement will have an impact in future periods if the Company performs acquisitions.

In December 2007, the FASB issued SFAS No. 160, Noncontrolling Interests in Consolidated Financial Statements, an amendment of ARB No. 51 (SFAS 160). SFAS 160 requires the ownership interests in subsidiaries held by parties other than the parent be clearly identified in the consolidated statement of financial position within equity, but separate from the parent's equity, and requires that the amount of consolidated net income attributable to the parent and to the noncontrolling interest be clearly identified and presented on the face of the consolidated statement of income. This statement is effective for financial statements issued for fiscal years beginning after December 15, 2008 (fiscal year 2010). The Company is evaluating the provisions of SFAS No. 160 to determine the potential impact, if any, the adoption will have on its consolidated financial statements in future periods if the Company performs acquisitions.

In March 2008, the FASB issued SFAS No. 161, Disclosures about Derivative Instruments and Hedging Activities – an amendment of SFAS No. 133 (SFAS 161). SFAS 161 requires entities that utilize derivative instruments to provide qualitative disclosures about their objectives and strategies for using such instruments, as well as any details of credit-risk-related contingent features contained within derivatives. SFAS 161 also requires entities to disclose additional information about the amounts and location of derivatives located within the financial statements, how the provisions of SFAS 133 have been applied, and the impact that hedges have on an entity's financial position, financial performance, and cash flows. SFAS 161 is effective for fiscal years beginning after November 15, 2008 (fiscal year 2010). The Company is currently evaluating the impact of SFAS 161 on the disclosures regarding its hedging activities and use of derivatives.

In April 2008, the FASB issued FASB Staff Position (FSP) FAS 142-3, Determination of the Useful Life of Intangible Assets. FSP FAS 142-3 amends the factors that should be considered in developing renewal or extension assumptions used to determine the useful life of a recognized intangible asset under SFAS No. 142, Goodwill and Other Intangible Assets. The intent of the FSP is to improve the consistency between the useful life of a recognized intangible asset and the period of expected cash flows used to measure the fair value of the asset under SFAS No. 141(R), Business Combinations, and other generally accepted accounting principles. FSP FAS 142-3 is effective for fiscal years beginning after December 15, 2008 (fiscal year 2010). The Company is currently evaluating the impact, if any, of adopting FSP FAS 142-3 on its consolidated financial statements.

In May 2009, the FASB issued FASB Staff Position (FSP) APB 14-1, Accounting for Convertible Debt Instruments that May Be Settled in Cash Upon Conversion (Including Partial Cash Settlement). FSP APB 14-1 clarifies that convertible debt instruments that may be settled in cash upon conversion (including partial cash settlement) are not addressed by paragraph 12 of APB Opinion No. 14, Accounting for Convertible Debt and Debt Issued with Stock Purchase Warrants. Additionally, this FSP specifies that issuers of such instruments should separately account for liability and equity components in a manner that will reflect the entity's nonconvertible debt borrowing rate when interest cost is recognized in subsequent periods. Convertible preferred shares that are classified in equity (or

the revisions are determined. Profit incentives are included in revenues when their realization is reasonably assured. Claims are included in contract costs when probable and the amount can be reliably estimated. Contract revenues have been recorded in amounts that are expected to be realized on final settlement.

Revenues from sales of products are recorded as the products are shipped or upon customer acceptance of title, provided that no significant vendor and post-contract support obligations remain and the collection of the related receivable is probable. Shipping and handling costs are included in contract direct costs within the consolidated statement of income.

The asset, "unbilled receivables," included in unbilled receivables on contracts, represents revenues recognized in excess of amounts billed. The liability, "billings in excess of costs," represents billings in excess of revenues recognized.

Price Redetermination

As a Government contractor, the Company is subject to price redetermination on certain fixed-price contracts if it is determined that the price of our products and services are not consistent with the requirements of the U.S. Federal Acquisition Regulations. The Company did not incur any material price redeterminations on any of our contracts during years-ended June 30, 2009 and 2008.

Income Taxes

Provisions for income taxes are based on taxes payable or refundable for the current year and deferred taxes on temporary differences between the amount of taxable income and pretax financial income and between the tax basis of assets ·l liabilities and their reported amounts in the consolidated financial ɜments. Deferred tax assets and liabilities are included in the consolidated tnancial statements at currently enacted income tax rates applicable to the period in which the deferred tax assets and liabilities are expected to be realized or settled as prescribed in SFAS No. 109, Accounting for Income Taxes. As changes in tax laws or rates are enacted, deferred tax assets and liabilities are adjusted through the provision for income taxes.

On July 1, 2007, the Company adopted the provisions of FASB Interpretation No. 48, Accounting for Uncertainty in Income Taxes, an Interpretation of SFAS No. 109 (FIN 48). FIN 48 provides recognition criteria and a related measurement model for tax positions taken by companies. In accordance with FIN 48, a tax position is a position in a previously filed tax return or a position expected to be taken in a future tax filing that is reflected in measuring current or deferred income tax assets and liabilities. Tax positions are recognized only when it is more likely than not (likelihood of greater than 50%), based on technical merits, that the position would be sustained upon examination. Tax positions that meet the more likely than not threshold are measured using a probability-weighted approach as the largest amount of tax benefit that is greater than 50% likely of being realized upon settlement. The adoption of FIN 48 did not result in a change to the liability of unrecognized benefits.

A reconciliation of the beginning and ending amount of unrecognized tax benefits is as follows:

	2009	2008
Balance at July 1	$ 300,894	$ 413,286
Additions based on tax positions related to the year ended June 30	13,627	31,605
Additions/Reductions for tax position of prior years	-	12,427
Reduction related to expiration of statute ·f limitations	-	(156,424)
ınce at June 30	$ 314,521	$ 300,894

At June 30, 2009 and 2008, $314,521 and $300,894 (net of the federal benefit on state issues) represents the amount of unrecognized tax benefits that, if recognized, would favorably affect the effective tax rate in future periods, respectively. The Company classifies interest expense and penalties related to unrecognized tax benefits as a component of income tax expense. This policy did not change with adoption of FIN 48. As of June 30, 2009 and 2008, the Company has not accrued any penalties related to its uncertain tax position as it believes that it is more likely than not that there will not be any assessment of penalties. The total amount of gross accrued interest resulting from such unrecognized tax benefits was $62,044 and $41,397 at June 30, 2009 and 2008, of which $20,647 and $18,828 was recognized in 2009 and 2008, respectively.

The Company files Federal income tax returns, as well as multiple state and foreign jurisdiction tax returns. The Company's federal income tax returns have been examined by the Internal Revenue Service through the year ended June 30, 2006. Significant state tax matters have been concluded for all years through June 30, 2004. There are no tax examinations currently underway.

Foreign Currency

Gains and losses resulting from foreign currency denominated transactions are included in the consolidated statement of income, and are included within other (expense) income. The Company recognized transaction (losses) and gains of approximately ($1,711,000) and $816,000 for fiscal years ended 2009 and 2008, respectively, within other (expense) income.

Research and Development

Research and development costs are expensed as incurred, as non-contract costs, up to the point where a contract has been obtained for the related developments or technology. Subsequent to obtaining a contract related to specific research and development efforts, those costs are charged as direct contract costs on the consolidated statement of income.

Stock-Based Compensation

In accordance with SFAS No. 123(R), Share-Based Payments (SFAS 123R), applying the modified prospective method the Company recognizes compensation cost beginning July 3, 2006 for costs related to 1) all share-based payments (stock options and restricted stock awards) granted before but not yet vested as of July 3, 2006 based on the grant-date fair value estimated under the original provisions of SFAS No. 123, Accounting for Stock-Based Compensation, and 2) all share-based payments (stock options and restricted stock units) granted after June 30, 2006 based on the grant-date fair value estimated under the provisions of SFAS 123R. For the fiscal years ended June 30, 2009 and 2008, the Company recorded non-cash compensation cost related to stock options totaling $344,941 and $256,114, respectively, which is included in the consolidated statement of income in general and administrative expenses. The net impact to earnings for fiscal 2009 and 2008 was $220,762 and $162,557, respectively. The compensation costs not yet recognized on the outstanding stock options for fiscal years ended 2009 and 2008 is $58,092 and $40,914, respectively, which will be amortized over a weighted average term of 2.9 years and 3.0 years, respectively.

To account for the tax effects of stock based compensation, SFAS 123(R) requires a calculation to establish the beginning pool of excess tax benefits, or the additional paid-in capital (APIC) pool, available to absorb any tax deficiencies recognized after its adoption. Tax deficiencies arise when the actual tax benefit for the tax deduction for share-based compensation at the statutory tax rate is less than the related deferred tax asset recognized in the consolidated financial statements. We have elected the alternative transition method for calculating the

useful lives of existing equipment. At the time property and equipment are replaced, retired, or otherwise disposed of, the cost and related accumulated depreciation are eliminated from the respective accounts and any gains or losses are included in income. Property and equipment are depreciated using straight-line or accelerated methods over their estimated useful lives, which range from 3 to 7 years for computers, equipment and software, 3 to 10 years for leasehold improvements and 35 years for buildings. Amortization of capital leases is included with depreciation and amortization expense.

Expenditures for maintenance, repairs and minor improvements are expensed when incurred.

Goodwill and Intangible Assets

Goodwill represents the excess purchase price over the fair value of assets acquired. The Company accounts for its goodwill in accordance with SFAS No. 142, Goodwill and Other Intangible Assets. The Company reviews goodwill and unamortizable intangible assets for impairment whenever events or changes in circumstances indicate the carrying amount of these assets may not be recoverable and annually each June. Goodwill and intangible assets deemed to have indefinite lives are not subject to amortization, while all other identifiable intangibles are amortized over their estimated useful lives. The value assigned to intangible assets is determined with the assistance of an independent valuation firm based on estimates and judgments regarding expectations for the success and life cycle of products and technology acquired.

Goodwill is tested annually using a two-step process. The first step is to identify any potential impairment by comparing the carrying value of the reporting unit to its fair value. If a potential impairment is identified, the second step is to compare the implied fair value of goodwill with its carrying amount to measure the impairment loss. A decline in fair value could result in an impairment charge to goodwill. There were no impairment charges recorded in fiscal 2009 and 2008.

Impairment of Long-Lived Assets

In accordance with SFAS No. 144, Accounting for the Impairment or Disposal of Long-Lived Assets, the Company reviews its long-lived assets with finite useful lives for impairment whenever events or changes in circumstances indicate that the carrying amount of an asset may not be recoverable. If such events or changes in circumstances are present, a comparison is made of the carrying value of the asset to the estimated undiscounted future cash flows expected to be generated by the asset. If the carrying amount of the asset exceeds its estimated undiscounted future cash flows, an impairment charge is recognized for the amount by which the carrying amount of the asset exceeds its fair value. The Company recorded impairment charges of $354,476 in fiscal 2008. See Note 4.

Warranties

The services and products the Company provides in connection with its contracts are sold with a one-year warranty for defects in material and workmanship. The Company establishes an accrual for estimated warranty costs at the time revenue is recognized on the contract. This estimate is based on projected product reliability using historical performance data.

The changes in the product warranty liability, included in accrued liabilities, for the years ended are summarized as follows:

	2009	2008
Beginning balance	$ (766,481)	$ (486,892)
Accruals for warranties issued during the year	(873,423)	(717,535)
Settlements made during the year	663,125	437,946
Ending Balance	$ (976,779)	$ (766,481)

Derivative Instruments

The Company accounts for derivatives and hedging activities in accordance with SFAS No. 133, Accounting for Derivative Instruments and Certain Hedging Activities, which requires entities to recognize all derivative instruments as either assets or liabilities in the balance sheet at their respective fair values. For derivatives designated as hedging relationships, changes in the fair value are either offset through earnings or recognized in accumulated other comprehensive income until the hedged item is recognized in earnings.

During fiscal year 2009, the Company entered into derivative instrument contracts, consisting of forward foreign exchange and interest rate swap contracts, to manage its exposure to foreign currency and interest rate volatility. The interest rate swap mitigates the cash flow effects of interest rate fluctuations on interest expense for variable-rate debt instruments. The forward foreign exchange contracts manage the Company's exposure to project revenues settled in foreign currencies.

The Company has not applied hedge accounting to its interest rate swap contract and has recorded an unrealized net loss of approximately $201,438 on the interest rate swap in other (expense) income within the consolidated statement of income for the year-ended June 30, 2009. The Company also recorded a corresponding liability in long-term liabilities totaling approximately $201,438 within the consolidated balance sheets.

The Company has not applied hedge accounting to its forward foreign exchange contracts and there were no unexpired contracts at June 30, 2009. For the year ended June 30, 2009, the Company recognized realized losses of approximately $726,000, which is reported in other (expense) income within the consolidated statement of income.

Revenue and Cost Recognition

Revenues derived from long-term contracts for design, development and production activities are accounted for consistent with the American Institute of Certified Public Accountants' (AICPA) audit and accounting guide, Audits of Federal Government Contractors, and the AICPA's Statement of Position 81-1, Accounting for Performance of Construction-Type and Certain Production-Type Contracts. The Company also enters into contracts to provide other services that are not associated with design, development or production activities. The Company accounts for those contracts in accordance with the U.S. Securities and Exchange Commission's Staff Accounting Bulletin (SAB) No. 104, Revenue Recognition, and other relevant revenue recognition accounting literature. The Company considers the nature of these contracts and the types of products and services provided when we determine the proper accounting method for a particular contract.

Revenues from certain contracts are recognized based upon the percentage of completion method of accounting. Anticipated losses on specific contracts in process are recorded in full when identified and the losses are included in the provision for contract losses. Unbilled accounts receivable are stated at estimated realizable value. Contract costs, including indirect expenses, are subject to audit and adjustment through negotiations between the Company and government representatives. Contract direct costs include all direct material, direct labor and taxes, fringe benefits including but not limited to health insurance and paid time off, facility costs, other direct costs and those indirect costs related to contract performance, such as indirect labor, supplies, tools, repairs, and depreciation costs. Selling, general and administrative costs are charged to expense as incurred. Changes in job performance, job conditions, and estimated profitability, including those arising from contract penalty provisions, and final contract settlements may result in revisions to costs and income and are recognized in the period in which

Statement Notes

1. Significant Accounting Policies

Nature of Operations

Sensis Corporation (the "Company") is a global provider of sensors, information processing and simulation and modeling services that advance human security and safety. The Company has technology deployed in more than 35 countries across six continents, offering innovative solutions for defense and security systems, air traffic control, airline and airport operations management, and data integration and distribution. Sensis Corporation is comprised of three primary business areas:

Defense & Security Systems (D&SS)

Defense & Security Systems provides protection, safety and security to the world's defense organizations through radar subsystems and upgrades; ground based radar; and performance optimization tools.

Air Traffic Systems (ATS)

Air Traffic Systems provides surveillance, automation, information technology, and simulation and modeling solutions for the aviation industry to ensure the safety of airline passengers worldwide. These solutions provide not only enhanced safety, but assist with delay and environmental challenges many airlines and airports face today.

Strategy & Development (S&D)

Strategy and Development, which began in fiscal 2008, is responsible for maximizing the long term value and profitable growth of the Company's key assets by building upon current strategies and business plans to expand existing and explore future business opportunities. S&D guides major corporate investments in research & development, intellectual property, acquisitions, strategic partnerships and new ventures. Additionally, S&D provides the marketing communication and government and community affairs services that support the Company's strategic intent and promotes the Sensis brand. Prospective business ventures are evaluated within this group. During fiscal 2009, S&D, operationally became Advanced Development. For financial reporting purposes, S&D activity was accumulated consistently for fiscal 2009 and 2008.

Consolidation

The consolidated financial statements include the accounts of the Company and its wholly-owned subsidiaries. All significant intercompany transactions have been eliminated in consolidation.

Fiscal Year

The Company uses a 52-53 week fiscal year ending on the Sunday closest to June 30. All references herein to fiscal year June 30, 2009 and 2008 are as of June 28, 2009 and June 29, 2008, respectively. There were 52 weeks in fiscal years 2009 and 2008.

Cash and Cash Equivalents

The Company considers all highly-liquid investments with a maturity of three months or less when purchased to be cash equivalents.

Trade Accounts Receivable

Trade accounts receivable are shown net of allowances for doubtful accounts of $10,000 at June 30, 2009 and 2008. Trade credit is extended based upon evaluation of each customer's ability to perform its obligations. The Company performs periodic credit evaluations of the financial condition of its customers and extends credit based on the customer's financial condition. Occasionally, a antee may be required for international projects. The Company considers e accounts receivable to be past due when in excess of 30 days past terms and charges off uncollectible balances when all collection efforts have been exhausted.

Inventory

Inventories are stated at the lower of average cost or market. The Company determines cost using the weighted average cost method and costs are removed from inventory at weighted average cost. In addition, the Company maintains spare parts in order to repair certain program products. The Company uses certain estimates and judgments and considers several factors including product demand and usage to provide for excess and obsolescence reserves to properly value inventory.

Fair Value of Financial Instruments

Financial instruments are disclosed in accordance with SFAS No. 107, Disclosure about Fair Value of Financial Instrument, which requires the Company to disclose the fair value of its financial instruments for which it is practicable to estimate the fair value. As of June 30, 2009 and 2008, the Company used the following methods and assumptions in estimating its fair value disclosure for financial instruments:

- The carrying value of cash and cash equivalents, accounts receivable, prepaid expenses and other current assets, line of credit, accounts payable and accrued expenses approximates fair value because of the relatively short term maturities of these instruments.
- Long-term debt: The fair value of long-term debt is based upon variable and fixed interest rates for new issues with similar remaining maturities and approximates its carrying value.

Fair Value Disclosures

On July 1, 2008, the Company adopted the provisions of SFAS No. 157, Fair Value Measurements (SFAS 157), which provides a consistent definition of fair value that focuses on exit price and prioritizes, within a measurement of fair value, the use of market-based inputs over company-specific inputs. SFAS No. 157 requires expanded disclosures about fair value measurements and establishes a three-level hierarchy for fair value measurements based on the observable inputs to the valuation of an asset or liability at the measurement date. The three levels of inputs are defined as follows:

- ***Level 1*** – unadjusted quoted prices for identical assets or liabilities in active markets;
- ***Level 2*** – inputs are observable in the marketplace other than those inputs classified as Level 1; and
- ***Level 3*** – inputs that are unobservable in the marketplace and significant to the valuation.

SFAS 157 encourages the Company to maximize the use of observable inputs and minimize the use of unobservable inputs. If a financial instrument valuation uses inputs that fall in different levels of the hierarchy, the instrument will be categorized based upon the lowest level of input that is significant to the fair value calculation. The Company's financial assets measured at fair value on a recurring basis are derivative financial instruments. The Company has an interest rate swap agreement which is considered to be the only financial instrument applicable to SFAS 157. The fair value determination was based upon the present value of expected future cash flows using the LIBOR rate, plus an applicable interest rate spread, a technique classified within Level 2 of the valuation hierarchy described above. As of June 30, 2009, the fair value of the interest rate swap instrument was ($201,438) based on Level 2 inputs.

Property and Equipment

Property and equipment, which includes capital lease assets, are recorded at cost or the present value of the future minimum lease payments and include expenditures for new equipment and items which substantially increase the

Statements of Cash Flow

	2009 (52 weeks)	2008 (52 weeks)
Cash flows from operating activities		
Net income	$ 3,371,991	$ 3,727,540
Adjustments to reconcile net income to net cash provided by (used in) operating activities:		
Stock awards	106,153	15,012
Compensation expense for stock options and warrants	344,941	256,114
Depreciation and amortization	4,312,027	3,692,726
Impairment of fixed asset	-	354,476
Loss on asset disposal	162,119	-
Provision for inventory obsolescence	(1,192)	610,577
Deferred income taxes	(328,809)	(1,442,219)
Unrealized loss on derivative instrument	201,438	-
Changes in operating assets and liabilities:		
Inventory	1,402,547	(1,375,162)
Accounts receivable	(14,081,586)	(4,924,992)
Unbilled receivables	(850,922)	(13,332,646)
Prepaid expenses and other assets	(570,221)	(246,995)
Income taxes payable	1,384,226	1,906,393
Accounts payable and accrued liabilities	3,527,254	8,033,421
Billings in excess of costs	5,417,995	(3,833,816)
Provision for contract losses	350,889	644,418
Net cash provided by (used in) operating activities	4,748,850	(5,915,153)
Cash flows from investing activities		
Purchase of plant and equipment	(6,204,196)	(4,298,214)
Earnout payment for purchase of Seagull Technology	(187,933)	(337,766)
Net cash used in investing activities	(6,392,129)	(4,635,980)
Cash flows from financing activities		
Payments on borrowings for Seagull Technology purchase	(1,575,000)	(900,000)
Borrowings from (payments on) note payable - line of credit, net	1,772,553	(1,937,387)
Tax benefit for exercise of stock options	348,480	93,557
Borrowings from (payments on) loans/notes payable	2,877,386	(1,578,761)
Proceeds from equity investment, net	-	14,896,200
Proceeds from the exercise of options	55,665	29,589
Payments on purchase of treasury stock	(72,994)	(52,065)
Net cash provided by financing activities	3,406,090	10,551,133
Increase in cash and cash equivalents	1,762,811	-
Cash and cash equivalents		
Beginning of year	-	-
End of year	$ 1,762,811	$ -
Supplemental cash disclosures:		
Income taxes paid, net	$ 452,908	$ 2,129,209
Interest paid	$ 1,996,543	$ 2,082,669

The accompanying notes are an integral part of the consolidated financial statements.

Statements of Stockholders' Equity

	Treasury Stock		Common Stock		Additional Paid-in Capital	Retained Earnings	Total
	Shares	Amount	Shares	Amount			
Balance at June 30, 2007	39,881	$ (359,785)	6,629,448	$ 66,296	$ 5,156,235	$ 13,024,135	$ 17,886,881
Exercise of stock options at $.25 to $3.25 per share			29,939	299	83,803		84,102
Stock option expense					256,114		256,114
Stock awards			1,251	12	15,000		15,012
Tax benefit for stock compensation					93,557		93,557
Net income						3,727,540	3,727,540
Accrued dividends						(1,155,864)	(1,155,864)
Accretion of redeemable preferred stock						(2,500,000)	(2,500,000)
Purchase of Company stock	8,641	(106,578)					(106,578)
Balance at June 30, 2008	48,522	(466,363)	6,660,638	66,607	5,604,709	13,095,811	18,300,764
Exercise of stock options at $.85 to $3.25 per share			111,807	1,118	307,807		308,925
Stock option expense					286,733		286,733
Warrant expense					58,208		58,208
Stock awards			8,846	88	106,065		106,153
benefit for stock compensation					348,480		348,480
Net income						3,371,991	3,371,991
Accrued dividends						(1,321,261)	(1,321,261)
Accretion of redeemable preferred stock						(2,500,000)	(2,500,000)
Purchase of Company stock	26,870	(326,254)					(326,254)
Balance at June 30, 2009	75,392	$ (792,617)	6,781,291	$ 67,813	$ 6,712,002	$ 12,646,541	$ 18,633,739

The accompanying notes are an integral part of the consolidated financial statements.

Statements of Income

	2009 (52 weeks)	2008 (52 weeks)
Revenue	$ 157,823,663	$ 127,227,107
Contract direct costs	91,247,012	71,114,293
Gross margin	66,576,651	56,112,814
Operating expenses	34,528,598	29,330,060
General and administrative expenses	10,560,267	8,935,541
Research and development	4,987,316	5,840,642
Business development	6,684,414	5,650,652
Total operating expenses	56,760,595	49,756,895
Income from operations	9,816,056	6,355,919
Interest expense, net	(1,991,029)	(1,757,952)
Other (expense) income	(2,590,747)	111,448
Income before taxes	5,234,280	4,709,415
Income tax expense (benefit)		
Current	2,191,098	2,424,094
Deferred	(328,809)	(1,442,219)
Total tax expense, net	1,862,289	981,875
Net income	$ 3,371,991	$ 3,727,540

The accompanying notes are an integral part of the consolidated financial statements.

Balance Sheets

Assets	2009	2008
Current assets		
Cash and cash equivalents	$ 1,762,811	$ -
Accounts receivable, net	30,356,156	16,274,570
Unbilled receivables on contracts, net	24,943,328	24,092,406
Inventory, net	6,703,369	8,104,724
Prepaid expenses and other current assets	2,055,246	1,424,609
Deferred tax assets	2,263,630	2,388,434
Total current assets	68,084,540	52,284,743
Property, plant and equipment, net	21,173,234	18,389,573
Identifiable intangibles, net	1,544,193	1,960,506
Goodwill	2,737,791	2,737,791
Deferred tax assets	378,822	218,416
Other non-current assets	320,258	247,763
Total assets	$ 94,238,838	$ 75,838,792

Liabilities and Stockholders' Equity

Current liabilities		
Note payable - line of credit	$ 5,941,096	$ 4,168,543
Current portion of long-term debt and capital lease obligations	2,934,563	2,410,570
Accounts payable	11,077,880	9,088,368
Accrued liabilities	10,310,630	8,927,666
Billings in excess of costs	10,204,314	4,786,319
Provision for contract losses	1,619,394	1,268,505
Income taxes payable	1,567,608	476,589
Total current liabilities	43,655,485	31,126,560
Long-term debt and capital lease obligations	9,374,851	7,859,404
Derivative financial instrument	201,438	-
Total liabilities	53,231,774	38,985,964
Redeemable convertible preferred stock, par value $.001	22,373,325	18,552,064
5,000,000 shares authorized; 1,184,328 issued and outstanding		
Commitments and contingencies (Notes 7, 9 and 14)		

Stockholders' Equity

Common stock, par value $.01		
12,000,000 shares authorized; 6,781,291 and 6,660,638		
shares issued and 6,705,899 and 6,612,116 outstanding		
at June 30, 2009 and 2008, respectively	67,813	66,607
Additional paid-in capital	6,712,002	5,604,709
Retained earnings	12,646,541	13,095,811
	19,426,356	18,767,127
Less: Treasury stock, at cost (75,392 and 48,522 shares at		
June 30, 2009 and 2008, respectively)	(792,617)	(466,363)
Total stockholders' equity	18,633,739	18,300,764
Total liabilities and stockholders' equity	$ 94,238,838	$ 75,838,792

accompanying notes are an integral part of the consolidated financial statements.

Report of Independent Auditors

To the Board of Directors
Sensis Corporation

We have audited the accompanying consolidated balance sheets of Sensis Corporation as of June 30, 2009 and 2008, and the related consolidated statement of income, stockholders' equity, and cash flows for the years then ended. These financial statements are the responsibility of the Company's management. Our responsibility is to express an opinion on these financial statements based on our audits.

We conducted our audits in accordance with auditing standards generally accepted in the United States. Those standards require that we plan and perform the audit to obtain reasonable assurance about whether the financial statements are free of material misstatement. We were not engaged to perform an audit of the Company's internal control over financial reporting. Our audits included consideration of internal control over financial reporting as a basis for designing audit procedures that are appropriate in the circumstances, but not for the purpose of expressing an opinion on the effectiveness of the Company's internal control over financial reporting. Accordingly, we express no such opinion. An audit also includes examining, on a test basis, evidence supporting the amounts and disclosures in the financial statements, assessing the accounting principles used and significant estimates made by management, and evaluating the overall financial statement presentation. We believe that our audits provide a reasonable basis for our opinion.

In our opinion, the financial statements referred to above present fairly, in all material respects, the consolidated financial position of Sensis Corporation at June 30, 2009 and 2008, and the consolidated results of their operations and their cash flows for the years then ended in conformity with U.S. generally accepted accounting principles.

Ernst + Young LLP

Buffalo, NY
September 25, 2009

liabilities and disclosures of contingent assets and liabilities at the dates of the financial statements and the reported amounts of revenues and expenses during the reporting periods. On an on-going basis, management evaluates its estimates and judgments, including, but not limited to, those related to revenue recognition, reserves for obsolescence and excess inventory, bad debt, warranty, goodwill and intangibles, and valuation allowances for deferred tax assets. Management bases its estimates and judgments on historical experience and on various other factors believed to be reasonable under the circumstances that form the basis for making judgments about the carrying values of assets and liabilities that are not readily apparent from other sources. Actual results may differ from these estimates under different assumptions or conditions. The following summarizes significant accounting policies:

Revenue Recognition and Cost Recognition – Revenues derived from long-term contracts for design, development and production activities are accounted for consistent with the American Institute of Certified Public Accountants' (AICPA) audit and accounting guide, Audits of Federal Government Contractors, and the AICPA's Statement of Position 81-1, Accounting for Performance of Construction-Type and Certain Production-Type Contracts. The Company also enters into contracts to provide other services that are not associated with design, development or production activities. The Company accounts for those contracts in accordance with the U.S. Securities and Exchange Commission's Staff Accounting Bulletin (SAB) No. 104, Revenue Recognition, and other relevant revenue recognition accounting literature. The Company considers the nature of these contracts and the types of products and services provided when we determine the proper accounting method for a particular contract.

Revenues from certain contracts are recognized based upon the percentage of completion method of accounting. Anticipated losses on specific contracts in process are recorded in full when identified and the losses are included in the provision for contract losses. Unbilled accounts receivable are stated at estimated realizable value. Contract costs, including indirect expenses, are subject to audit and adjustment through negotiations between the Company and government representatives. Contract direct costs include all direct material, direct labor and taxes, fringe benefits including but not limited to health insurance and paid time off, facility costs, other direct costs and those indirect costs related to contract performance, such as indirect labor, supplies, tools, repairs, and depreciation costs. Selling, general and administrative costs are charged to expense as incurred. Changes in job performance, job conditions, and estimated profitability, including those arising from contract penalty provisions, and final contract settlements may result in revisions to costs and income and are recognized in the period in which the revisions are determined. Profit incentives are included in revenues when their realization is reasonably assured. Claims are included in contract costs when probable and the amount can be reliably estimated. Contract revenues have been recorded in amounts that are expected to be realized on final settlement.

Revenues from sales of products are recorded as the products are shipped or upon customer acceptance of title, provided that no significant vendor and post-contract support obligations remain and the collection of the related receivable is probable. Shipping and handling costs are included in the contract direct costs within the consolidated statement of income.

The asset, "unbilled receivables," included in unbilled receivables on contracts, represents revenues recognized in excess of amounts billed. The liability, "billings in excess of costs," represents billings in excess of revenues recognized.

Price Redetermination – As a Government contractor, we are subject to price redetermination on certain fixed-price contracts if it is determined that the price of our products and services are not consistent with the requirements of the U.S. Federal Acquisition Regulations.

Goodwill and Intangible Assets – Goodwill represents the excess purchase price over the fair value of assets acquired. The Company accounts for its goodwill in accordance with SFAS No. 142, Goodwill and Other Intangible Assets. The Company reviews goodwill and unamortizable tangible assets for impairment whenever events or changes in circumstances indicate the carrying amount of these assets may not be recoverable and annually each June. Goodwill and intangible assets deemed to have indefinite lives are not subject to amortization, while all other identifiable intangibles are amortized over their estimated useful lives. The value assigned to intangible assets is determined with the assistance of an independent valuation firm based on estimates and judgments regarding expectations for the success and life cycle of products and technology acquired. Goodwill is tested annually using a two-step process. The first step is to identify any potential impairment by comparing the carrying value of the reporting unit to its fair value. If a potential impairment is identified, the second step is to compare the implied fair value of goodwill with its carrying amount to measure the impairment loss. A decline in fair value could result in an impairment charge to goodwill. There were no impairment charges recorded in fiscal year 2009 and 2008.

Warranties – The accrual for the estimated cost of product warranties is provided for at the time revenue is recognized. While the Company engages in extensive product quality programs and processes, including actively monitoring and evaluating the quality of our component suppliers, our warranty obligation is affected by product failure rates, material usage, and service delivery costs incurred in correcting a product failure. Should actual product failure rates, material usage or service delivery costs differ from the Company's estimates, revisions to the estimated warranty liability may be required.

Inventory – Inventories are stated at the lower of cost or market. The Company determines cost using the weighted average cost method and costs are removed from inventory at weighted average cost. In addition, the Company maintains spare parts in order to repair certain program products. The reserve for estimated obsolescence or unmarketable inventory is equal to the difference between the cost of inventory and the estimated fair value based upon assumptions about future demand and market conditions. If actual future demand or market conditions are less favorable than those projected by management, additional inventory write-downs may be required.

In 2008, management established a $0.9 million reserve for probable reimbursement of legal expenses related to an ongoing legal action that was settled in August 2009. The legal action was settled for $0.8 million and the $0.1 million balance was recorded as a favorable adjustment in fiscal 2009.

Interest Expense

Interest expense for 2009 was $2.0 million as compared to $1.8 million and $2.5 million in 2008 and 2007, respectively. The interest expense relates primarily to the interest associated with the capital lease for the Company's Collamer facility, interest on the term note payable loan, interest related to capital leases for equipment utilized in operations and interest associated with the Company's short term working capital facility.

Liquidity and Capital Resources

On July 27, 2007, the Company secured $15 million in equity capital to support its capital needs. In exchange for this investment, the Company issued 1,184,328 shares of Series "A" Preferred Stock. The Preferred Stock is convertible into common stock, at the sole option of the holder, at a conversion rate of 1 to 1. Additionally, the preferred securities accrue dividends at the rate of 2% per quarter, and receive liquidation preferences over common stockholders. Holders of the preferred securities have the right to redeem all or some of their stock at any time after July 27, 2010 at a redemption price of 1.5 times the issue price for each share. Management is currently negotiating with the Series A Preferred stockholders to extend the anniversary of the closing date of the stock purchase requiring the Company to redeem any or all the shares of Series A Preferred Stock of record owned by the holder until July 2012.

The Company has three facilities that it utilizes in support of operations. A $14,000,000 Revolving Line of Credit commitment used for working capital (including $2,000,000 for domestic Letters of Credit), a $25,000,000 Export-Import Bank Line of Credit commitment used exclusively for international Letters of Credit and Performance Guarantees and a Term Note Payable for capital expenditures. The term note payable matures on September 1, 2013. In April 2009, Management renewed the Revolving Line of Credit commitments with its commercial bank which now expires in July 2010. In February 2009, Management renewed the Export-Import Bank Line of Credit commitment with its commercial bank, which now expires July 2010.

The Revolving Line of Credit is subject to a borrowing base calculation that limits available borrowings based upon formulaic calculations related to accounts receivable, unbilled accounts receivable balances, extended letters of credit and current borrowings. Total available borrowings at June 30, 2009 under the Revolving Line of Credit, after the borrowing base calculation, were approximately $12,504,000. The Company had approximately $5,941,000 and $4,169,000 of working capital borrowings as of June 30, 2009 and 2008, respectively. Outstanding borrowings under the line of credit are collateralized principally by all corporate assets. Interest under the line of credit is computed at the LIBOR rate plus a rate ranging from 2.75% to 4.25%, with the applicable rate set at a predetermined schedule based on the ratio of funded debt to EBITDA. The interest rate was 3.57% as of June 30, 2009. The Company is subject to annual renewal fees and a monthly unused Revolving Line of Credit commitment fee.

Additionally, the Company has a $5,000,000 term note payable for capital expenditures. The Company has approximately $4,250,000 and $1,575,000 outstanding on the term note payable at June 30, 2009 and 2008, respectively. During fiscal year 2009, the Company paid down the remaining $1,575,000 balance of the note payable that was utilized as part of the financing for an acquisition in 2005 and refinanced the term note payable for capital expenditure use. The Company pays $83,333 per month plus variable interest of the LIBOR rate plus a rate ranging from 2.75% to 4.25%, with the applicable rate set at a predetermined schedule based on the ratio of funded debt to EBITDA. The interest rate was 3.57% as of June 30, 2009.

In August 2008, the Company entered into an interest rate swap agreement associated with the above $5,000,000 term note payable to manage its exposure of market risk from changes in interest rates by locking in a fixed rate of 3.92% for the entire term of the loan and minimize significant unplanned fluctuations in earnings and cash flows caused by interest rate volatility. The interest rate swap has a notional amount of approximately $4,250,000 as of June 30, 2009 and expires in August 2013. The Company has described the accounting treatment of the interest rate swap agreement in Note 1 in the financial statement notes.

The Company entered into a separate note payable agreement with a third party in relation to a software purchase during fiscal year 2009. The amount financed totaled approximately $737,000 and the Company is required to make eight quarterly payments of $99,360 beginning in fiscal year 2010. The interest rate is fixed at 6.84% for the life of the note payable, which matures in June 2011. There are no covenants associated with the note payable. The software purchase was presented as a non-cash item in the consolidated statements of cash flows.

The Company had approximately $20,231,000 and $22,000,000 of standby letters of credit issued as of June 30, 2009 and 2008, respectively.

The Revolving Line of Credit, Export-Import Bank Line of Credit and Term Note Payable agreements provide that the Company must meet certain financial ratio covenants relating to total funded debt, fixed charge coverage, tangible net worth and certain capital expenditure limits. The Company was in compliance with all covenants as of June 30, 2009 and 2008.

Management believes its credit facilities coupled with the estimated cash flow generated from operations will provide sufficient funding for the Company's current operating plan and capital expenditure needs. Management is continually assessing and monitoring its liquidity and cash flow to ensure the Company has adequate liquidity and capital resources to meet its current and future capital needs.

Significant Accounting Policies and Estimates

The preparation of financial statements in conformity with accounting principles generally accepted in the United States of America requires management to make estimates and assumptions that affect the reported amounts of assets and

Revenue

Revenue for 2009 was $157.8 million, as compared to $127.2 million and $94.9 million in 2008 and 2007, respectively. Revenue increased 24.0% from 2008 and 66.2% from 2007.

The Air Traffic Systems (ATS) division contributed $111.4 million in revenue in 2009 as compared to $98.0 million and $82.2 million in 2008 and 2007, respectively. ATS contributed 70.6% of the Company's revenue for 2009 as compared to 77.0% and 86.6% of revenue in 2008 and 2007, respectively.

ATS' 13.7% revenue growth was driven in large part by its continued international expansion of its core surface surveillance product line, coupled with two key large program awards... the FAA's RWSL Program, and Australia's National Tower Program.

The Company's Defense & Security Systems (D&SS) division generated $46.4 million in revenue in 2009 as compared to $29.2 million and $12.7 million in 2008 and 2007, respectively. D&SS contributed 29.4% of the Company's revenue for 2009 as compared to 23.0% and 13.4% of revenue in 2008 and 2007, respectively.

The significant revenue increase from 2008 is attributed to the Ground/Air Task Oriented Radar (G/ATOR) Program in which Sensis is a major contractor to Northrop Grumman.

Gross Margin

Gross Margin for 2009 was $66.6 million or 42.2% of sales as compared to $56.1 million or 44.1% of sales and $46.1 million or 48.6% of sales in 2008 and 2007, respectively. The steady decline in gross margin percentage can be attributed to a shift towards a higher ratio of vendor material and subcontractor content versus Sensis direct labor.

Operating Expenses

Operating expenses in 2009 were $34.5 million as compared to $29.3 million and $26.2 million in 2008 and 2007, respectively. Operating expenses as a percentage of revenue in 2009 were 21.9% as compared to 23.1% and 27.6% in 2008 and 2007, respectively.

In 2009, the Company created a Business Execution Council and numerous Centers of Excellence based on engineering disciplines. The work of all councils is to standardize and improve best practices across the enterprise, with the stated objective of improving profitability and business performance. The increase in operating expenses from 2008 were driven by increased compensation and benefits ($1.5 million) as additional support personnel were added, professional and consulting fees ($1.0 million), workforce training ($0.6 million), increased travel and living ($0.5 million) added facilities costs as a result of a new office in Reston, Virginia ($0.3 million) and depreciation ($0.3 million). Relative to 2007, $3.6 million of operating expense were eliminated from the business following the discontinuation of its Corporate Ventures activities. The savings, in 2007, from the discontinuation of Corporate Ventures were offset in 2008 by increased employee benefits relating to new hires ($1.6 million), labor associated with strengthening product teams ($3.5 million), increased expenditures on outside and professional services, recruiting and relocation, travel and lodging and other expenditures ($1.6 million).

General & Administrative Expenses

General and administrative expenses in 2009 were $10.6 million as compared to $8.9 million and $8.0 million in 2008 and 2007, respectively. General and administrative expenses as a percentage of revenue in 2009 were 6.7% as compared to 7.0% and 8.4% in 2008 and 2007, respectively. The increase in costs for 2009 over 2008 resulted from increases of approximately $0.8 million in salaries and benefits and $0.9 million in costs associated with consulting, recruiting and trade shows.

Research & Development Expenses

Research and development expenses in 2009 were $5.0 million as compared to $5.8 million and $7.6 million in 2008 and 2007, respectively. Research and development expenses as a percentage of revenue in 2009 were 3.2% as compared to 4.6% and 8.0% in 2008 and 2007, respectively.

For the second year in a row, the Company spent less than originally planned on Research and Development. Consistent with last year's disclosure, the planned R&D projects that were deferred were more experimental or speculative in nature.

Business Development Expenses

Business development expenses in 2009 were $6.7 million as compared to $5.7 million and $6.9 million in 2008 and 2007, respectively. Business development expenses as a percentage of revenue in 2009 were 4.2% as compared to 4.4% and 7.3% in 2008 and 2007, respectively.

Business development expenses are primarily driven by resources required to secure a contract once a business opportunity has been identified. Business development expenses include visits to existing/prospective customers, determining appropriate solutions to customers' needs, writing customer proposals and negotiating customer contract documents. The increase in business development expenses from 2008 relates primarily to the Company's pursuit of the 3DELRR Technology Development Program. In 2009, the Company invested in Customer Relationship Management (CRM) software. We anticipate that the tool will provide for more effective business capture.

Other (Expense) Income

Other (expense) for 2009 was ($2.6) million as compared to other income of $0.1 million and $0.1 million in 2008 and 2007, respectively.

The Company recorded losses from unfavorable foreign exchange rates and realized forward foreign exchange contracts of $2.4 million in 2009 and income from exchange rate gains of $0.8 million and $0.6 million in 2008 and 2007, respectively. Royalties in 2009 added income of $0.03 million and $0.1 million and $0.04 million in 2008 and 2007, respectively. These related to technology licenses in accordance with development agreements with Antenna Associates Inc. and Mitsubishi Corporation.

Management Discussion & Analysis

Larry Harris, Senior Vice President & CFO

The following management discussion should be read in conjunction with the financial statements and related notes and the other financial information included elsewhere in this report. The decisions management makes today are to a great extent based on the future view of its business. Management regularly reviews the financial results that follow from these decisions to determine how its plans may need to change going forward. This changing environment does not always align with management's expectations, which can impact the Company's operating results.

In addition, business risks specific to the Aerospace and Defense Industry, including, but not limited to, changes in procurement policies, budget considerations, changing technical requirements, political developments, patent infringement claims, product liability claims, and competitive offerings can influence the Company's future operations. Such factors are largely beyond the Company's control.

overview

For the fiscal year ending 2009, Sensis Corporation (the "Company") built on its 2008 momentum, delivering 24.0% year-over-year top line growth. Supported by long term contracts and a diversified customer base, the Company has been able to weather the recent global financial crisis with minimal adverse affects. In 2009, for the second consecutive year, the Company attained record revenues. 2009 revenues of $157.8 million exceeded the previous high of $127.2 million recorded in 2008. For the two year period ending fiscal 2009, total revenue increased by 66.2%.

Although revenue grew substantially, a similar growth in earnings was not realized. The Company's earnings were adversely impacted by the recognition of foreign exchange losses. Where practical, management attempts to mitigate the Company's exposure to foreign currency volatility through both contract language and hedging strategies. As the world's banking system coped with a rapid loss of confidence, there was unprecedented strengthening of the U.S. dollar against foreign currencies as currency traders took flight towards safety. The unexpected strength of the U.S. dollar resulted in the Company recording $2.4 million of realized forward foreign exchange contracts and foreign currency losses during the year. Had it not been for the foreign currency charge to operations, pre-tax earnings would have been $7.6 million, or 62.9% greater than last fiscal year.

As mentioned elsewhere in this report, 2009 was a successful year for securing key strategic contracts. The Runway Status Lights contract awarded by the FAA leverages our ASDE-X installed base and strengthens our role as a major prime contractor for the FAA. Australia's demonstrated confidence in Sensis by awarding the next generation tower automation contract through the National Tower Program further diversifies the Company in the airport automation market segment. Finally, the United States Air Force's award of the 3DELRR Technology Development Program is a necessary precursor to a potential production award that represents a truly transformational opportunity for the Company.

The continued support of our financial partners through the recession validates management's long term strategy as well as day-to-day operations. In October of 2008, during one of the worst weeks in U.S. banking history, Citizens Bank extended the terms of our credit facilities. In addition, Bank of America, with a very strong Aerospace and Defense Practice, has been brought into the relationship as a second bank, and ExIm Bank has significantly increased its credit facilities to the Company.

Not only have the debt lenders demonstrated confidence in the Company's future, Needham Capital Partners and Dolphin Equity Partners, our Series "A" investors, continue to provide excellent board room consultation on preparing the Company for an IPO. As of this writing, the equity partners are working with management to extend their original exit date. By allowing their capital to be more patient, the team of Needham and Dolphin have endorsed management's strategy for the Company's growth and prosperity.

The table for 2010 and beyond has been set. Sensis approaches the new fiscal year addressing markets in need and looking towards market expansion and diversification. Through several linchpin strategic programs, a dedicated and talented workforce, strong and supportive capital partners, and an experienced management team, momentum is building like it never has built before.

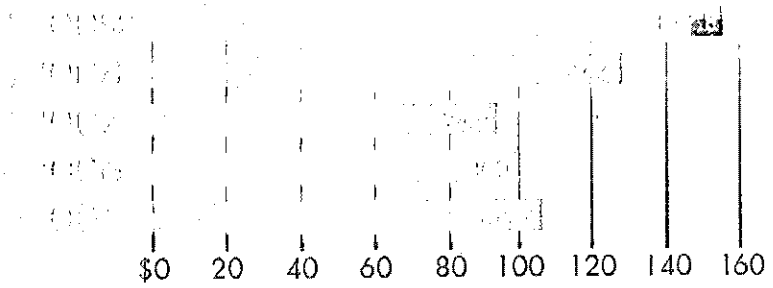
Results of Operation

Net income (loss) – Net income was $3.4 million for 2009 as compared to $3.7 million in 2008 and a net loss of $(3.2) million in 2007. Basic earnings (loss) per share (EPS) for 2009 were $(0.07) as compared to $0 in 2008 and $(0.48) in 2007.

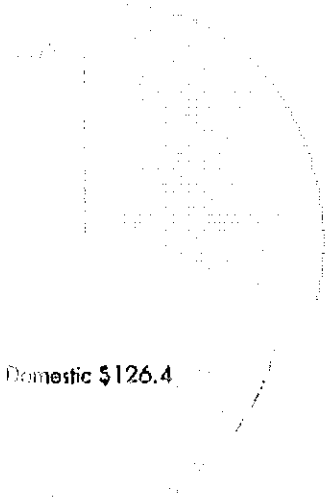
Income from operations grew 54.4% to $9.8 million (6.2% of revenue) in 2009 vs. $6.4 million (5.0% of revenue) in 2008. The additional margin that resulted from the 24.0% growth in sales was offset by losses on realized forward foreign exchange contracts and foreign exchange transactions of $2.4 million coupled with higher taxes. The lower effective tax rate in 2008 resulted from a combination of higher research & development tax credits coupled with the impact of loss carry forwards that were fully absorbed in 2008.

Financial Highlights

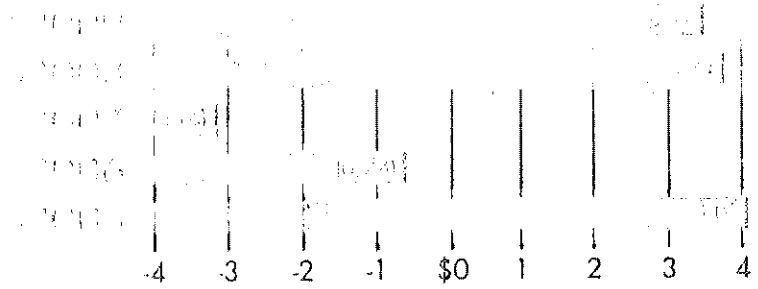
Revenue ($M)



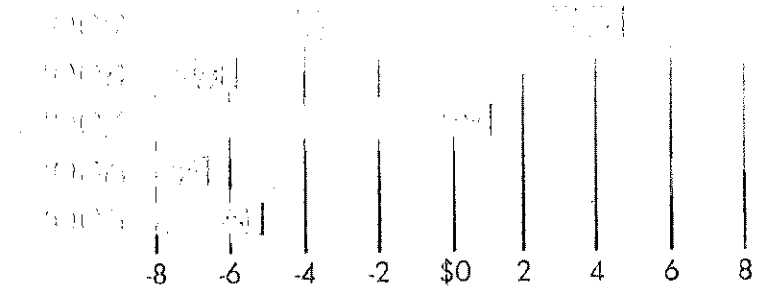
Revenue by Geography ($M)



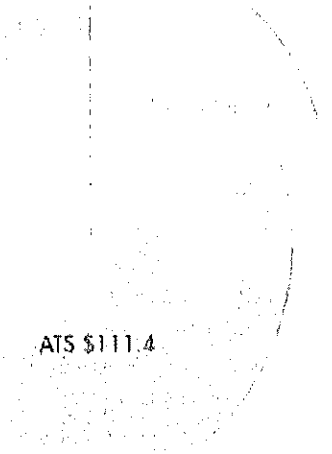
Net Income (Loss) ($M)



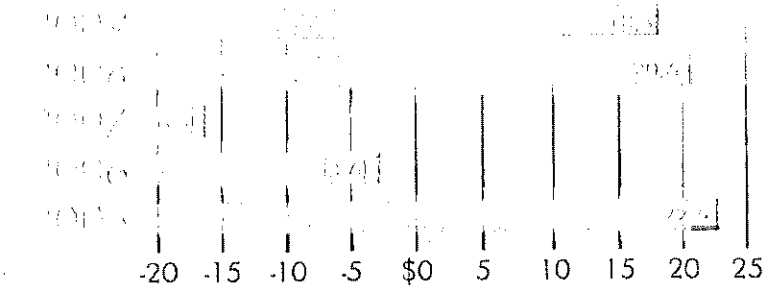
Cash Flow from Operations ($M)



Revenue by Area ($M)



Return on Stockholders' Equity (%)



To Our Shareholders continued

Advanced Development (AD)

The AD group is comprised of the Seagull Technology Center in Campbell, California, the Reston Technology Center – an engineering office recently opened in Reston, Virginia – and the New York Technology Center – part of our Global Headquarters in Syracuse, NY. In fiscal 2009, AD was remarkably successful in capturing and executing R&D contracts that will help position the company to be a thought leader and major provider of NextGen air traffic solutions.

AD was awarded three NASA contracts which are contributing in an important way to the development of the FAA's next generation air traffic management system. The first is entitled "Integration of Advanced Concepts and Vehicles into the Next Generation Air Transportation System." The effort employs advanced modeling and simulation techniques to examine the effect that new aircraft types (e.g., UAVs) may have on the efficiency, safety and environmental impact of emerging next generation solutions. The second NASA award is a contract entitled "Integration of Weather Data into Airspace and Traffic Operations Simulation (ATOS) for Trajectory-Based Operations Research." Its objective is to integrate weather forecast information and weather phenomena into an industry standard simulator to ensure that future air traffic management concepts meet critical safety and efficiency targets. And the third contract award, entitled "Three Dimensional Paths for Arrival Management," is to develop a decision support tool that recommends aircraft descent trajectories that are more efficient in the sense that they increase throughput while minimizing fuel burn and environmental impact.

"...fiscal 2009 was a year of building the momentum needed to propel us toward our vision of flourishing as a public diversified technology company."

Looking Ahead

As suggested by the annual report cover, fiscal 2009 was a year of building the momentum needed to propel us toward our vision of flourishing as a public diversified technology company, world renowned as a source of innovative high-tech products that advance human safety, security and health. And, at least at the time of this writing, it appears that we'll be able to sustain the momentum in fiscal year 2010. Of course, we'll actually realize the vision only if we sustain it well beyond fiscal 2010.

For the past few years, we've stated that the company is committed to a liquidity event in the second quarter of fiscal 2011. Although we're still working hard to make that happen, it now appears likely that it will slip to the third or even fourth quarter. To be entirely candid, we could avoid the slip by selling or recapitalizing the company, but we consider these options to be so onerous and incompatible with the company's vision that we've rejected them. We could also execute the IPO on the previously stated date, but not without risking a significant financial penalty. The current view of the timing of new awards and the resulting sales and profit growth is such that a one or two quarter slip has a surprisingly significant impact. One especially noteworthy prospective award is of the Air Force's 3DELRR engineering and manufacturing development contract – now planned for January 2011. An award of that contract prior to the IPO would materially increase our market capitalization, stock value and post-IPO robustness.

Jud Gostin
Chairman, President & CEO

surveillance system at Whistler, British Columbia.

Fiscal 2009 was also a year of significant momentum building for our Aerobahn© automation and management product. Large Aerobahn installations were purchased by the Port Authority of New York/New Jersey for JFK International Airport and by Atlanta's Department of Aviation for the Hartsfield-Jackson Atlanta International Airport. In both cases, the goal is to provide airport stakeholders with a comprehensive view and analysis of surface traffic to enable collaboration and traffic flow decisions that will increase capacity, and reduce delays and fuel consumption. We are becoming increasingly optimistic that validation of Aerobahn's positive impact on the operational efficiency of these two major airports – and early indications are encouraging – will promote sales at numerous other major airports, both in the U.S. and abroad. In part, this optimism stems from the growing global commitment to reducing fuel consumption. The world's airlines are motivated by economic concerns, as fuel has become their major cost ·ement, and the general public is tivated by mounting ecological concerns.

And finally, ATS together with NAV CANADA, its teammate and principal subcontractor – and one of the world's leading Air Navigation Service Providers – won a substantial contract from Airservices Australia to design and deliver an integrated Air Traffic Control solution for its National Tower Program (NTP) Technology Project. Our team's solution, referred to as the Integrated Tower Automation Suite (INTAS), will provide controllers with a state-of-the-art "glass tower" solution that combines flight data, operational data, surveillance and voice communications into a scalable air traffic management system. The ultimate project goal is to modernize and, where necessary, replace up to 26 air traffic control towers. This contract is significant not only as a revenue generator but also as a stepping stone to move ATS beyond surveillance into the substantially larger automation market segment. More specifically, it provides the experience and credibility that will help ATS become a major player in an emerging Next Generation (NextGen) Tower Automation market.

"This was the second consecutive year of well over 20% growth – a growth rate few other Aerospace & Defense companies have been able to approach."

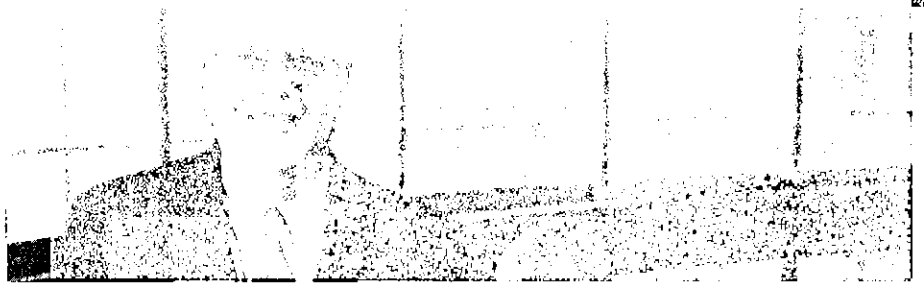
Defense & Security Systems (D&SS)

In Fiscal 2009, D&SS won two technology demonstration contracts that move us closer to the goal of winning prime contracts to supply new long-e radars to replace aging Air Force and Marine Corps systems (i.e., the AN/TPS-75 and AN/TPS-59). Becoming a USAF and/or USMC long-range radar supplier would be truly transformative, not only because it would generate tremendous revenue, but also because it would elevate Sensis to major Defense prime contractor status.

The first key win was a $22 million Air Force contract referred to as the Three-Dimensional Expeditionary Long-Range Radar (3DELRR) Technology Development (TD) Program. Lockheed Martin also won an award, and a third competitor, Northrop Grumman, lost. The 3DELRR TD program's primary objective is to demonstrate the maturity of the technologies critical to achieving requisite radar performance and affordability. We are ably assisted in achieving this objective by Raytheon's Integrated Defense Systems division, our teammate and principal subcontractor. A successful TD program will lead directly to a competition for a single major radar development contract early in calendar year 2011. D&SS' second key win was of a complementary $4.3 million contract from the Marines to reduce the technological risks associated with development of a 3DELRR-like radar. We are working hard on both programs to demonstrate to the Air Force and Marine Corps that, as their next generation radar supplier, they can rely on us for unmatched quality, service and value.

Also in fiscal 2009, D&SS took a major step forward in ensuring sustainable rapid growth by its progress in penetrating the Safety and Security market. Although we all wish it weren't so, given the harsh world reality, this is a large market segment that will undoubtedly continue to grow. Working with the multiple federal organizations charged with protecting the security of our troops and homeland from terrorist attack, D&SS has developed a variety of products that counter terrorist weapons like Improvised Explosive Devices (IEDs) and Explosively Formed Projectiles (EFPs); protect our troops from snipers; assist medics in providing more effective care for the wounded; and detect illegal penetration of our borders. Encouraged by our success in securing product development contracts, the expectation that some of these developments will transition into production, and the solid reputation we have developed as an exceptionally innovative, responsive and agile supplier, we have become quite bullish on the future of this business segment.

To Our Shareholders



Jud Gostin, Chairman, President & CEO

Fiscal 2009 started slowly but kept getting better and ended up a very positive year in a number of important ways. First, a strong fourth quarter drove sales to $157.8 million and net income to $3.4 million. This was the second consecutive year of well over 20% growth – a growth rate few other Aerospace & Defense companies have been able to approach. Second, the movement toward a healthier level of diversification that began last year continued with further rapid growth of the Defense & Security Systems division – its sales increased by 59% – and expansion of the Air Traffic Systems division's contract and customer base. Third, we made notable progress in introducing processes and disciplines that will improve project execution efficiency and thereby generate higher contract margins. And finally, we won several strategically important contracts that will help propel us toward a future which includes large contract awards and entry into major, adjacent market segments. These contracts are outlined below.

We filled two new senior management positions in fiscal 2009 to ensure that our leadership team has the knowledge and expertise to effectively address the increasingly complex execution and business development challenges accompanying our rapid growth. To take advantage of a breadth of experience and remarkable track record built over a thirty-year career in business management and complex sensor and automation systems development, Senior Vice President Marc Viggiano was appointed Chief Operating Officer. In this role, he is responsible for the success of our established business segments, Operations and the Advanced Development group (formerly Strategy & Development). And recently retired Vice Admiral John Morgan, whose illustrious naval career included participation in the Joint Chiefs of Staff and assignment as Deputy Chief of Naval Operations for Information, Plans and Strategy, joined the company as Senior Vice President and Chief Strategy Officer. In this role, John will use the knowledge and experience accumulated in constructing complex strategic plans for the U.S. Navy to develop the company's overall strategic direction and identify growth opportunities beyond the scope of our existing businesses.

Two awards won in fiscal 2009 are worthy of mention. First, Sensis was selected by the U.S. Defense Security Service to receive the James S. Cogswell Outstanding Industry Security Achievement Award. This award honors defense contractors that have demonstrated superior industrial security processes and procedures for handling U.S. government classified information. Of the nearly 12,000 cleared contractor facilities, less than one percent are selected annually to receive the award. Second, our CFO, Larry Harris, was honored as "CFO of the Year" in the above $40 million revenue category by *The Central New York Business Journal*. Larry was cited for outstanding performance in his role as a financial professional, for his leadership, and for his community involvement.

Fiscal 2009 Highlights

Air Traffic Systems (ATS)

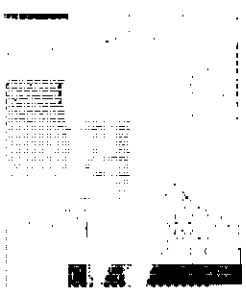
ATS maintained its historic strength in airport surveillance. In the U.S., ASDE-X went operational at seven more major airports: Detroit Metropolitan, Phoenix Sky Harbor, Fort Lauderdale/Hollywood, John F. Kennedy, Los Angeles, Boston Logan and Newark. This increases the number of U.S. airports with operational ASDE-X systems to 19 (of a planned total of 35).

ASDE-X has gotten a considerable amount of favorable recognition of late, and deservedly so. One recent example that we're especially proud of: on May 29th of this year, the National Transportation Safety Board announced that the ASDE-X system at Charlotte/Douglas International Airport had alerted controllers of a runway incursion between two aircraft both cleared to take off from the same runway and that, as a result, a controller was able to cancel the takeoff clearance for one of the aircraft, averting a potential collision.

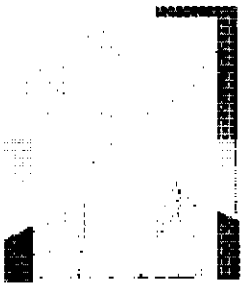
In fiscal 2009, ATS was awarded a contract by the FAA to install runway status lights at up to 35 major U.S. airports. Embedded in the pavement of runways, the lights will be controlled by data provided by ASDE-X to automatically warn pilots if it is unsafe to enter or cross a runway, or if a runway is unsafe for departure. Worth well over $100 million, the competitively won contract is testimony to the FAA's confidence in Sensis as a source of quality "safety of flight" solutions.

Fiscal 2009 was another year of notable international successes. ATS won contracts to provide airport surveillance sensors and systems for the Montreal-Trudeau Airport, the Perth Airport in Western Australia, London's Stansted Airport, Tokyo's Narita Airport, the Lisbon, Portugal Airport, and airports serving Jeddah and Dammam in the Kingdom of Saudi Arabia. It also received a contract from NAV CANADA to deploy a wide area

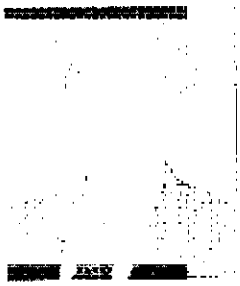
Sensis Executives



Jud Gostin
Chairman, President & Chief Executive Officer



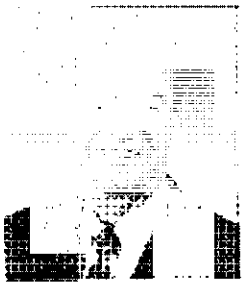
Larry Harris
Senior Vice President & Chief Financial Officer



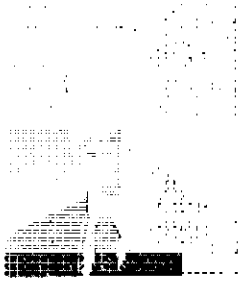
Marc Viggiano
Senior Vice President & Chief Operating Officer

Peggy Dudarchik
Senior Vice President & Chief People Officer

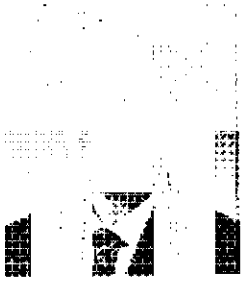
John Morgan
Senior Vice President & Chief Strategy Officer



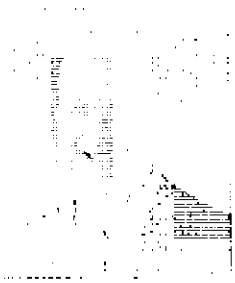
David Montanaro
Acting General Manager, Air Traffic Systems



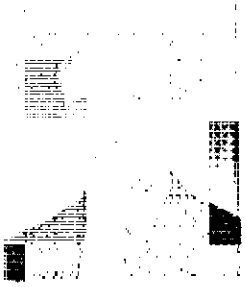
Dave Kovarik
Vice President & Director, Ground-based Radar



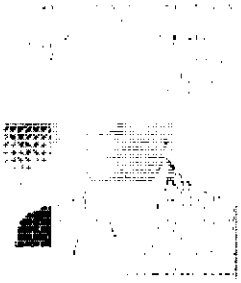
Ken Kaminski
Director, Advanced Development



Tom Uva
Vice President & Chief Information Officer



Greg Farnham
Vice President & Director of Operations



Ken Tollstam
Vice President & Director of Marketing, Planning and Strategy, Air Traffic Systems

Sensis Overview

Sensis Corporation is dedicated to providing distinctively elegant, innovative technical solutions for air traffic control, airline and airport automation, air defense and personnel security. Our most valuable asset – our exceptional workforce – continually solves challenging, real-world problems. We serve a global client base, with technology deployed in more than 35 countries across six continents.

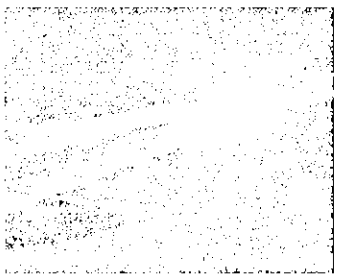
Entering FY09, Sensis was comprised of Air Traffic Systems (ATS), Defense & Security Systems (D&SS) and Strategy & Development (S&D). As a result of a new Chief Strategy Officer and the addition of a Chief Operating Officer, the S&D group became the Advanced Development (AD) group.

Air Traffic Systems:

Air Traffic Systems provides surveillance and automation solutions for air navigation service providers, airlines, and airports to optimize the safety and security of airline passengers on a global scale. In addition, these solutions increase operational efficiency and positively impact environmental factors challenging the aviation industry today.

"[Aerobahn® is being used for] improving overall operational efficiency and enhancing our customer's travel experience at [John F. Kennedy International Airport], one of the world's busiest airports."

– Bill Huisman, Executive Director, Aviation Development Council

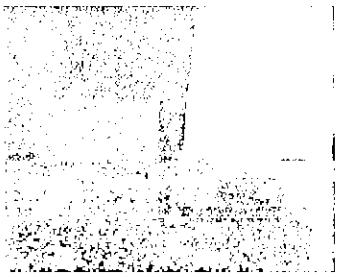


Defense & Security Systems:

Defense & Security Systems provides ground-based radar solutions in support of the world's defense organizations. A full spectrum of capability exists to design and produce next generation systems, as well as upgrades and service life extensions to currently fielded systems.

"Radar technology represents the next generation of critical air and ground warfighting capabilities for Marine Corps and Joint Force Commanders."

– John Burrow, G/ATOR's Technical Authority and U.S. Marine Corps Systems Command's Executive Director

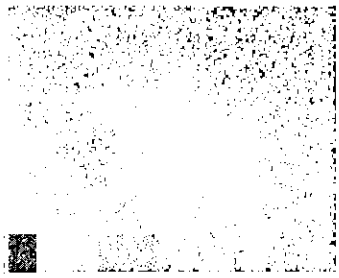


Advanced Development:

Advanced Development provides the advanced concepts, requirements, technologies and prototypes needed by Sensis' existing businesses to achieve their long-range strategic goals. It also incubates new businesses which will accelerate corporate diversified growth.

"The FAA Joint Planning and Development Office (JPDO) should receive substantial value from [the new vehicle integration research]... and produce results that the JPDO can use to help update NextGen plans."

– Bob Pearce, Deputy Director, JPDO



YOP, Bonus

Wins

Diversification

Execution

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MOMENTUM

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CONSOLIDATED FINANCIAL STATEMENTS

Sensis Corporation
Years Ended June 30, 2010 and 2009
With Report of Independent Auditors

PRELIMINARY AND TENTATIVE FOR DISCUSSION ONLY

Sensis Corporation

Consolidated Financial Statements

Years Ended June 30, 2010 and 2009

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PRELIMINARY AND TENTATIVE FOR DISCUSSION ONLY

Report of Independent Auditors

The Board of Directors
Sensis Corporation

June __, 2011

Draft
For Discussion Only

Sensis Corporation

Consolidated Balance Sheets

	June 30 2010	June 30 2009
Assets		
Current assets:		
Cash and cash equivalents	$ **1,862,483**	$ 1,762,811
Accounts receivable, net	**23,958,030**	30,356,156
Unbilled receivables on contracts, net	**25,131,365**	24,943,328
Inventory, net	**6,166,758**	6,703,369
Prepaid expenses and other current assets	**2,275,229**	2,055,246
Income taxes receivable	**598,859**	–
Deferred tax assets	**–**	2,263,630
Total current assets	**59,992,724**	68,084,540
Property, plant, and equipment, net	**29,757,022**	21,173,234
Indentifiable intangible assets, net	**1,183,488**	1,544,193
Goodwill	**2,737,791**	2,737,791
Deferred tax assets	**–**	378,822
Other non-current assets	**322,408**	320,258
Total assets	$ **93,993,433**	$ 94,238,838

	June 30 2010	June 30 2009
Liabilities and stockholders' equity		
Current liabilities:		
Note payable – line of credit	$ 12,800,000	$ 5,941,096
Current portion of long-term debt and capital lease obligations	7,353,127	2,934,563
Accounts payable	9,735,739	11,077,880
Accrued liabilities	11,459,312	10,310,630
Billings in excess of costs	5,324,086	10,204,314
Provision for contract losses	1,283,990	1,619,394
Derivative financial instruments	167,633	–
Income taxes payable	–	1,567,608
Total current liabilities	48,123,887	43,655,485
Long-term debt and capital lease obligations	5,472,769	9,374,851
Derivative financial instruments	–	201,438
Deferred tax liability	346,387	–
Total liabilities	53,943,043	53,231,774
Series A redeemable convertible preferred stock, par value $.001; 5,000,000 shares authorized; 1,184,328 issued and outstanding	24,285,989	22,373,325
Series A-1 redeemable convertible preferred stock, par value $.001; 112,741 shares authorized; 112,741 issued and outstanding	3,164,961	–
Commitments and contingencies (*Notes 6, 7, 9, and 14*)		
Stockholders' equity:		
Common stock, par value $.01; 12,000,000 shares authorized; 6,796,045 and 6,781,291 issued and 6,684,319 and 6,705,899 outstanding at June 30, 2010 and 2009, respectively	67,960	67,813
Additional paid-in capital	7,584,174	6,712,002
Retained earnings	6,344,542	12,646,541
	13,996,676	19,426,356
Less treasury stock (111,726 and 75,392 shares at June 30, 2010 and 2009, respectively)	1,397,236	792,617
Total stockholders' equity	12,599,440	18,633,739
Total liabilities and stockholders' equity	$ 93,993,433	$ 94,238,838

See accompanying notes.

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For Discussion Only

Sensis Corporation

Consolidated Statements of Operations

	Year Ended June 30	
	2010	**2009**
	(52 Weeks)	
Revenue	**$ 172,581,011**	$ 157,823,663
Contract direct costs	**102,565,203**	91,075,629
Gross margin	**70,015,808**	66,748,034
Operating expenses	**37,364,746**	34,528,598
General and administrative expenses	**12,210,845**	10,560,267
Research development	**9,875,377**	4,987,316
Business development	**5,734,372**	6,684,414
Total operating expenses	**65,185,340**	56,760,595
Income from operations	**4,830,468**	9,987,439
Interest expense, net	**1,893,614**	1,991,029
Other expense	**854,145**	2,762,130
Income before taxes	**2,082,709**	5,234,280
Income tax expense (benefit)		
Current	**303,190**	2,191,098
Deferred	**3,003,893**	(328,809)
Total tax expense, net	**3,307,083**	1,862,289
Net loss	**$ (1,224,374)**	$ 3,371,991

See accompanying notes.

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Sensis Corporation

Consolidated Statements of Stockholders' Equity

	Treasury Stock		Common Stock		Additional Paid-in	Retained	
	Shares	Amount	Shares	Amount	Capital	Earnings	Total
Balance at June 30, 2008	48,522	$ (466,363)	6,660,638	$ 66,607	$ 5,604,709	$13,095,811	$ 18,300,764
Exercise of stock options at $.85 to $3.25 per share	–	–	111,807	1,118	307,807	–	308,925
Stock option expense	–	–	–	–	286,733	–	286,733
Warrant expense	–	–	–	–	58,208	–	58,208
Stock awards	–	–	8,846	88	106,065	–	106,153
Tax benefit for stock compensation	–	–	–	–	348,480	–	348,480
Net income	–	–	–	–	–	3,371,991	3,371,991
Accrued dividends	–	–	–	–	–	(1,321,261)	(1,321,261)
Accretion of redeemable preferred stock	–	–	–	–	–	(2,500,000)	(2,500,000)
Purchase of Company stock	26,870	(326,254)	–	–	–	–	(326,254)
Balance at June 30, 2009	75,392	(792,617)	6,781,291	67,813	6,712,002	12,646,541	18,633,739
Exercise of stock options at $3.00 to $3.25 per share	–	–	**13,608**	**136**	**43,590**	–	**43,726**
Exercise of warrants at $10 per share	–	–	**500**	**5**	**4,995**	–	**5,000**
Stock option expense	–	–	–	–	**309,224**	–	**309,224**
Warrant expense	–	–	–	–	**3,548**	–	**3,548**
Stock awards	–	–	**646**	**6**	**10,007**	–	**10,013**
Tax benefit for stock compensation	–	–	–	–	**39,905**	–	**39,905**
Net loss	–	–	–	–	–	**(1,224,374)**	**(1,224,374)**
Accrued dividends	–	–	–	–	–	**(1,432,889)**	**(1,432,889)**
Accretion of redeemable preferred stock	–	–	–	–	–	**(3,644,736)**	**(3,644,736)**
Surrender of Sensis stock (*Note 10 and 14*), net of tax expense of $75,03(	**31,996**	**(535,933)**	–	–	**460,903**	–	**(75,030)**
Purchase of Company stock	**4,338**	**(68,686)**	–	–	–	–	**(68,686)**
Balance at June 30, 2010	**111,726**	**$ (1,397,236)**	**6,796,045**	**$ 67,960**	**$ 7,584,174**	**$ 6,344,542**	**$ 12,599,440**

See accompanying notes.

PRELIMINARY AND TENTATIVE FOR DISCUSSION ONLY

Draft
For Discussion Only

Sensis Corporation

Consolidated Statements of Cash Flows

	Year Ended June 30	
	2010	2009
	(52 Weeks)	
Operating activities		
Net (loss) Income	$ (1,224,374)	$ 3,371,991
Adjustments to reconcile net (loss) income to net cash provided by operating activities:		
Stock awards	10,013	106,153
Compensation expense for stock options and warrants	312,772	344,941
Depreciation and amortization	4,494,702	4,312,027
Loss on asset disposal	(10,694)	162,119
Provision for bad debt	10,973	–
Provision for inventory obsolescence	332,070	(1,192)
Tax expense for surrender of Sensis stock	(75,030)	–
Deferred income taxes	3,003,893	(328,809)
Unrealized loss on derivative instrument	78,034	201,438
Changes in operating assets and liabilities:		
Inventory	204,541	1,402,547
Accounts receivable	6,387,153	(14,081,586)
Unbilled receivables	(188,037)	(850,922)
Prepaid expenses and other assets	(820,992)	(570,221)
Income taxes payable	(1,582,662)	1,384,226
Accounts payable and accrued liabilities	(272,142)	3,527,254
Billings in excess of costs	(4,880,228)	5,417,995
Provision for contract losses	(335,404)	350,889
Net cash provided by operating activities	5,444,588	4,748,850
Investing activities		
Purchase of plant and equipment	(12,607,822)	(6,204,196)
Net cash used in investing activities	(12,607,822)	(6,204,196)
Financing activities		
Payments on borrowings for Seagull Technology purchase	–	(1,575,000)
Borrowings from note payable – line of credit, net	6,858,904	1,772,553
Borrowings from loans/notes payable	3,445,552	5,000,000
Payments on loans/notes payable	(3,061,495)	(2,122,614)
Earnout payment for purchase of Seagull Technology	–	(187,933)
Proceeds from the exercise of options	25,980	55,665
Tax benefit for exercise of stock options	39,905	348,480
Payments on purchase of treasury stock	(45,940)	(72,994)
Net cash provided by financing activities	7,262,906	3,218,157
Increase in cash and cash equivalents	99,672	1,762,811
Cash and cash equivalents at beginning of year	1,762,811	–
Cash and cash equivalents at end of year	$ 1,862,483	$ 1,762,811
Supplemental cash disclosures		
Income taxes paid, net	$ 3,047,520	$ 452,908
Interest paid	$ 2,114,846	$ 1,996,543

See accompanying notes.

Sensis Corporation

Notes to Consolidated Financial Statements

June 30, 2010 and 2009

1. Significant Accounting Policies

Nature of Operations

Sensis Corporation (the Company) is a global provider of sensors, information processing and simulation and modeling services that advance human security and safety. The Company has technology deployed in more than 35 countries across six continents, offering innovative solutions for defense and security systems, air traffic control, airline and airport operations management, and data integration and distribution. Sensis Corporation is comprised of three primary business areas:

Defense & Security Systems (D&SS)

Defense & Security Systems provides protection, safety, and security to the world's defense organizations through radar subsystems and upgrades, ground-based radar, and performance optimization tools.

Air Traffic Systems (ATS)

Air Traffic Systems provides surveillance, automation, and information technology for the aviation industry to ensure the safety of airline passengers worldwide. These solutions provide not only enhanced safety, but assist with delay and environmental challenges many airlines and airports face today.

Advanced Development (AD)

Advanced Development, which began in fiscal 2008 as Strategy & Development (S&D) and was renamed in fiscal 2009, is responsible for maximizing the long-term value and profitable growth of the Company's key assets by building upon current strategies and business plans to expand existing and explore future business opportunities. In addition to providing modeling, simulation and analysis capabilities, AD guides major corporate investments in research and development, intellectual property, acquisitions, strategic partnerships, and new ventures. Prospective business ventures are evaluated within this group.

1. Significant Accounting Policies (continued)

Going Concern Uncertainty

As of June 30, 2010, the Company had cash and cash equivalents of approximately $1,862,000 and total debt outstanding of approximately $25,626,000 (consisting of $12,800,000 in a line of credit, and approximately $12,826,000 in term loans and capital lease obligations). The Company also has the ability to borrow additional funds on its line of credit, subject to asset borrowing base restrictions and a restriction on total line of credit borrowings of $17,000,000. As of June 30, 2010, total available collateral in excess of borrowings was approximately $4,447,000. However, the restriction on total line of credit borrowings limited the amount the Company could borrow to approximately $3,129,000 at June 30, 2010.

An event of default occurred under the terms of the Company's three credit facilities, specifically related to the calculation of the ratio of total funded debt plus letters of credit to EBITDA, as of June 30, 2010. This covenant violation constituted events of default under the Company's debt agreement, causing all of the Company's obligations with the lender to become immediately due and payable under this agreement. The Company continued to be in default of certain debt covenants throughout fiscal year 2011. Also, the Company has incurred significant operating losses in the period subsequent to June 30, 2010.

In December 2010, the Company and its lenders entered into a forbearance agreement, under which the lenders agreed to forbear from taking any Enforcement Action, including any action to collect on the Company's indebtedness, against the Company. The original forbearance agreement was subsequently amended and extended under a second and a third forbearance agreement (collectively, the forbearance agreements). The second and third forbearance agreements extended the forbearance period through April 15, 2011 and through June 30, 2011, respectively. Under the terms of the third forbearance agreement, dated April 13, 2011, $11,000,000 of the line of credit balance was converted to a term loan bearing interest at the LIBOR rate plus a rate ranging from 3.25% to 4.75%, and maturing on July 27, 2011, and the Line of Credit Facility commitment was reduced from $17,000,000 to $14,000,000, to allow the Company to continue to borrow under the Line of Credit Facility.

This event of default and the related lack of long-term financing in conjunction with the losses incurred subsequent to June 30, 2010 creates uncertainty relating to the Company's ability to continue as a going concern. The financial statements do not include any adjustments to reflect the possible future effects on the recoverability and classification of assets or the amounts and classification of liabilities that may result from the outcome of this uncertainty.

1. Significant Accounting Policies (continued)

Our condensed consolidated financial statements have been prepared on a going-concern basis, which contemplates continuity of operations, realization of assets and liquidation of liabilities in the ordinary course of business. However, as a result of our default, such realization of assets and liquidation of liabilities are subject to uncertainty.

Subsequent to June 30, 2010, management entered negotiations with a number of parties regarding a possible sale of the Company. The Company has entered into an Exclusivity Period with a potential buyer. The Company expects that it will complete the sale of a 100% interest in the Company on or about June 30, 2011.

Consolidation

The consolidated financial statements include the accounts of the Company and its controlled subsidiaries. All significant intercompany transactions have been eliminated in consolidation.

Fiscal Year

The Company uses a 52 – 53 week fiscal year ending on the Sunday closest to June 30. All references herein to fiscal year June 30, 2010 and June 30, 2009 are as of June 27, 2010 and June 28, 2009, respectively. There were 52 weeks in fiscal years 2010 and 2009.

Use of Estimates

The preparation of financial statements in conformity with accounting principles generally accepted in the United States of America requires management to make estimates and assumptions that affect the reported amounts of assets and liabilities and disclosures of contingent assets and liabilities at the date of the financial statements and the reported amounts of revenues and expenses during the reporting periods. Due to the size and nature of some of our programs, the estimate of total revenues and the cost at completion are subject to a number of variables, including assumptions for the schedule and technical issues. Actual results could differ from those estimates.

1. Significant Accounting Policies (continued)

Cash and Cash Equivalents

The Company considers all highly liquid investments with a maturity of three months or less when purchased to be cash equivalents. The Company maintains no cash accounts with a balance in excess of the Federal Deposit Insurance Corporation (FDIC) limits. The carrying value of cash and cash equivalents approximates fair value because of the relatively short-term maturities of these instruments.

Accounts Receivable

Accounts receivable are shown net of allowances for doubtful accounts of $10,000 at June 30, 2010 and 2009. Trade credit is extended based on an evaluation of each customer's ability to perform its obligations. The Company performs periodic credit evaluations of the financial condition of its customers and extends credit based on the customer's financial condition. Occasionally, a customer may require a letter of credit guarantee by the Company for international projects. The Company considers trade accounts receivable to be past due when in excess of 30 days past terms and charges off uncollectible balances when all collection efforts have been exhausted.

Inventory

Inventory is stated at the lower of cost or market. The Company determines cost using the weighted-average cost method and costs are removed from inventory at weighted-average cost. In addition, the Company maintains spare parts in order to repair certain program products. The Company uses certain estimates and judgments and considers several factors including product demand and usage to provide for excess and obsolescence reserves to properly value inventory.

Fair Value of Financial Instruments

As of June 30, 2010 and 2009, the Company used the following methods and assumptions in estimating its fair value disclosure for financial instruments:

- Cash, accounts receivable and accounts payable: Due to the short term nature of these financial balances, the fair value approximates carrying value.

- Long-term debt, including line of credit: The Company has recently entered into forbearance agreements and all debt, with the exception of capital leases, has been

classified as current. Therefore, due to the short term nature of the debt the fair value approximates the carrying value.

1. Significant Accounting Policies (continued)

Fair Value Disclosures

The Company values financial instruments using a consistent definition of fair value that focuses on exit price and prioritizes, within a measurement of fair value, the use of market-based inputs over company-specific inputs. The Company's fair value measurement utilizes a three-level hierarchy based on the observable inputs to the valuation of an asset or liability at the measurement date. The three levels of inputs are defined as follows:

Level 1 – unadjusted quoted prices for identical assets or liabilities in active markets;

Level 2 – inputs are observable in the marketplace other than those inputs classified as Level 1; and

Level 3 – inputs that are unobservable in the marketplace and significant to the valuation.

The Company maximizes the use of observable inputs and minimizes the use of unobservable inputs. If a financial instrument valuation uses inputs that fall in different levels of the hierarchy, the instrument will be categorized based upon the lowest level of input that is significant to the fair value calculation. The Company's financial instruments measured at fair value on a recurring basis are derivative financial instruments. The Company holds an interest rate swap agreement designed to fix the interest rate on a portion of its variable-rate debt (see Note 6), and multiple foreign currency forward contracts designed to fix the exchange rate on its foreign currency-denominated letters of credit. Both types of financial instruments are valued by utilizing the three-level hierarchy, utilizing the Level 2 inputs. As of June 30, 2010 and 2009, the fair value of the interest rate swap instrument was a liability of $166,277 and $201,438, respectively. As of June 30, 2010, the fair value of the foreign currency forward contracts was a liability of $113,195.

1. Significant Accounting Policies (continued)

Property, Plant, and Equipment

Property, plant, and equipment, which includes capital lease assets, are recorded at cost or the present value of the future minimum lease payments and includes expenditures for new equipment and items which substantially increase the useful lives of existing equipment. At the time property and equipment are replaced, retired, or otherwise disposed of, the cost and related accumulated depreciation are eliminated from the respective accounts and any gains or losses are recognized in the consolidated statement of operations. Property, plant, and equipment are depreciated using straight-line or accelerated methods over their estimated useful lives, which range from 3 to 7 years for computers, equipment and software, 3 to 10 years for leasehold improvements and 35 years for buildings. Amortization of capital leases is included with depreciation and amortization expense. Expenditures for maintenance, repairs, and minor improvements are expensed when incurred.

Goodwill and Intangible Assets

Goodwill represents the excess purchase price over the fair value of assets acquired. Goodwill is not subject to amortization, while all other identifiable intangibles are amortized over their estimated useful lives. The Company reviews goodwill for impairment whenever events or changes in circumstances indicate the carrying amount of these assets may not be recoverable and annually each June. The initial value assigned to acquired intangible assets was determined based on estimates and judgments regarding expectations for the success and life cycle of products and technology acquired.

Goodwill is reviewed for impairment using a two-step process. The first step is to identify any potential impairment by comparing the carrying value of the reporting unit to its fair value. If the carrying value of a reporting unit exceeds its fair value, the second step is to compare the implied fair value of goodwill with its carrying amount to measure the impairment loss. A decline in fair value could result in an impairment charge to goodwill. There were no impairment charges recorded in fiscal year 2010 and 2009.

1. Significant Accounting Policies (continued)

Impairment of Long-Lived Assets

The Company reviews its long-lived assets with finite useful lives for impairment whenever events or changes in circumstances indicate that the carrying amount of an asset may not be recoverable. If such events or changes in circumstances are present, a comparison is made of the carrying value of the asset to the estimated undiscounted future cash flows expected to be generated by the asset. If the carrying amount of the asset exceeds its estimated undiscounted future cash flows, an impairment charge is recognized for the amount, if any, by which the carrying amount of the asset exceeds its fair value. No impairment charges were recorded in fiscal 2010 or 2009.

Warranties

The services and products the Company provides in connection with its contracts are sold with a one-year warranty for defects in material and workmanship. The Company establishes an accrual for estimated warranty costs at the time revenue is recognized on the contract. This estimate is based on projected product reliability using historical performance data.

The changes in the product warranty liability, included in accrued liabilities, for the fiscal years ended are summarized as follows:

	2010	2009
Beginning balance	$ 976,779	$ 766,481
Accruals for warranties issued during the year	1,055,959	873,423
Settlements made during the year	(1,061,884)	(663,125)
Ending balance	$ 970,854	$ 976,779

Derivative Instruments

The Company recognizes all derivative instruments as either assets or liabilities in the balance sheet at their respective fair values. For derivatives designated as hedging relationships, changes in the fair value are either recorded through earnings or recognized in accumulated other comprehensive income until the hedged item is recognized in earnings.

1. Significant Accounting Policies (continued)

The Company has entered into derivative instrument contracts, consisting of forward foreign exchange and interest rate swap contracts, to manage its exposure to foreign currency and interest rate volatility. The forward foreign exchange contracts manage the Company's exposure to project revenues settled in foreign currencies. The interest rate swap mitigates the cash flow effects of interest rate fluctuations on interest expense for variable-rate debt instruments.

The Company has not applied hedge accounting to its forward foreign exchange contracts and there were unexpired contracts at June 30, 2010, with a cumulative notional amount of $9,436,000 and a fair value of $113,195 that are recorded in current and long-term liabilities within the consolidated balance sheets. There were no unexpired contracts at June 30, 2009. During fiscal years 2010 and 2009, the Company recognized losses of approximately $256,000 and $726,000, respectively, within other expense in the consolidated statements of operations.

The Company has not applied hedge accounting to its interest rate swap contract and has recorded unrealized net losses of $166,277 and $201,438 on the interest rate swap in other expense within the consolidated statements of operations for fiscal years 2010 and 2009, respectively. The Company has recorded a corresponding liability in current liabilities totaling $166,277 at June 30, 2010 and a corresponding liability in long-term liabilities totaling $201,438 at June 30, 2009 within the consolidated balance sheets.

Revenue and Cost Recognition

The Company derives the majority of its revenue from long-term contracts for design, development, and production activities, which are accounted for consistent with accounting principles generally accepted in the United States of America (GAAP) for the performance of construction-type and production-type contracts and federal government contractors. The Company also enters into contracts to provide other services that are not associated with design, development, or production activities. The Company accounts for those contracts in accordance with other relevant revenue recognition accounting literature. The Company considers the nature of these contracts and the types of products and services provided when determining the proper accounting method for a particular contract. Contracts that include more than one type of product or service are accounted for under the relevant guidance for revenue arrangements with multiple elements. Accordingly, for applicable arrangements, revenue recognition includes the proper identification of separate units of accounting and the allocation of revenue across all elements based on relative fair values. The Company combines contracts when they are so closely related

1. Significant Accounting Policies (continued)

that they are, in effect, parts of a single project with an overall profit margin. The Company segments contracts, or groups of contracts, when they include separately negotiated and performed phases.

Revenues from certain contracts are recognized based upon the percentage of completion method of accounting. Anticipated losses on specific contracts in process are recorded in full when estimates of total costs to be incurred on a contract exceed estimates of total revenue to be earned, and a liability for the losses is included in the provision for contract losses. Contract costs, including indirect expenses, are subject to audit and adjustment through negotiations between the Company and government representatives. Contract direct costs include all direct material, direct labor and taxes, fringe benefits including but not limited to health insurance and paid time off, facility costs, other direct costs, and those indirect costs related to contract performance, such as indirect labor, supplies, tools, repairs, and depreciation costs. Selling, general, and administrative costs are charged to expense as incurred. Changes in job performance, job conditions, and estimated profitability, including those arising from contract penalty provisions, and final contract settlements may result in revisions to costs and income and are recognized in the period in which the revisions are determined using the cumulative catch-up method of accounting. This method recognizes in the current period the cumulative effect of the changes on current and prior periods. A significant change in an estimate on one or more contracts could have a material effect on the consolidated financial position or results of operations. Profit incentives are included in revenues when their realization is reasonably assured. Claims are included in contract costs when probable and the amount can be reliably estimated. Contract revenues have been recorded in amounts that are expected to be realized on final settlement.

Revenues from sales of products are recorded as the products are shipped or upon customer acceptance of title, provided that no significant vendor and post-contract support obligations remain and the collection of the related receivable is probable. Shipping and handling costs are included in contract direct costs within the consolidated statement of operations.

Percentage-of-Completion Accounting – The Company generally recognizes revenues from long-term contracts under the cost-to-cost or the units-of-delivery measures of the percentage-of-completion method of accounting. The percentage-of-completion method recognizes income as work on a contract progresses. For most contracts, revenue is calculated based on the percentage of total costs incurred in relation to total estimated costs at completion of the contract. The units-of-delivery measure is a modification of the percentage-of-completion method, which recognizes

1. Significant Accounting Policies (continued)

revenues as deliveries are made to the customer generally using unit sales values in accordance with the contract terms. The Company estimates profit as the difference between total estimated revenue and total estimated cost of a contract and recognize that profit over the life of the contract based on deliveries. The use of the percentage-of-completion method depends on the ability to make reasonably dependable cost estimates for the design, manufacture, and delivery of the Company's products and services. Such costs are typically incurred over a period of time, and estimation of these costs requires the use of judgment. Revenue is recognized under cost-type contracts as costs are incurred.

Cost Estimation – The cost estimation process requires significant judgment and is based upon the professional knowledge and experience of the Company's engineers, program managers, and financial professionals. Factors that are considered in estimating the work to be completed and ultimate contract recovery include the availability, productivity, and cost of labor, the nature and complexity of the work to be performed, the effect of change orders, the availability of materials, the effect of any delays in performance, the availability and timing of funding from the customer, and the recoverability of any claims included in the estimates to complete. A significant change in an estimate on one or more contracts could have a material effect on the consolidated financial position or results of operations. The Company updates the contract cost estimates at least annually and more frequently as determined by events or circumstances. The Company generally reviews and reassesses the cost and revenue estimates for each significant contract on a monthly basis. No material portion of the Company's business is considered to be seasonal. Revenue recognition timing is based on several factors, including the timing of contract awards, the incurrence of contract costs, cost estimation, and unit deliveries.

The asset, "unbilled receivables on contracts," represents revenues recognized in excess of amounts billed and is stated at estimated realizable value. The liability, "billings in excess of costs," represents billings in excess of revenues recognized.

1. Significant Accounting Policies (continued)

Price Redetermination

As a Government contractor, the Company is subject to price redetermination on certain fixed-price contracts if it is determined that the price of the Company's products and services are not consistent with the requirements of the U.S. Federal Acquisition Regulations. The Company did not incur any material price redeterminations on any of its contracts during fiscal years 2010 and 2009.

Precontract Costs

Costs incurred for a specific anticipated contract and that will result in no future benefits unless the contract is obtained are excluded from contract costs prior to the receipt of the contract. Such costs may be deferred if they can be directly associated with a specific anticipated contract and their recoverability from that contract is probable. Costs incurred for assets expected to be used in connection with anticipated contracts are deferred if their recoverability from future contract revenue or from other dispositions of the asset are probable. Costs deferred in anticipation of a contract are included in contract direct costs upon receipt of the anticipated contract. The Company had no capitalized precontract costs at June 30, 2010 and 2009.

Income Taxes

Provisions for income taxes are based on taxes payable or refundable for the current year and deferred taxes on temporary differences between the amount of taxable income and pretax financial income and between the tax basis of assets and liabilities and their reported amounts in the consolidated financial statements. Deferred tax assets and liabilities are included in the consolidated financial statements at currently enacted income tax rates applicable to the period in which the deferred tax assets and liabilities are expected to be realized or settled. As changes in tax laws or rates are enacted, deferred tax assets and liabilities are adjusted through the provision for income taxes.

The Company periodically assesses its tax filing exposures related to periods that are open to examination, both domestic and foreign. Based on the latest available information, the Company evaluates tax positions to determine whether the position will more-likely-than-not be sustained upon examination by the Internal Revenue Service (IRS) or similar state and foreign agencies. If the Company determines that the tax position is more-likely-than-not to be sustained, the Company will record the largest amount of benefit that is more-likely-than-not to be realized when the tax position is settled. If the Company cannot reach that determination, then no benefit

is recorded. The Company records interest and penalties related to income taxes as a component of income tax expense in its consolidated financial statements.

1. Significant Accounting Policies (continued)

A reconciliation of the beginning and ending amount of unrecognized tax benefits is as follows:

	2010	2009
Balance at July 1	$ 314,521	$ 300,894
Additions based on tax positions related to the year ended June 30	171,694	13,627
Reductions for tax position of prior years	(144,818)	–
Balance at June 30	$ 341,397	$ 314,521

At June 30, 2010 and 2009, $341,397 and $314,521, respectively, (net of the federal benefit on state issues) represents the amount of unrecognized tax benefits that, if recognized, would favorably affect the effective tax rate in future periods, respectively. The Company classifies interest expense and penalties related to unrecognized tax benefits as a component of income tax expense. As of June 30, 2010 and 2009, the Company has not accrued any penalties related to its uncertain tax position as it believes that it is more-likely-than-not that there will not be any assessment of penalties. The total amount of gross accrued interest resulting from such unrecognized tax benefits was $95,417 and $62,044 at June 30, 2010 and 2009, of which $33,373 and $20,647 was recognized in fiscal years 2010 and 2009, respectively.

The Company files federal income tax returns and multiple state and foreign jurisdiction tax returns. The Company's federal income tax returns have been examined by the IRS through the year ended June 30, 2009. The Company's state income tax returns for fiscal years 2007 through 2010 are open to examination due to the statute of limitations. The Company's Australian and Dutch tax returns for fiscal years 2008 through 2010 are open to examination.

Foreign Currency

Gains and losses resulting from foreign currency denominated transactions are included within other expense in the consolidated statements of operations. The Company recognized transaction losses of approximately $(124,000) and $(1,711,000) during fiscal years ended 2010 and 2009, respectively.

1. Significant Accounting Policies (continued)

Research and Development

Research and development costs are expensed as incurred, as non-contract costs, up to the point where a contract has been obtained for the related developments or technology. Subsequent to obtaining a contract related to specific research and development efforts, those costs are charged as direct contract costs on the consolidated statements of operations.

Stock-Based Compensation

For the fiscal years ended June 30, 2010 and 2009, the Company recorded non-cash compensation cost related to stock options and warrants of $312,772 and $344,941, respectively, which is included in the consolidated statements of operations in general and administrative expenses. The compensation costs not yet recognized on the outstanding stock options as of June 30, 2010, is $87,557, which will be amortized over a weighted-average term of 2.3 years.

To account for the tax effects of stock-based compensation, the Company is performs a calculation to establish the beginning pool of excess tax benefits, or additional paid-in capital pool, available to absorb any tax deficiencies recognized after its adoption. Tax deficiencies arise when the actual tax benefit for the tax deduction for share-based compensation at the statutory tax rate is less than the related deferred tax asset recognized in the consolidated financial statements.

Prior Year Presentation

Certain prior year amounts have been reclassified to conform to current year presentations. This includes a reclassification between contract direct costs and other expenses on the consolidated statement of operations.

1. Significant Accounting Policies (continued)

Recent Accounting Pronouncements

In October 2009, the Financial Accounting Standards Board (FASB) issued Accounting Standards Update 2009-13, *Revenue Recognition (Topic 605): Multiple-Deliverable Revenue Arrangements* (ASU 2009-13). The guidance relates to the determination of when the individual deliverables included in a multiple-element arrangement may be treated as separate units of accounting and modifies the manner in which the transaction consideration is allocated across the individual deliverables, thereby affecting the timing of revenue recognition in certain situations. Also, the guidance expands the disclosure requirements for revenue arrangements with multiple deliverables. ASU 2009-13 is effective for fiscal years beginning after June 15, 2010, or the beginning of fiscal year 2011, and may be applied retrospectively for all periods presented or prospectively to arrangements entered into or materially modified after the adoption date. Early adoption is permitted provided that the guidance is retroactively applied to the beginning of the year of adoption. The Company is currently evaluating the potential effect, if any, the adoption will have on its consolidated financial statements in future periods.

In October 2009, the FASB issued ASU 2009-14, *Software (Topic 985): Certain Revenue Arrangements That Include Software Elements*. ASU 2009-14 changes the accounting for revenue arrangements that include both tangible products and software elements. Tangible products containing software components and non-software components that function together to deliver the tangible product's essential functionality are no longer within the scope of the software revenue guidance. ASU 2009-14 requires that any hardware components of such arrangements be excluded from software revenue guidance and that any essential software that is sold with or embedded within the product also be excluded from software revenue guidance. This ASU is effective for fiscal years beginning after June 15, 2010, or the beginning of fiscal year 2011, and may be early adopted, but must be adopted in the same period and with the same implementation method as ASU 2009-13. The Company is currently evaluating the potential effect, if any, the adoption will have on its consolidated financial statements in future periods.

2. Contract Billing Status

Components of accounts receivable under contracts are presented in the consolidated balance sheets at June 30 as follows:

	2010	2009
Billed receivables	$ 23,968,030	$ 30,366,156
Unbilled receivables	25,131,365	24,943,328
Less reserves	(10,000)	(10,000)
	$ 49,089,395	$ 55,299,484

Billings in excess of costs and unbilled receivables are presented in the consolidated balance sheets at June 30 as follows:

	2010	2009
Unbilled receivable	$ 25,131,365	$ 24,943,328
Less billings in excess of costs	(5,324,086)	(10,204,314)
Unbilled receivables, net	$ 19,807,279	$ 14,739,014

Costs and estimated earnings on uncompleted contracts at June 30 are as follows:

	2010	2009
Costs incurred on uncompleted contracts	$ 843,194,988	$ 688,137,294
Estimated earnings	109,016,468	91,589,579
	952,211,456	779,726,873
Less billings to date	(932,404,177)	(764,987,859)
Unbilled receivables, net	$ 19,807,279	$ 14,739,014

3. Inventory

The components of inventory, net of related reserves, consist of the following at June 30:

	2010	2009
Work-in-process	$ 158,048	$ 309,479
Purchased parts	6,008,710	6,393,890
Inventory, net	$ 6,166,758	$ 6,703,369

The Company recorded reserves for obsolete inventory of approximately $1,915,000 and $1,566,000 at June 30, 2010 and 2009, respectively.

4. Property, Plant, and Equipment

Property, plant, and equipment at June 30 is summarized as follows:

	2010	2009
Office and text equipment	$ 25,892,880	$ 13,920,391
Aerobahn tracking systems	3,263,763	3,263,762
Computer software	9,155,619	8,295,042
Leased equipment	13,664,156	13,664,156
Leasehold improvements	1,120,677	975,928
Other equipment	277,258	255,269
Building and land	8,856,256	9,061,794
	62,230,609	49,436,342
Less accumulated depreciation	(32,473,587)	(28,263,108)
Property, plant, and equipment	$ 29,757,022	$ 21,173,234

Depreciation expense was approximately $4,123,000 and $3,896,000 and includes approximately $569,000 and $364,000 related to capitalized software in fiscal years 2010 and 2009, respectively.

5. Goodwill and Identifiable Intangibles

Goodwill and identifiable intangible assets consist of the following at June 30:

	2010			2009		
	Gross Carrying Value	Accumulated Amortization	Net Carrying Value	Gross Carrying Value	Accumulated Amortization	Net Carrying Value
Goodwill	$ 2,737,791	$ –	$ 2,737,791	$ 2,737,791	$ –	$ 2,737,791
Identifiable intangible assets:						
Completed technology	1,817,172	(1,548,368)	268,804	1,817,172	(1,384,101)	433,071
Customer relationships	1,964,371	(1,049,687)	914,684	1,964,371	(853,249)	1,111,122
Tradename:	120,000	(120,000)	–	120,000	(120,000)	–
Total identifiable intangible assets	$ 3,901,543	$ (2,718,055)	$ 1,183,488	$ 3,901,543	$ (2,357,350)	$ 1,544,193

Amortization expense was approximately $361,000 and $416,000 in fiscal years 2010 and 2009, respectively. The weighted-average amortization remaining for the identifiable intangible assets of completed technology and customer relationships are 1.8 years and 4.7 years, respectively.

Future amortization of identifiable intangible assets by year is as follows:

Fiscal year ending June 30:	
2011	$ 347,383
2012	314,294
2013	196,437
2014	182,124
2015	143,250
Total amortization of intangibles	$ 1,183,488

6. Debt and Capital Lease Obligations

The components of the Company's debt, financing, and capital lease obligations as of June 30, 2010 and 2009 are as follows:

	2010			2009
	Short-Term	Long-Term	Total	Total
Note payable – line of credit (a)	$ 12,800,000	$ –	$ 12,800,000	$ 5,941,096
Notes payable (a)	6,720,532	–	6,720,532	4,987,054
Capital leases (b)	632,595	606,607	1,239,202	2,471,066
Built to suit – Collamer facility (c)	–	4,866,162	4,866,162	4,851,294
	7,353,127	5,472,769	12,825,896	12,309,414
	$ 20,153,127	$ 5,472,769	$ 25,625,896	$ 18,250,510

Notes payable (a) consists of:

	2010			2009
	Short-Term	Long-Term	Total	Total
Equipment line of credit	$ 3,089,515	$ –	$ 3,089,515	$ –
Capital expenditure term note	3,250,000	–	3,250,000	4,250,000
Third-party software purchase	381,017	–	381,017	737,054
Notes payable (a)	$ 6,720,532	$ –	$ 6,720,532	$ 4,987,054

(a) Debt

The Company has three credit facilities that it utilizes in support of operations. A $17,000,000 Revolving Line of Credit commitment used for working capital and domestic letters of credit, a $25,000,000 Export-Import Bank Line of Credit commitment used for international letters of credit and performance guarantees and working capital, and a $5,000,000 term note payable for capital expenditures. The term note payable matures on September 1, 2013. In March 2010, the Company renewed the Revolving Line of Credit commitment with its commercial bank, which now expires in July 2011. In June 2010, the Company renewed the Export-Import Bank Line of Credit commitment with its commercial bank, which now expires in July 2012. In April 2011, the Revolving Line of Credit commitment was reduced to $14,000,000 (see Note 1). The Company also has a separate note payable related to a purchase of software.

6. Debt and Capital Lease Obligations (continued)

Notes payable – line of credit

The Revolving Line of Credit is subject to a borrowing base calculation that limits available borrowings based upon a calculation of available collateral, consisting primarily of accounts receivable, unbilled receivables on contracts, extended letters of credit, and current borrowings. The Company had approximately $12,800,000 and $5,941,000 of working capital borrowings as of June 30, 2010 and 2009, respectively. Excess collateral under the Revolving Line of Credit was approximately $4,447,000 at June 30, 2010. The Company had approximately $3,130,000 in available borrowings under the Revolving Line of Credit at June 30, 2010. Outstanding borrowings under the line of credit are collateralized principally by all corporate assets. Interest under the line of credit is computed at the LIBOR rate plus a rate ranging from 3.25% to 4.75%, with the applicable rate set at a predetermined schedule based on the ratio of funded debt to EBITDA. The interest rate was 3.85% and 3.57% as of June 30, 2010 and 2009. The Company is subject to annual renewal fees and a monthly unused Revolving Line of Credit commitment fee.

The Export-Import Bank Line of Credit is subject to a borrowing base calculation that limits available borrowings based upon formulaic calculations related to accounts receivable, unbilled accounts receivable balances, and extended letters of credit. The Company had approximately $13,892,000 and $20,231,000 of standby letters of credit issued as of June 30, 2010 and 2009, respectively. Total available letter of credit borrowings at June 30, 2010 under the Export-Import Bank Line of Credit, after the borrowing base calculation, were approximately $6,769,000. The Company pays an annual guaranty fee equal to 1.5% of the existing Line of Credit commitment on the anniversary date of the agreement, as well as a Letter of Credit Fee equal to 2.75% of the maximum amount available under each letter of credit.

Notes payable

During fiscal year 2010, the Company's Revolving Line of Credit facility was amended to establish a non-revolving Equipment Line of Credit, under which the Company is able to borrow up to an additional $4,000,000 through January 11, 2011 to fund the purchase of equipment. On January 11, 2011, any outstanding borrowings will be converted to a term note maturing on January 11, 2015. Interest on the non-revolving Equipment Line of Credit is the same as the Revolving Line of Credit. The Company had approximately $3,090,000 outstanding on the Equipment Line of Credit at June 30, 2010. Subsequent to June 30, 2010, the Company entered into a forbearance arrangement with the lender. Additionally, the Company anticipates it will pay off the Revolving Line of Credit facility upon executing the sale of the Company (see Note 1).

6. Debt and Capital Lease Obligations (continued)

The Company also has a $5,000,000 term note payable for capital expenditures. The Company has approximately $3,250,000 and $4,250,000 outstanding on the term note payable at June 30, 2010 and 2009, respectively. The Company pays $83,333 per month plus variable rate interest of LIBOR plus a rate ranging from 3.25% to 4.75%, with the applicable rate set at a predetermined schedule based on the ratio of funded debt to EBITDA. The interest rate was 3.85% and 3.57% as of June 30, 2010 and 2009, respectively. Subsequent to June 30, 2010, the Company entered into a forbearance arrangement with the lender. Additionally, the Company anticipates it will pay off the term note payable upon executing the sale of the Company (see Note 1).

In August 2008, the Company entered into an interest rate swap agreement associated with the above term note payable to manage its exposure of market risk from changes in interest rates by locking in a fixed rate of 3.92% for the entire term of the loan and minimize significant unplanned fluctuations in earnings and cash flows caused by interest rate volatility. The interest rate swap has a notional amount of $5,000,000, a fair value of approximately $166,000 as of June 30, 2010, and expires in August 2013. The Company has described the accounting treatment of the interest rate swap agreement in Note 1. Subsequent to June 30, 2010, the Company entered into a forbearance arrangement with the lender (see Note 1).

The Company entered into a separate note payable agreement with a third party related to a software purchase during fiscal year 2009. The amount outstanding as of June 30, 2010 and 2009 was approximately $381,000 and $737,000, respectively. The Company is required to make quarterly payments of $99,360 through June 2011. The interest rate is fixed at 6.84% for the life of the note payable. There are no covenants associated with the note payable.

The Revolving Line of Credit, Export-Import Bank Line of Credit, and Term Note Payable agreements provide that the Company must meet certain financial ratio covenants relating to total funded debt, fixed charge coverage, tangible net worth, and certain capital expenditure limits. The Company was in violation of its financial covenant related to the ratio of total funded debt plus letter of credit obligations to EBITDA as of June 30, 2010 (see Note 1). The Company continued to be in default of certain debt covenants throughout fiscal year 2011.

6. Debt and Capital Lease Obligations (continued)

The combined future principal payments of the notes payable are as follows:

Fiscal year ending June 30:

2011	$ 6,720,532
2012	–
2013	–
2014	–
2015	–
Total principal payments	6,720,532
Less current installments	(6,720,532)
Long-term notes payable	$ –

(b) Capital Leases

Capital lease assets, which are included in property, plant, and equipment, are stated at cost, and totaled $15,431,666 and $15,056,883 as of June 30, 2010 and 2009, net of accumulated amortization of $11,750,413 and $11,469,539 as of June 30, 2010 and 2009, respectively. Future minimum lease payments under capital leases consist of the following:

Fiscal year ending June 30:

2011	$ 677,805
2012	475,554
2013	148,065
Net minimum lease payments	1,301,424
Less amount representing interest	62,222
Present value of minimum lease payments	1,239,202
Less current portion of capital lease obligation	632,595
Long-term portion of capital lease obligation	$ 606,607

6. Debt and Capital Lease Obligations (continued)

(c) Built-to-Suit – Collamer Facility

The Company entered into an arrangement to lease a built-to-suit facility. The Company capitalized the cost of construction totaling $8,795,929 as of June 30, 2010 and 2009.

The annual lease payments of the building are $1,349,895 for the first ten years of the lease, and $1,439,888 in years eleven through twenty. The Company has the right to renew the lease term, and assuming the Company would renew the lease for years 21 through 35, the annual payments are as follows: $1,583,820 in years 21 through 25, $1,887,340 in years 26 through 30 and $1,916,760 in years 31 through 35. The future financing payments are as follows:

Fiscal year ending June 30:

2011	$ 1,349,895
2012	1,349,895
2013	1,349,895
2014	1,349,895
2015	1,364,894
Thereafter	41,098,499
Net minimum lease payments	47,862,973
Less amount representing interest	42,996,811
Present value of minimum lease payments	4,866,162
Less current portion of capital lease obligation	–
Long-term portion of capital lease obligation	$ 4,866,162

7. Operating Leases

The Company leases an operating facility and certain office equipment under operating leases which expire at various dates through 2020. Rent expense for operating leases totaled $1,604,370 and $1,537,460 during fiscal years 2010 and 2009, respectively. Future minimum lease payments due under all non-cancelable operating lease commitments greater than one year are as follows:

2011	$ 2,137,056
2012	477,294
2013	214,370
2014	102,609
2015	50,993
Thereafter	308,848
Total	$ 3,291,170

8. Income Taxes

Income tax expense (benefit) consists of the following:

	Current	Deferred	Total
Year ended June 30, 2010:			
Federal	$ 205,805	$ 2,749,189	$ 2,954,994
State	62,107	254,704	316,811
Foreign	35,278	–	35,278
Income tax expense (benefit)	$ 303,190	$ 3,003,893	$ 3,307,083
Year ended June 30, 2009:			
Federal	$ 1,773,019	$ (310,542)	$ 1,462,477
State	161,061	(18,267)	142,794
Foreign	257,018	–	257,018
Income tax expense (benefit)	$ 2,191,098	$ (328,809)	$ 1,862,289

Income tax expense differed from the amounts computed by applying the U.S. federal income tax rate of 34% to pretax income for fiscal years 2010 and 2009 as a result of changes in the valuation allowance, state income taxesnet of federal income tax benefit, and permanent differences offset by research and development tax credits generated, and alternative minimum tax credits generated.

8. Income Taxes (continued)

Deferred tax assets (liabilities) are comprised of the following at June 30:

	2010	2009
Bad debt reserve	$ 3,600	$ 3,600
Allowances for inventory and warranty	1,027,693	910,751
Capitalized inventory	830,004	45,340
Benefit accruals	663,133	565,248
Amortization	125,193	158,003
Accrued loss provision	462,237	459,929
Stock options granted	469,480	356,882
Other accrued liabilities	234,876	395,761
Tax credits and carryovers	1,823,642	291,547
Valuation allowance	(4,126,916)	(194,047)
Gross deferred tax assets	1,512,942	2,993,014
Depreciation	(1,859,329)	(350,562)
Gross deferred tax liabilities	(1,859,329)	(350,562)
Net deferred tax (liabilities) assets	$ (346,387)	$ 2,642,452

The deferred taxes are classified in the June 30 consolidated balance sheets as follows:

	2010	2009
Current deferred taxes, net	$ -	$ 2,263,630
Long-term deferred taxes, net	(346,387)	378,822
Net deferred tax (liabilities) assets	$ (346,287)	$ 2,642,452

8. Income Taxes (continued)

In assessing the realizability of deferred tax assets, management considers whether it is more-likely-than-not that some portion or all of the deferred tax assets will not be realized. The ultimate realization of deferred tax assets is dependent upon the generation of future taxable income and the taxable income in the two previous tax years to which tax loss carryback can be applied. Management considers the scheduled reversal of deferred tax liabilities, projected future taxable income, taxable income in the carryback period and tax planning strategies in making this assessment. Based upon the level of projected future taxable income over the periods in which the deferred tax assets are deductible , a full valuation allowance of $4,126,916 and a partial valuation on state tax credits $194,047 at June 30, 2010 and 2009, respectively, is included in deferred tax assets above. The net deferred tax assets represent a level where management believes it is more-likely-than-not that the Company will realize the benefits of those deductible differences. The increase in valuation allowance in 2010 relates to the Company placing a full valuation allowance on it net deferred tax asset as management is uncertain as to when the benefit will be realized. The amount of the deferred tax asset considered realizable could be increased if estimates of future taxable income during the carryforward period are increased.

9. Preferred Stock

In July 2007, the Company amended and restated its Certificate of Incorporation to authorize the issuance of 5,000,000 shares of Preferred Stock, of which 1,200,000 shares are designated as Series A Preferred Stock with a par value of $0.001. On July 27, 2007, the Company issued 1,184,328 shares of Series A Preferred Stock for $15,000,000. The Company is contractually obligated to issue an additional 13,333 shares based upon the terms in the equity agreement outlined in the section titled, "subsequent share issuance."

On October 14, 2009, the Company modified the terms of the Series A Preferred Stock agreement, which extended the agreement for an additional three years. The agreement introduced 112,741 shares of Series A-1 Preferred Stock in lieu of the dividends due and owing from the Company to the investors through July 23, 2009.

9. Preferred Stock (continued)

The rights, preferences, and privileges relating to the Series A and Series A-1 Preferred Stock are as follows:

Rank

The Series A and A-1 Preferred Stock shall, with respect to the right to receive dividends and distributions of assets and rights upon liquidation, rank (i) senior to any other class or series of preferred Stock issued by the Company and designated as senior to the Series A Preferred Stock, (ii) equal to any other class or series of preferred stock issued by the Company and designated as equal to the Series A and A-1 Preferred Stock, and (iii) prior to any other class or series of preferred stock issued by the Company and designated as junior to the Series A and A-1 Preferred Stock and to the Common Stock.

Dividends

Holders of shares of Series A Preferred Stock and Series A-1 Preferred Stock are entitled to receive dividends at an annual rate of 8%, compounded quarterly, of the issue price, when, as and if declared by the Board of Directors, accruing quarterly. Dividends began accruing on the shares of Series A Preferred Stock on July 27, 2007. Dividends accrued on the Series A Preferred Stock were $2,477,125 at June 30, 2009, $2,579,823 at July 23, 2009 (the date of issuance of the Series A-1 Preferred Stock in lieu of dividends accrued to date, immediately after which the accrued dividends on Series A were $0), and $1,237,996 at June 30, 2010. Dividends began accruing on the shares of Series A-1 Preferred Stock on July 23, 2009. Dividends accrued on the Series A-1 Preferred Stock were $194,893 at June 30, 2010.

Conversion

The Series A and A-1 Preferred Stock is convertible into shares of Class A Common Stock at any time at such holder's option, at a preferred conversion rate of 1 to 1, as defined in the Certificate of Incorporation.

9. Preferred Stock (continued)

Voting Rights

The holders of the Series A and A-1 Preferred Stock have voting rights. The holder of each share of Series A and A-1 Preferred Stock shall be entitled to the number of votes equal to the number of shares of Common Stock into which such shares of Series A and A-1 Preferred Stock could be converted on the record date for the vote or consent of stockholders. While at least 66% of the authorized shares of Series A and A-1 Preferred Stock are outstanding, the Corporation will not, directly or indirectly, without the vote at a meeting or the written consent of the holders of at least 66% of the outstanding shares of Series A and A-1 Preferred Stock, (i) amend, alter, or repeal any of the provisions of the Amended and Restated Certificate of Incorporation, (ii) create any class of stock ranking prior to or on a parity with the Series A and A-1 Preferred Stock, (iii) sell all or substantially all of its assets or merge or consolidate with or into another entity, (iv) redeem, purchase, or otherwise acquire shares of Common Stock, (v) declare or pay any distributions to holders of shares of Common Stock, (vi) authorize any of the Company's subsidiaries to sell, issue, or transfer any class or series of stock to a third party, (vii) authorize or issue additional shares of Series A and A-1 Preferred Stock, and (viii) issue a number of options in excess of the number authorized in the Company's stock incentive plan. While shares of Series A and A-1 Preferred Stock are outstanding, the holders of the Series A and A-1 Preferred Stock shall be entitled to elect one director of the Company at each annual meeting of the stockholders.

Liquidation

In the event of any voluntary or involuntary liquidation, dissolution, or winding-up of the Company, the holders of the Series A and A-1 Preferred Stock then outstanding will be entitled to payment, prior to holders of all other classes of Common Stock, an amount equal to the preferred fixed preference, as defined. Amounts remaining after payment to the holders of Series A and A-1 Preferred Stock, if any, will be distributed ratably to the holders of the Common Stock.

9. Preferred Stock (continued)

Redemption

Under the terms of the Series A and A-1 Preferred Stock Agreement, the Company may be required to redeem the Series A and A-1 Preferred Stock for cash at any time after July 23, 2012 at the Redemption Price per Series A and A-1 Preferred Stock equal to 2.013 and 1.5, respectively, times the Issuance Price of $12.66 for that same share plus any accrued dividends. The Company has determined the Series A and A-1 Preferred Stock include redemption features that have the potential to be outside the control of the Company, and accordingly, has classified the Series A and A-1 Preferred Stock outside of stockholders' equity. The Company accretes the carrying value of the Series A and A-1 Preferred Stock to the redemption value on a straight line basis. The Company has accreted $3,644,737 and $2,500,000 to the stated value of the Series A and A-1 Preferred Stock as of June 30, 2010 and June 30, 2009, respectively.

10. Treasury Shares

During fiscal years 2010 and 2009, the Company purchased for cash 2,980 and 5,826 shares, respectively, of common stock at aggregate prices of approximately $46,000 and $73,000, respectively. These purchases were recorded as treasury stock during the fiscal years 2010 and 2009. Additionally, during fiscal year 2010, the Company received 31,996 shares of its stock in connection with the settlement of litigation it had commenced against the employers of three former Company employees (see Note 14). The Company recorded this non-cash transaction as an increase to both treasury stock and additional paid-in capital in the amount of $535,933, based on the estimated fair value of the shares.

11. Warrants

The Company issued 16,165 warrants in calendar year 2004 that are exercisable at the earlier of 60 months from the issuance date or an initial public offering. The exercise price for the warrants is $10 per share for the Company's common stock. The warrants contain a cashless exercise provision whereby the holder may pay the exercise price associated with any exercise by having the Company withhold a number of shares otherwise issuable upon such exercise having a fair market value equal to the applicable aggregate exercise price. A total of 500 warrants were exercised during fiscal year 2010, leaving 15,665 warrants outstanding as of June 30, 2010.

11. Warrants (continued)

In fiscal year 2009, the unexercised warrants were amended with the exercise date being extended by five years and the termination date being extended seven years, with each holder signing a new warrant agreement. The Company calculated the warrant expense using the Black-Scholes option pricing model in order to derive the grant-date fair value of the warrants as of the new warrant agreement date. The Company recorded $3,548 and $58,208 in fiscal year 2010 and 2009, respectively, within operating expenses and general and administrative expenses in the consolidated statement of operations.

12. Stock Options

The Company has adopted various stock option plans, with the approval of its stockholders, for officers, directors, employees, and consultants of the Company that provide for the award of up to 1,450,000 shares of the Company's common stock. The term of each stock option is fixed by the Board of Directors, but no stock option can be exercised more than ten years after the option is granted. Stock options are generally granted at amounts equal to the fair value of the Company's common stock at the grant date and vest over one to three years. Other pertinent information related to the plan is as follows:

	2010	2009
Number of shares under option		
Beginning of year	**329,700**	482,488
Granted	**41,500**	45,000
Exercised	**(13,608)**	(111,807)
Forfeited	**(14,300)**	(85,981)
End of year	**343,292**	329,700
Options exercisable, end of year	**296,792**	282,200
Weighted-average exercise price per option		
Granted during the year	**$ 16.60**	$ 15.11
Exercised during the year	**3.21**	2.76
Outstanding at end of year	**12.00**	10.31
Weighted-average intrinsic value per option		
Granted during the year	**$ –**	$ –
Exercised during the year	**13.54**	9.68
Outstanding at end of year	**4.75**	5.19
Forfeited during the year	**12.24**	8.65

12. Stock Options (continued)

The aggregate intrinsic value of options exercised during the fiscal years 2010 and 2009 was approximately $184,000 and $1,082,000, respectively. The aggregate intrinsic value of exercisable options was approximately $1,599,000 and $1,569,000, as of June 30, 2010 and 2009, respectively. The aggregate intrinsic value of options outstanding as of June 30, 2010 and 2009 was approximately $1,629,000 and $1,710,000, respectively. The weighted-average grant-date fair value of options granted during fiscal years 2010 and 2009 was $9.61 and $8.41, respectively. The total grant-date fair value of shares vested during fiscal years 2010 and 2009 was approximately $366,000 and $297,000, respectively.

The following summarizes information about stock options outstanding and exercisable at June 30, 2010:

	Outstanding Options			Exercisable Options	
Range of Exercisable Prices	Number Outstanding	Weighted-Average Remaining Contractual Life	Weighted-Average Exercise Price	Number Exercisable	Weighted-Average Exercise Price
$0.01 – $16.75	343,292	6.28 years	$ 12.00	296,792	$ 13.19

The fair value for these options, as disclosed in Note 1, was estimated at the date of grant using a Black-Scholes option pricing model with the following weighted-average assumptions for fiscal years 2010 and 2009; risk-free interest rates of 2.99% and 3.24%, respectively, expected dividend yields of 0%, and expected life of the option of 6.8 years and 6.7 years, respectively. In determining the volatility of the Company's common stock, a market approach was utilized in the current year whereby a reasonably comparable group of publicly traded companies were identified and their common stock's long-term price volatility was utilized as a benchmark. The long-term measure of volatility selected for the Company's common stock was 50% for fiscal years 2010 and 2009.

13. Employee Benefits

The Company sponsors a defined contribution plan that covers substantially all employees. The plan is qualified under Section 401(k) of the Internal Revenue Code (IRC) and provides for employee contributions up to certain IRC limitations. Prior to January 1, 2010, the Company matched 50% of the employee contribution not to exceed 8% of an employee's salary. Subsequent to January 1, 2010, the Company matched 50% of the employee contribution not to exceed 9% of an employee's salary. Company contributions amounted to approximately $2,085,000 and $1,675,000 in fiscal years 2010 and 2009, respectively.

In fiscal year 2010, the Company approved a Long-Term Incentive Compensation Program. Under this plan, on an annual basis, a pool of deferred stock units (DSU) will be created for distribution to eligible employees, as well as shares of restricted stock. Each vested DSU entitles the holder to receive either one share of the Company's common stock, or a cash payment equal to the then-current value of one share of the Company's common stock. Each vested share of restricted stock entitles the holder to receive one share of the Company's common stock. The restricted stock and the deferred stock units both vest at the later of three years from the award date, or six months following an initial public offering of the Company's common stock. At June 30, 2010, the Company had accrued approximately $131,000 related to this plan.

14. Contingencies

The Company is subject to legal proceedings, which arise in the ordinary course of business. These matters are currently in various stages of litigation and the Company intends to defend such claims vigorously. In the opinion of management, the ultimate liability, if any, with respect to these actions will not materially affect the consolidated financial position, consolidated results of operations, or consolidated cash flows of the Company.

In May 2007, the Company initiated legal action against three of its former engineers (defendant employees) and the companies (defendant companies) with whom they are now associated (collectively defendants). The Company asserted claims for trade secret misappropriation, breach of contract, and conversion. In addition to the Company's claim, the defendant employees have initiated a counterclaim against the Company seeking indemnification for legal expenses incurred in the legal action brought against them. The defendant employees' claim that, pursuant to the Company's bylaws and Delaware General Corporation Law, legal expenses incurred to defend the claim brought against them are recoverable under certain provisions of Delaware law that exonerate employees from legal costs they may incur to defend claims that relate to their employment with the Company.

14. Contingencies (continued)

During fiscal year 2008, the Company amended its initial legal action against the defendants to exclude the former defendant employees and continued the action against the defendant companies. The Company established a reserve as of June 30, 2008, in the amount of $937,000 to cover potential legal expenses and fees related to this claim. In August 2009, the Company settled the counterclaim by the defendant employees for approximately $837,000, paid in cash. The Company recorded the difference between the reserve and the settlement amount in other expense within the consolidated statement of operations for the year ended June 30, 2009.

On December 1, 2009, the Company entered into a settlement agreement and mutual relief with the former defendant employees and companies. As a condition of the settlement, the defendant employees and companies transferred, assigned, and released the Company of the defendant's interest in 31, 996 shares of the Company's common stock. The defendants also released the Company from all actions, suits, and claims, with the exception of the settlement amount of approximately $837,000, as noted above. In return, the Company, released the defendants from all actions, suits, and claims

15. Concentrations of Risk

Revenues from five customers aggregated 74% and 73% of total contract revenues, and 54% and 77% of billed accounts receivable, for fiscal years 2010 and 2009, respectively. The revenues and accounts receivable from these customers, for the years ended and as of June 30, are as follows:

	Revenues		Billed Accounts Receivable	
	2010	2009	2010	2009
Customer 1	$ 61,246,982	$ 58,952,287	$ 8,102,139	$ 16,136,899
Customer 2	24,177,059	31,670,071	57,140	2,571,850
Customer 3	26,371,525	6,749,300	1,008,192	1,218,856
Customer 4	9,023,145	8,082,041	3,345,593	1,792,187
Customer 5	7,646,830	10,041,959	652,386	1,555,665

16. Subsequent Events

The Company has evaluated potential subsequent events through June , 2011, which represents the date the financial statements were issued. There were no events that occurred subsequent to

the date of the financial statements, other than the potential transaction and significant losses incurred in fiscal year 2011 that are disclosed in the going concern uncertainty in Note 1 and the issuance of debt forbearance agreements and the continuation of the Company to default on certain debt covenants in fiscal year 2011 as noted in Notes 1 and 6, through the date of issuance that would have had a significant impact on the financial statements and accompanying notes.

Sensis

March FY11

QTD & YTD Actual Results

SENSIS CORPORATION
P&L
As of 3/27/11

Sensis

($ In 000's)	3Q ACT	YTD ACT
Sales	31,890	94,718
Total Direct Costs	17,606	51,015
Total Gross Margin	14,284	43,703
%	44.8%	46.1%
Research and Development	1,311	4,869
%	4.1%	5.1%
Bid and Proposal	2,094	5,063
%	6.6%	5.3%
Operating Expenses	13,745	41,023
%	43.1%	43.3%
Depreciation	1,251	2,972
%	3.9%	3.1%
Amortization	85	263
%	0.3%	0.3%
Total Operating Expenses	18,486	54,190
	58.0%	57.2%
Income (Loss) from Operations	(4,202)	(10,487)
	-13.2%	-11.1%
Other (Income) / Expense	(102)	(372)
%	-0.3%	-0.4%
Interest Expense	648	1,892
%	2.0%	2.0%
Pre-Tax Income / (Loss)	(4,748)	(12,007)

**note above results do not include allocations for GAAP reporting*

Sensis

Sensis Corporation
Balance Sheet
MARCH 2011

	March 27 2011 (unaudited)	June 27, 2010
Assets		
Current assets		
Cash and cash equivalents	$ 6,735,185	$ 1,862,483
Accounts receivable, net	23,256,128	24,158,030
Unbilled receivables on contracts, net	22,485,094	24,816,299
Inventory, net	7,896,819	6,231,508
Prepaid expenses and other current assets	1,305,600	2,988,220
Income tax receivable	4,215,990	722,242
Deferred tax assets	2,063,750	2,033,502
Total current assets	67,958,566	62,812,284
Property, plant and equipment, net	29,538,929	29,470,974
Identifiable intangibles, net	920,572	1,183,488
Goodwill	2,737,791	2,737,791
Deferred tax assets	-	51,413
Other non-current assets	452,130	322,408
Total assets	$ 101,607,988	$ 96,578,358
Liabilities and Stockholders' Equity		
Current liabilities		
Note payable - line of credit	$ 20,829,764	$ 12,800,000
Current portion of long-term debt and capital lease obligations	2,026,148	2,307,483
Accounts payable	20,404,535	9,824,474
Accrued liabilities	7,060,492	11,878,608
Billings in excess of costs	5,939,036	5,294,492
Provision for contract losses	766,604	1,283,990
Total current liabilities	57,026,579	43,389,047
Long-term debt and capital lease obligations	8,672,496	10,143,630
Deferred tax liability	186,985	-
Derivative financial instrument	105,334	167,633
Total liabilities	65,991,394	53,700,310
Series A Redeemable Convertible Preferred Stock	27,769,226	25,873,628
Series A-1 Redeemable Convertible Preferred Stock	3,655,020	3,164,961
Stockholders' equity		
Common stock, par value $.01	67,979	67,960
Additional paid-in capital	7,874,578	7,619,299
Retained earnings	(2,352,973)	7,549,436
	5,589,584	15,236,695
Less: Treasury stock, at cost	(1,397,236)	(1,397,236)
Total stockholders' equity	4,192,348	13,839,459
Total liabilities and stockholders' equity	$ 101,607,988	$ 96,578,358

Cash Flow Statement
MARCH 2011

	March 27, 2011 (39 weeks)	June 27, 2010 (52 weeks)
Cash flows from operating activities		
Net (loss) income	$ (7,516,752)	$ 1,568,159
Adjustments to reconcile net income to net cash provided by operating activities:		
Stock awards	-	10,013
Compensation expense for stock options and warrants	250,774	312,772
Depreciation and amortization	3,235,050	4,484,008
Provision for bad debts	1,935	10,973
Provision for inventory obsolescence	350,186	332,070
Deferred income taxes	208,150	(29,707)
Unrealized loss on derivative instrument	(141,068)	78,034
Changes in operating assets and liabilities:		
Inventory	(2,015,497)	139,791
Accounts receivable	899,967	6,187,153
Unbilled receivables	2,331,205	127,029
Prepaid expenses and other assets	1,552,898	(893,721)
Income taxes payable	(3,493,748)	(1,702,606)
Accounts payable and accrued liabilities	5,840,714	235,889
Billings in excess of costs	644,544	(4,909,822)
Provision for contract losses	(517,386)	(335,404)
Net cash provided by operating activities	1,630,972	5,614,631
Cash flows from investing activities		
Purchase of plant and equipment	(3,465,103)	(12,744,276)
Net cash used in investing activities	(3,465,103)	(12,744,276)
Cash flows from financing activities		
Borrowings from note payable - line of credit, net	8,029,764	6,858,904
(Payments on) borrowings from loans/notes payable	(1,327,455)	390,373
Proceeds from the exercise of options	4,524	48,726
Payments on purchase of treasury stock	-	(68,686)
Net cash provided by financing activities	6,706,833	7,229,317
Increase in cash and cash equivalents	4,872,702	99,672
Cash and cash equivalents		
Beginning of year	1,862,483	1,762,811
End of period	$ 6,735,185	$ 1,862,483

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1. Summary of Services

The Contractor shall design, furnish, and install, and maintain a Surface Management System (SMS), hereafter referred to as the "System," host, operate, maintain and support the System, hereafter referred to as the "Services," that will provide the foundation for an information sharing, processing and display platform and service for the airline industry at John F. Kennedy International Airport (JFK). Elements of the service shall align with the FAA best practices and be adapted to meet local airport needs. The Contractor shall furnish and install necessary hardware and software in facilities selected and provided by the Contractor to host the System, subject to Port Authority approval, and establish connectivity between the System and external systems, and enable remote access through the Internet. The Contractor shall provide all hardware, software, specialized equipment, communications, tools, transportation and labor required to design, build, install, host, connect and integrate the System with other systems in order to make the System operational and provide the services as described herein.

The Contractor shall operate, maintain the System and provide system administration, train the Users and provide User support as per the requirements described in Attachment C Section X Maintenance of the System, which will begin upon completion of the 30-day operational test.

1.1 Service Overview

Combining the industry's leading providers of airport surface management, traffic flow management, air traffic control, and ramp control solutions, the Sensis, Robinson Aviation, and ANSA Team proposes a best-of-breed Airport Surface Management System (SMS) and Service consisting of a fully integrated, hosted, operated, maintained, and supported web-based software service. The proposed system is built on Sensis' proven Aerobahn SMS Platform and Service Infrastructure, enhanced with new departure metering, sequencing, and airspace modeling capabilities. In addition to the tools provided, the Sensis Team will leverage Robinson Aviation's extensive experience to provide hands-on operations staff to coordinate all departure metering activities at Kennedy, and ensure maximum utilization and benefit of the provided services. The Team's experience, mature tool set, and fully detailed staffing and transition plans will enable a seamless and low risk transition for all users at JFK.

No other team can provide the level of direct experience and product maturity as the Sensis Team. Sensis' Aerobahn SMS is an information sharing, processing, and display platform that is deployed at 17 of the world's busiest airports (including the existing JFK service), and is in use by over 23 air carriers, 4 airport operators, and 4 different air navigation service providers. With thousands of users, millions of hours of use, and over 10 years of development, Aerobahn has defined what a SMS is and has continually delivered real and cutting-edge benefits to airport stakeholders around the world. Of equal importance is the significant experience Sensis has with successful deployments of Aerobahn in the United States. The unique interaction between U.S. airport operators, airlines, and the FAA requires special consideration and knowledge. Going even further, Sensis' extensive work with Aerobahn in the NY Metroplex and its familiarity with the

specific data sources and stakeholders at JFK will shorten delivery timelines and improve the quality of the provided service. Sensis is more than a technology provider though; it is known as the "Gold Standard" in customer support and is dedicated to exceeding customer expectations.

An efficient airport requires an efficient airspace and collaboration from all airport stakeholders. Sensis has a long history of involvement in FAA, NASA, NYSERDA, and industry programs and research projects that have provided a strong understanding of what works and does not work in the NAS today. This participation has helped Sensis form the relationships and insight it needs to improve safety and efficiency on the ground and in the air. The Aerobahn SMS product, which forms the foundation of Sensis' offering to the Port Authority, was in fact developed in close collaboration with airline, airport, and FAA customers. For 10 years, Sensis has listened to and observed airport stakeholders manage a diverse array of airports and problems, and has responded with a set of constantly evolving products and services that have never failed to deliver real and significant benefit. **That is why no customer has ever canceled, or chosen to not renew, Aerobahn SMS Service.**

In addition to Sensis' provision of Aerobahn at the world's busiest and most complex airports, some of their other key involvements are listed below. Based on these experiences, Sensis has a significant advantage in that they already meet the majority of requirements, and have more familiarity interfacing with and coalescing diverse stakeholder systems at US airports.

Figure 1 Previous Sensis Project Experience Minimizes Risk of Delivering the JFK SMS.

[redacted]	[redacted]
NYSERDA – JFK **Departure Manager**	Designed and implemented a per flight (specific call-for-taxi) departure metering and sequencing application for JFK. • Fully implemented all algorithms for both per flight metering and sequencing • Integration tested with live JFK data via Aerobahn, including ASDE-X surveillance and flight plans, ASDI flight schedules and estimates, FIDS gate assignments and schedules, and FlightStats gate assignments and schedules • Crucial experience at JFK. The complexities of the JFK surface, diverse terminal control, and airline make-up make it very unique and ultimately more difficult to handle for departure

	metering. Competitor experience at smaller and less complex airports, and use of less robust flow-based departure queue management techniques are only of limited value.
FAA – Memphis Collaborative Departure Queue Management (CDQM)	Collaborated with FAA, airline, and industry partners to develop and test departure metering tools. • Participated as Delta Airline's industry partner and SMS provider to develop and field a fully integrated departure metering application within Aerobahn. • Identified gaps and unfulfilled benefits in the rationing algorithm and flight binning approach that was employed (i.e. count based metering). • Incorporated airline suggestions on process improvement into Aerobahn interface and into Sensis' JFK Departure Manager. o **In particular, airlines were not satisfied with the RBS algorithm trialed in MEM due to the fact that it inequitably shifted delays from one airline to another. Sensis' rationing algorithms address this issue and maintain an equitable distribution of delays across operation banks.**
US Airways – CLT Departure Metering	Collaborated with US Airways to implement a custom departure metering program actively being used at CLT. • Developed and deployed a departure management tool in active use • Worked closely with US Airways OCC, Ramp Tower, and Operations Team to design a process that worked for everyone. • Customized Aerobahn to each user's unique needs and built specialized views and reports
FAA – ZTL Traffic	In second phase of a project with the Atlanta

Management Advisor (TMA)	ARTCC (ZTL), ATL Department of Aviation, and participating airlines to leverage the Aerobahn SMS to proactively coordinate push back times and TMA fix times. • Successfully utilized Aerobahn for a true CDM application with FAA, airport, and airline participants. • Harnessed Aerobahn's infrastructure for sharing data that was otherwise isolated in proprietary systems • Helped develop and promote participation and buy-in across organizations
FAA – SE2020	**Continuing work in a multi-year project for the FAA's Aviation Safety (AVS) Division to proactively analyze safety issues.** • **Successfully developed automated detection algorithms to identify anomalous aircraft behavior on the airport surface.** • **Demonstrated the algorithms utility through adaptation and detection of anomalous aircraft actions at JFK airport.**
FAA – ASDE-X and RWSL	System Integrator of ASDE-X and Runway Status Lights (RWSL) for FAA. • As the provider of ASDE-X, Sensis is intimately familiar with interfacing with and utilization of ASDE-X surveillance data, which will be at the heart of the JFK SMS solution • Experience extends beyond software and service to surveillance hardware and on-airport construction, sensor and communication optimization, and maintenance • Designed and deployed cutting edge safety-critical surveillance processing and safety
European Airport CDM	**Active industry participant in EUROCONTROL**

A-CDM development discussions and demonstrations.

- Early contributor to EUROCONTROL A-CDM concept of operations with demonstrated thought leadership
- Active participation maintains awareness of global CDM processes and lessons learned
- FAA Surface CDM Group and concept of operations borrows heavily from the work of European A-CDM. Participation provides Sensis with in-depth background

With 93 airports already depending on Robinson Aviation (RVA) for air traffic control, there is no one better equipped to ensure that real operational efficiencies, and not just technologies, are delivered to the Port Authority. RVA has already worked with Sensis at Seattle-Tacoma International Airport and has instituted their own successful departure metering program there. Furthermore, at the head of Robinson's on-site staff will be former FAA Operations Manager at the JFK Air Traffic Control Tower – Dave Pagagua, again ensuring that the entire proposed solution, from technology to personnel, are capable and ready to meet the Port Authority's vision from the onset.

ANSA is a privately owned company that provides extensive research expertise in the areas of control, optimization, and system analysis and design, as well as subject matter expertise with real-world knowledge of airport operations and constraints. They also served as principal investigator of a previous surface optimization NASA research project that developed a suite of modules to optimize surface operations. They provide innovative airport performance measurement capabilities and research, development and deployment of CDAs and other airline and government NextGen concepts including pre-tactical and tactical aircraft sequencing, scheduling, and runway allocation advisory systems.

The Sensis Team's proposed solution in its current state today, even without any additional development, better meets the Port Authority's requirements than any other product or combination of products on the market. Aerobahn is already deployed at JFK with an excellent track record of usage, customer satisfaction, and airline buy-in; has a more comprehensive feature set than any competing offering; and is already being delivered to the busiest airports in the world with a high level of availability, support, and training. Atop the base Aerobahn product, Sensis has also performed significant departure metering and sequencing development under two separate projects for the New York State Energy Research and Development Authority (NYSERDA) and the FAA. This position, along with the demonstrated thought leadership of each team member,

allows the Sensis Team to offer the lowest risk, highest reward solution to the Port Authority's immediate tender and to uniquely meet their very aggressive schedule goals. Additionally, as discussed in the Executive Summary, Sensis is also committed to helping fulfill the Port Authority's long term goals for the entire NY Metroplex by offering integrated solutions for sustainable efficiency improvements. Along this line, the Sensis Team's proposed solution includes the provision of Aerobahn SMS Service for the Port Authority for LaGuardia and Newark airports. Sensis and its partners are confident that they can deliver more short term and long term benefit than anyone else.

Sensis is the most capable of delivering success to the Port Authority because:

- Sensis is focused on commercial SMS development and not just government research or ATC applications
    - Unlike other SMS developers that get all of their development funding from government resources and have had limited deployment success, Sensis has always kept a laser-focus on the real needs of airlines and airport operators. Sensis' commercial deployment success in the U.S. and the rest of the world is a reflection of an unparalleled dedication to satisfying customers with demanding 24/7 needs.
- Sensis is focused on delivering benefits today
    - Unlike other SMS developers, Sensis is not satisfied with doing piecemeal government research that has years to go before SMS functionality actually delivers its promised benefits. Sensis prides itself on deploying SMS functionalities that deliver tangible benefits today. Aerobahn is NextGen, just without the wait.

There are other companies that do SMS research and some that deploy SMS operational capabilities, but there is no company that has the unique combination of world-class SMS research and development, surface surveillance and air traffic management system integration, and unparalleled SMS commercial application development, deployment, and operational support that Sensis has.

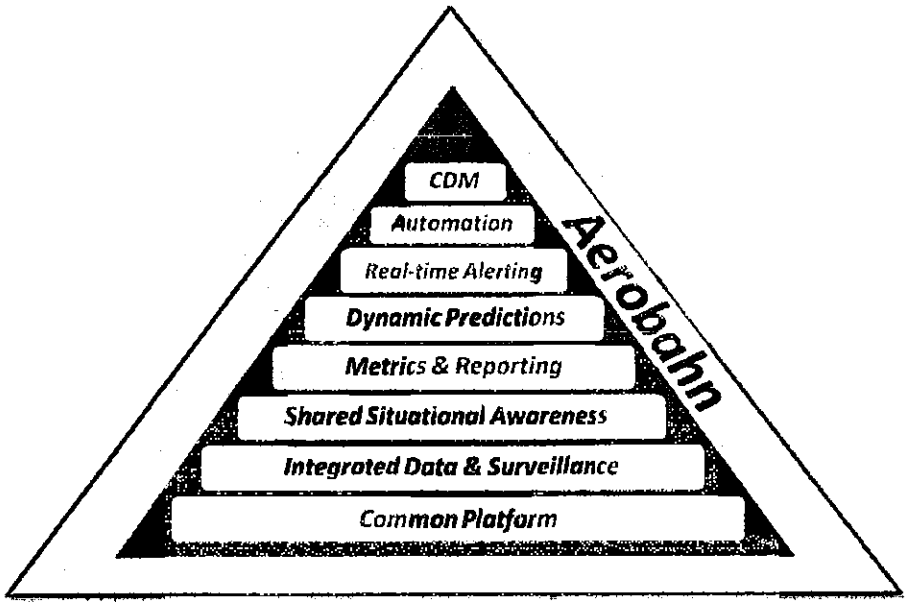
1.2 System Functionality

The Aerobahn Surface Management System is the most comprehensive and widely deployed SMS in the past 10 years and forms the backbone of the proposed solution. And because Aerobahn has largely been shaped by customer needs and user feedback, which includes the Port Authority, many of the Authority's requirements are already met today. Also, as one of its mature service offerings, Sensis has continually invested in Aerobahn to stay at the forefront of the industry. For these reasons, the Sensis Team is in an excellent position to immediately deliver and exceed many of the needs at JFK and the

entire Metroplex today, and promptly evolve to meet the rest of them on the requested schedule.

Aerobahn was architected from the ground up to deliver flexible, yet focused, solutions to the diverse group of stakeholders at an airport. This is evidenced by the assorted types of organizations procuring Aerobahn, and the even greater variety of them using it. The following figure, Figure 2, illustrates the Aerobahn feature set and how it delivers building value to users.

Figure 2 Aerobahn's Multi-tiered Platform Builds Value for Users



Aerobahn consists of a modular software architecture that supports the evolution of more advanced and automated solutions on top of the prerequisite and existing ones. The Port Authority's departure management process requirements provide a perfect example in that they require automation and collaborative decision making functions that can only truly be solved by first establishing the lower level functions in the above pyramid. A sustainable departure management program first requires a common software platform for communication and dissemination of information, integrated surveillance and high quality schedule data, compliance monitoring and reporting, dynamic taxi time and throughput predictions, and dynamic alerts on airport conditions or flight status before it can be realized.

Due to Aerobahn's maturity and proven architecture, it has the necessary foundational features required to expand upon for departure metering. The depth and breadth of these

foundational areas also exceed the Port Authority's requested functionality in many cases, allowing Aerobahn to provide additional benefits for the Port Authority and other stakeholders. Regarding other stakeholders, Aerobahn has been extremely well received by airlines, many of which contract directly with Sensis for Aerobahn service at other airports and at their operational control centers. If the Sensis Team's proposal is selected, airlines' favorability towards the Aerobahn platform, and their ability to derive additional business benefits beyond departure metering, will serve to improve their participation in Port Authority programs like departure metering that are to be implemented within the procured SMS.

The following table, Figure 3, summarizes the reasons why the Sensis Aerobahn SMS is the software platform best positioned to meet the Authority's needs.

Figure 3 Sensis Aerobahn SMS Features and Benefits

Aerobahn is already deployed at JFK.	**Continuity of service can be provided with very low risk and the Port Authority's aggressive timeline can be met.**
Aerobahn is the most mature SMS product available and has a proven, extensible architecture.	A significant portion of the requested functionality is already being delivered and the remainder can be added with a lower risk and shorter timeline. The extensible architecture will not only allow the new functionality being requested today to be implemented, but also provides a stable growth path for evolving needs.
Aerobahn has the most comprehensive feature set, especially around region processing, data correlation, dynamic rules and alerting, and reporting.	**Users can have Aerobahn tailored to their unique needs, providing real and targeted benefits beyond what any other system can do.** **Systems lacking Aerobahn's maturity and breadth of deployment can only offer basic situational awareness, and not the in-depth processing, alerting, and reporting capabilities developed over several generations of software based on real-world data constraints, performance impact, and user feedback.**

Aerobahn has an existing service infrastructure and has a long track record of high availability.	The Port Authority can be confident that the proposed solution will live up to its promises and meet their needs.
Aerobahn is the platform of choice for most of the major airlines at JFK and is in use at their operational control centers.	**The collaborative departure metering process the Port Authority is aiming to establish requires collaboration from all of the airlines. Selecting Aerobahn, which they already utilize heavily for their own business needs, will improve participation and enable more integrated automation processes going forward.**
Aerobahn service will be provided to the Port Authority for LGA and EWR.	The procured solution at Kennedy will not standalone and the Port Authority will be poised to incorporate Aerobahn into an integrated Metroplex solution to maximize the efficiency and equity of traffic management across the major New York airports. Sensis recognizes that a comprehensive Surface Management System for JFK requires visibility into operations at LGA and EWR.
Aerobahn has a huge user base at other airports (Over 1000 users at 16 other airports worldwide) and receives significant input and product development investment.	**The Port Authority will benefit from continual product improvement and external investments.**
Aerobahn is a not an ATC system being force-fitted to the Port Authority's surface needs	Sensis' solution will directly target the needs of the Port Authority and airlines at JFK. While Aerobahn is extensible and leverages an open architecture, it has always been focused on airport users and does not address their problems as an afterthought on top of an existing FAA system.

1.3 Automated Departure Metering and Sequencing

The Sensis Team's proposed automated departure metering and sequencing process leverages the successful parts of the current manual process at Kennedy, but better integrates the sub-processes and systems in order to automate additional components.

This increased automation provides performance improvements for the overall airport and individual flight operators, as well as enables more sustainable gains during reduced capacity conditions. In other words, when the conditions at the airport get bad, Sensis' departure metering and sequencing solution will continue to perform and make the most out of the remaining capacity.

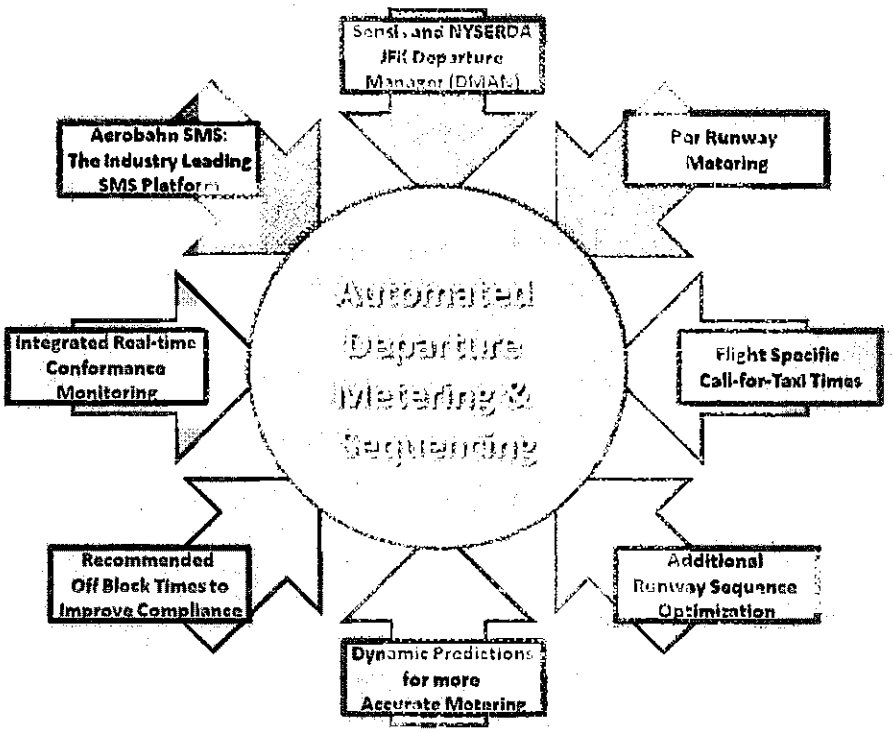
Aerobahn already plays a crucial role in the current departure metering process at JFK. In the proposed solution however, instead of relying on a manual metering and flight binning process, Sensis' existing JFK Departure Manager (DMAN) will be fully integrated into Aerobahn to automatically generate individual Target Movement Area Times (TMATs), also known as transition spot call-for-taxi or CFT, for each flight based on their scheduled flight plan and updated flight readiness information. The TMATs will be pushed out to all users and made available in Aerobahn within its numerous tools, rule criteria, and reports. These TMATs will account for planned and actual departure rates, assigned departure runways, departure fix balancing, updated ready to push times, dynamic taxi time predictions, and traffic management initiatives. Aerobahn's adaptive TMAT algorithms will take the place of the manual flight binning process used today, but will still allow for stakeholder reprioritization and ad-hoc adjustments to be made.

With a goal of maximizing runway throughput, even after TMAT swaps and adjustments are made, Aerobahn's dynamic sequencing algorithm will perform minor adjustments to the specific flight order to ensure efficient departure ordering based on aircraft types and departure fix utilization. Even though a TMAT is an absolute time, the overall metering process allows for a time window around the specific TMAT in which a given flight is considered compliant. The more rigidly the TMATs are followed however, the more likely the actual departure order on a given runway will match the optimized plan as calculated by Aerobahn, and therefore the better the overall airport performance will be. Again, because there is a conformance window around the specific TMAT times, these adjustments will not unfairly impact flight operators if they cannot strictly adhere to them.

Sensis' proposed approach accrues even more performance improvements by separately metering specific runways and not just metering all departures on an airport wide basis. Runway specific metering will leverage Sensis' advanced airspace modeling capabilities, which will be plugged into Aerobahn to combine operation plans with dynamic configuration and throughput forecasts. The proposed departure metering and sequencing solution also continuously tracks and predicts taxi times from gate to the transition spot, so that recommended off block times (ROBTs) can be calculated. Operators able to meet their ROBTs will be more likely to hit their TMATs and maintain the optimum sequence. The automatic generation of ROBTs will ultimately help stabilizes runway queue lengths to prevent the runways from being starved and also allow shorter queues to be maintained, which will substantially increases the overall savings at JFK.

Figure 4 below highlights some of the key components comprising Sensis' automated departure metering and sequencing solution.

Figure 4 Key Components of Sensis' Automated Departure Metering & Sequencing



While the existing departure metering program at JFK has produced significant benefits – in particular a reduction in taxi-out time – Sensis' analysis of ASDE-X surveillance and schedule data from before and during the program demonstrates some ways in which the proposed solution will enable additional improvements:

- Under the existing program, large, short-term fluctuations in departure queue length require a relatively high value for the target queue length to avoid starving the runway. This reduces the overall taxi time savings. With per runway metering, and individual flight TMAT times, the Sensis solution provides more consistent queue lengths, allowing a shorter queue to be maintained without risk of the runway running dry.

- The existing program has not reduced overall delay or improved the departure sequence. Aerobahn's added sequencing algorithms apply a final optimization to all metering and swaps in order to maximize airport utilization.

- The existing program has transferred delay from the departure queue to the ramp, but much of this ramp delay is not taken at the gate. By calculating dynamic recommended off block times (ROBTs), Aerobahn will provide more guidance to

airlines and ramp controllers to allow a greater percentage of delays to be taken at the gate with greater confidence that metering slots will be hit.

- Under the existing program, metering points are rarely used. The proposed solution allows for an automated metering point request and assignment mechanism to facilitate the process. Increased usage of metering points when necessary will reduce ramp congestion and again lead to more consistent and short ramp taxi times.

1.4 Future Sustainability

Sensis has always placed an equal importance on being ready to handle tomorrow's issues as it does on solving real-world problems today. This dual focus is why Aerobahn was not only the first SMS on the market, but has remained the leader for the last decade. Following this same philosophy, Sensis' proposed solution promptly addresses the Port Authority's immediate needs, provides an even broader set of benefits than those explicitly requested, and establishes a sustainable platform for success well into the future. Perhaps of even greater importance to the Port Authority though, is that Aerobahn is first and foremost an airport automation system, designed and tailored to solve problems for airport stakeholders; it is not an ATC system that is being forcefully retrofitted to try and meet the Port Authority's requests. This means that while being ready to grow and tackle broader operational issues well into the future, Sensis will always be focused on the Port Authority's needs and the crucial role of airports in the NAS will not be an afterthought.

Sensis has reliably invested significant internal funds to maintain Aerobahn's market leading position. By constantly evolving a long term product roadmap, it works to stay ahead of market needs, which is why Sensis is in such a capable position of responding to the Port Authority's current requirements. Along these same lines, a few areas Sensis is working on that may be of particular relevance to the Port Authority at JFK and in the NY Metroplex are itemized in the next sections.

1.4.1 Integrated Surface Management for NY Metroplex

Due to the proximity of JFK, LGA, and EWR, and the volume of air traffic they support, the airports are inextricably linked. Comprehensive surface management at any of these airports requires integrated awareness of the others. Sensis recognizes the critical impact of LGA and EWR on JFK surface management, and therefore included in its proposal Aerobahn SMS Service for them. Going beyond that however, Sensis' long term vision is to develop Aerobahn into an enterprise-wide surface management solution, enabling an even tighter integration between separate airport systems. This will allow predictions and forecasts summaries from one airport to influence those at another and provide stakeholders to view an integrated picture of the Metroplex.

An enterprise-wide Aerobahn System will also support Sensis' work on expanding its flow management capabilities further into the airspace, driving even greater throughput improvements.

1.4.2 Centralized De-icing Management

De-icing is one of the earliest operational problems that Aerobahn was applied to and it is a crucial part of the management plan for some of the world's most demanding de-icing operations (DEN, DTW, MSP, PHL). Through the targeted development of new de-icing features over the past several years, Aerobahn already provides significant benefits during winter operations.

After fully integrating its departure metering capabilities into Aerobahn, Sensis will extend them to leverage a similar process for managing centralized de-icing pads. Aerobahn will support the automatic metering of flights into de-icing pads in much the same way it meters aircraft into the movement area for runway queue management. This will effectively extend the same benefits of departure metering into the de-icing process, reducing taxi times, surface congestion, and secondary de-icing occurrences.

As JFK's de-icing procedures evolve, no other SMS will be as ready as Aerobahn to support the Port Authority.

1.4.3 Collaborative Decision Making with FAA

As already discussed earlier, Sensis is an active participant in the development and prototyping of CDM concepts in US and Europe. Sensis' involvement allows them to stay abreast of the latest industry and policy direction to ensure future support. Also, Sensis' close working relationship with the FAA, in particular the fact that the FAA uses Aerobahn, affords Sensis and the Port Authority opportunity to leverage collaboration work done between airport stakeholders and the FAA at other airports in order to improve operations at JFK and elsewhere in the NY Metroplex. Two prime examples of Aerobahn being used for collaboration with the FAA are the Coded Departure Reroute process employed by the FAA and United Continental in IAH and the TMA work being done in the ATL Center (ZTL).

1.4.4 Managed Gate Operations

Sensis Corporation is developing a managed gate operations (MGO) decision support tool through a contract co-funded by the New York State Energy Research and Development Authority (NYSERDA). The Sensis managed gate operations tool will provide airline and airport ramp operators who are charged with managing a portion of the taxi-in and taxi-out of aircraft with automated recommendations on the most advantageous flight timing and sequencing in the vicinity of the gates. By taking advantage of automated, optimized recommendations, the Port Authority will be able to

add to the efficiency gains created by their departure metering program and even further reduce taxi times; increase on-time performance; and lower fuel burn and CO2 emissions.

Sensis proposed departure metering and sequencing solution already includes the provision of a Recommended Off Block Time (ROBT) for each departure in order to improve metering compliance. This ROBT time is a ready extension point for enabling managed gate operations. Instead of being based primarily on dynamic taxi times, Sensis MGO product will augment the recommended off block logic with greater automated intelligence.

1.4.5 Direct Cockpit Messaging

Sensis is a participating member of the Data Communications Implementation Team (DCIT), a collaborative environment to perform advocacy and outreach activities on behalf of the NextGen Data Communications Program. In addition to working with the FAA, Sensis is also collaborating with its airline customers and industry partners to enable messages and alerts to be sent directly to the cockpit. Eventually, this improved automation will allow participating airlines to improve communication with the flight deck and reduce radio communications. For the Port Authority, this could provide a hands-free mechanism to ensure the reliable distribution of metering times and recommended off block times.

Sensis proposed solution will deliver immediate and sustainable success allowing the Port Authority to keep improving airport operations and keep up with the future growth of air traffic.

1.4.6 Next Level Decision Support

Since its inception a decade ago, Aerobahn has been constantly evolving from a situational awareness tool into a hands-on management system with advanced predictive and decision support features. Sensis' long term Aerobahn roadmap continues this trajectory, and Sensis is already engaged in activities to provide automated conflict resolution and solution generation features. Projects like these, such as Managed Gate Operations as discussed above, are yet another way that Sensis plans on keeping up with its users' needs.

1.5 System Architecture

The Sensis SMS solution, the Aerobahn SMS Service, is a web-enabled service oriented architecture. The solution proposed is based on the current Aerobahn Service model already in place with the Port Authority, but with significant upgrades to further improve the industry leading service availability Sensis already provides. With the exception of the client computers which will run the required web-browser applications, Sensis will be providing all hardware, software and communications circuits necessary to deliver the

service. Additionally, Sensis will also be providing all the hardware software and communications circuits required for the SMS Operators to use in the Metering Coordination Center at the airport. The service architecture proposed has the following features to provide the highest availability and fault tolerant system possible:

- Geographically diverse data centers utilized for primary service and disaster recovery service located in Staten Island and Philadelphia.
- In addition to a high bandwidth backbone between the data centers, there is also physically diverse redundant communications paths provided to each of the data centers for data feeds and client service access.
- Within each data center, the service runs on a fault tolerant virtualized environment able to achieve better than 0.9999 availability.

1.6 System Administration and Operation

Sensis operates and provides system administration for the Aerobahn system to customize the service to the user mission. These functions are closely tied to the Customer Support function described in Section 1.10.

Sensis engineers, with years of experience designing and building products for the airport and air traffic communities, are uniquely qualified to keep the production Aerobahn system is running at peak efficiency and effectiveness.

When Sensis upgrades the Aerobahn service at JFK, site engineers configure the system to fit the operational environment. Configuration includes installing the latest software build; installing a new or modified background map; working with customers to design or modify regions of interest; adjusting performance parameters to ensure target tracking and correlation are working properly; entering the list of runway configurations; and adjusting a myriad of other parameters to make the system work in the Kennedy airport operating environment.

While configuration takes place periodically, Sensis monitors the system continuously to catch and resolve operational and performance issues before they affect Port Authority stakeholders. Software running on each production server monitors Aerobahn software and hardware and reports the results to an external performance measurement and alerting tool. The monitoring software periodically checks software status, processor usage, memory usage, and status of the various data communication interfaces. If it detects an abnormality it sends a cell phone message to a designated engineer so the problem can be rapidly investigated and, if necessary, fixed.

As Sensis develops new features or resolves problems in the software, new software releases become available. Part of operating the system is to make sure these new releases are installed on shadow (demonstration) systems and dry run with the users

before the software is installed for Production Service. Many engineers are involved in the dry run process, testing the software to find any remaining issues.

Backups are disk-based, taken nightly. In addition to that Sensis will employ a secondary failover capability with snapshots taken at configurable intervals, defaulted to 10 minutes.

In addition to keeping the system running smoothly, Sensis administers user activity and customize the application software.

When the system is about to be deployed, Sensis system administrators coordinate with customer representatives to compile a list of users, organized by functional groups. Then, they determine what access rights the various users and user-groups need. Some groups of users only need access to certain tools on the Real-Time Display. Others may only use the Reports. Also, permissions are set up to ensure access to proprietary airline data is restricted to employees of each airline. Aerobahn allows administrators to control accessibility to virtually every individual feature and data element for a given user. This provides total control over system tools and content.

System administrators also work with customers to define groups of users who will be authorized to participate in various Chat Channels or Chat Conferences. Chat is a text-based messaging system within Aerobahn. It is arranged in custom-defined radio-style channels so that multiple users may conference together. Chat Channels are active all the time and allow multiple users to participate in an ongoing conversation, similar to a radio channel. Chat Conferences are established on an ad hoc basis and allow two or more users to have a conversation spontaneously.

Finally, system administrators configure the system for vehicle tracking. When there are vehicles at the airport equipped with Mode S transponders or GPS devices, Aerobahn may be configured with Mode S or network ID's to enable the system to find the vehicles. Further, the vehicle type, name, and other identifying information for each vehicle can be entered into the database. The vehicle information can then be displayed in the icon data block or the Selection Details tool; and it can be used for alerting.

1.7 System Maintenance

The Aerobahn JFK Service offering is comprised of components that are owned and maintained by Sensis and components that are owned and maintained by the FAA. Authorized Port users and authorized sub-licensees will contact Sensis Customer Service in the event of an observed anomaly with the Service, and Sensis will make every effort to promptly identify and resolve the source of the anomaly. Sensis ensures optimum performance by executing a proactive maintenance plan for all of the hardware and software comprising the Sensis owned elements of the Service infrastructure. In the event of an unforeseen degradation in the quality of the Service element owned and

maintained by Sensis, qualified experts are rapidly deployed to identify and resolve problems.

1.8 Documentation

Sensis Technical Communications produces comprehensive documentation and performance-support solutions that support system administration and enhance the on-the-job effectiveness of Aerobahn users. Working in partnership with Aerobahn technical experts and Port Authority personnel, the Technical Communications group develops information products that help Port Authority stakeholders leverage Aerobahn tools.

The following documents will be provided to support project management, implementation, training, and daily use of Aerobahn services:

- Project Plan
- Project Schedule
- Progress Schedules
- Weekly Status Meeting Agendas
- System Diagram
- Security Practices and Policy Document
- Aerobahn System Documentation
- Manuals: Aerobahn User's Guide, Aerobahn Quick Reference, and Aerobahn System Administration Manual
- Disaster Recovery Plan, Phase A and Phase B
- Certification of the security policies and practices employed in system operation
- Training Plan
- Database Documentation

1.9 Training

Since 2009, Sensis has provided Aerobahn service and training to more than 250 Aerobahn Port Authority and the airline users at JFK. Sensis has Aerobahn trainers, technical personnel, and project managers who are experienced with the systems and the people at JFK. This mix of training and coaching providers with an existing Aerobahn

user base provides a foundation for building efficient training and for realizing cost savings for the Port Authority Surface Management project.

The training solution we propose builds skills through a blended instructional approach that includes e-learning, instructor-led courses, hands-on practice, on-site coaching, and refresher training.

Specifically, Aerobahn training provides effective development of general and job-specific competencies. The training is divided into five courses:

1. Online Introduction to Aerobahn
2. Phase A Aerobahn Basic User's Training
3. Phase A Metering Training
4. Phase B Metering Training
5. Phase B Aerobahn Upgrade Training

In addition, job coaches and refresher training will help to ensure that skill transfer is taking place and that skills are reinforced and extended over time. Our award-winning Aerobahn help utilities are also available 24x7 to assist SMS Users.

1.10 Customer Support

Sensis employs a proven support services infrastructure and adheres to a rigorous Service delivery approach that positions Sensis to extend outstanding Service to the Port of New York and New Jersey. Sensis maintains the expertise, equipment, training and documentation required to provide exemplary support for Aerobahn JFK Service.

Sensis' Service Delivery paradigm combines a highly reliable and easily maintained Service with a responsive Customer Service and technical support team that is accessible 24 hours per day, 7 days per week, 365 days per year (24x7). The components of the Aerobahn Service are maintained by Sensis, and therefore require minimal Customer intervention in the event of a technical issue. Sensis ensures optimum performance by following a proactive maintenance plan for all of the hardware and software comprising the Service infrastructure. In the event of an unforeseen degradation in the quality of the Service, Sensis rapidly deploys qualified experts to identify and resolve problems.

Sensis Customer Service stands ready to ensure optimum Aerobahn JFK Service performance and availability by:

- Acting as a single point of contact for all Users;
- Logging, tracking, and communicating the status of all problem-resolution efforts;
- Providing information about how to use functions/features; and

- Capturing User suggestions for new features and sharing them with the Aerobahn Integrated Product Team.

1.11 Test

The Sensis Test and Evaluation process is designed to ensure the high-level of quality and Customer satisfaction expected from a leading global supplier of Aerobahn Systems. The test process is regulated by Sensis Quality Assurance personnel and a set of Standard Operating Procedures to maintain Sensis Quality standards. Following these Standard Operating Procedures has earned Sensis ISO-9001-2008 certification and helps achieve the highest Customer satisfaction possible.

A software release will be created for Phase A. Following Sensis internal integration and testing, the Customer System Inspection and Tests will be conducted and once the release is approved by the Port Authority, the release will be installed on the Aerobahn SMS Service production server. The same process will be followed for the Phase B release.

2. References

All Work shall conform to the latest edition of the regulations, codes, standards and specifications listed below and all local codes, which would be applicable if the Authority were a private corporation. Where specific requirements are not listed the Contractor shall, at a minimum, conform to the latest revision of the references, standards, and publications listed below. In the event of a conflict, the more stringent criteria shall govern.

- *FAA 7233-1 Form, Exhibit 1*
- *Data Elements Sheet, Exhibit 2*
- *Statement on Auditing Standards No. 70-Level 2 (SAS-70 Level 2)*
- *Port Authority Audit Department Check lists, Exhibit 5*

The Aerobahn SMS Service will conform to the specified references as detailed in the appropriate sections of this proposal.

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1. Project Delivery Guidelines

II. Project Delivery Guidelines

II. A. Implementation Schedule

II. A. The project shall be delivered in two phases or "Implementation Periods". The two Implementation Periods are Phase A and Phase B. Phase A shall be the implementation and commencement of a system to replace the existing system and services that presently exist and are being performed at JFK as described in Attachment C. Section IV.B. Functional Requirements, with a final delivery/completion to be on or before January 15, 2012 (Base Date of Operational Usage).

II. A. Also beginning on the Base Date of Operational Usage, the Contractor shall assume responsibility for hosting, operation, administration and maintenance of the system, which shall continue, to the end of the contract.

II. A. Phase B shall consist of the design, deployment and operation of the System and Services, which shall include the expanded functionalities and capabilities stated in Attachment C, Section IV.C. Functional Requirements of Enhanced System and Services Phase B, and must be fully operational on or before July 1, 2012.

II. A. The successful Contractor shall provide the System and Services as described herein through a web-based platform that will be hosted, operated, administered and maintained by the Contractor in a location approved by the Port Authority.

II. A. The Contractor may, at its option, elect to deliver any or all of the functional capabilities identified in Phase B as part of Phase A, as long as the Base Date of Operational Usage is achieved.

II. A. The Proposer shall provide a Detailed Implementation Plan that addresses all the requirements of Attachment C, Scope of Work, and anticipates a short-term transition from the current hosting vendor and environment to the proposed implementation for hosted managed services and administration of the Surface Management System. The Proposer should describe the methodology they have used successfully in the past and describe how existing system integrity will not be lost. The Contractor must propose how they will guarantee the Authority's access to all data in the event of the termination or expiration of the current contract.

II. A. The Contractor must propose how it will assist with the transition to a new vendor to minimize service interruption to the Authority in the event of termination or expiration of contract.

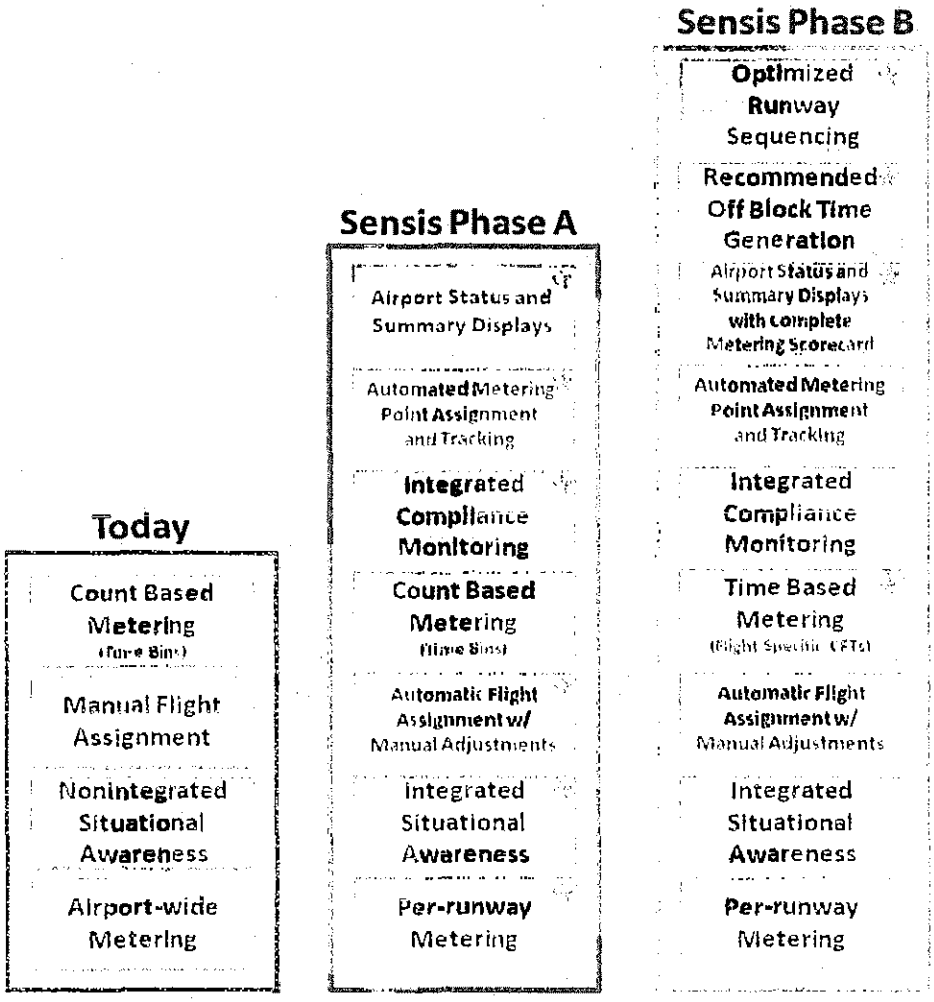
II. B. Base Date of Operational Usage

II. B. The Base Date of Operational Usage is on or before January 15, 2011. The Contractor shall complete all work, finish the Operational Acceptance Test and begin to provide the System and Services as described herein prior to the Base Date of Operational Usage. Failure to provide the System and Services by the Base Date of Operational Usage will result in liquidated damages as described in the Contract, Section 16, Liquidated Damages.

Aerobahn is the most advanced SMS on the market and is most capable of meeting the Port Authority's needs at Kennedy and their progressive, pace setting, surface management goals. Moreover, the new development work required is well on its way given the Sensis Team's active industry participation, leading research, and proactive approach. As such, the Sensis Team believes they are uniquely capable of meeting the Port Authority's requested timeline by leveraging Aerobahn along with major components of other already developed and fielded concepts. Combining existing components not only shortens the delivery schedule, but ultimately increases the probability of success and enables a smoother transition to occur. It is not just about being quick though; Aerobahn is inarguably the most mature and full featured SMS available and exceeds the Port Authority's minimum requirements now and into the future.

The following two sections describe in detail how the Sensis Team can meet the Port Authority's requested project phases while Figure 1 illustrates the major features, mostly those pertaining to departure metering, present in each phase.

Figure 1 Major Features in Each Delivery Phase



1.1 Requested Phase A

Given the very early requested start date for Phase A, the Sensis Team has devised a plan to provide Phase A system requirements including an interim departure metering solution for the Port Authority that will maintain existing service and functionality continuity at JFK, while adding benefits and incrementally transitioning to the final concept of operations as described up until now. As opposed to the optimal *Time Based Metering* solution that will be provided in Phase B, in Phase A an automated *Count Based Metering* program will be delivered, staffed, and fully executed by Robinson Aviation using the Aerobahn SMS Service. The *Count Based Metering* is essentially what is being implemented today at Kennedy, and involves rationing a number of flights to different carriers or terminal operators in time buckets or bins. The Sensis Team's Phase A solution will utilize an enhanced version of the Flight Operator Surface Application

(FOSA) interface that was built into Aerobahn for the FAA's CDQM trials in Memphis. Sensis' Phase A proposal provides all of the necessary functionality to keep running departure metering at JFK in January, and does so with field tested components that closely mimic the current metering process in order to limit training and transition pains. Beyond just maintaining the current state of functionality, Sensis' Phase A solution also provides significant additional benefits.

The proposed Phase A solution:

- Incorporates Sensis' latest rationing algorithms to ensure equitable distribution within the buckets;
- Utilizes metering by buckets, which is the currently employed system to minimize the training and transition pain;
- Utilizes the already fielded FOSA departure metering interface, which has received favorable feedback from Delta Airlines, to reduce risk and improve likelihood of quick success;
- Maintains all crucial components of the Port Authority's current departure metering program with the additional benefits of:
    - Integrated conformance monitoring
    - Integrated situational awareness (metering, communications, and graphical displays are unified and consistent)
    - Improved automated mechanism for requesting and assigning metering points, enabling more frequent and effective use of metering points
    - Metering point tracking
    - Metering by runway instead of airport wide
    - Playback and reporting on metering assignments and performance

Additional details about the departure metering tools in Phase A, along with compliance approach for the remaining features requested in Phase A are included later in the Functional Requirements section.

1.2 Requested Phase B

If the departure metering process is viewed as consisting of personnel, tools, and processes, then while the proposed Phase A solution evolves the personnel and tools, Phase B improves the process and further evolves the tools. In Phase A, the Sensis Team assumes control of departure coordination and the software features used are integrated into Aerobahn. In Phase B, the Sensis Team is proposing transitioning the existing *Count*

Based Metering program to the *Time Based Metering* program as described earlier, and adding in sequence optimization, and rounding out the supporting software feature set.

The proposed Phase B solution builds on Phase A and:

- Utilizes time based metering with the assignment of flight specific target movement area times (TMATs, also known as Call For Taxis) in order to reduce runway queue length variability, provide recommended off block times (ROBTs), and ultimately allow a greater percentage of delays to be taken at the gate
    - TMATs are equivalent to call-for-taxi times (CFTs). TMAT is used because it is the term chosen by the FAA's Surface CDM Working group and is gaining adoption as an industry standard.
- Leverages Sensis' existing Departure Manager (DMAN) developed with NYSERDA to ensure a timely and successful delivery
- Augments the metering process with per runway sequence optimizations that incorporate minor sequence adjustments to optimize runway throughput based constraints (e.g., wake vortex class, departure fix balancing).
- Improves upon Sensis' rationing algorithm based on feedback from Phase A.
- Incorporates final enhancements to the Aerobahn Scorecard, and real-time performance monitoring tools to meet the Port Authority's requirements

Additional details about the departure metering tools in Phase B, along with compliance approach for the remaining features requested in Phase B are included in the Functional Requirements section.

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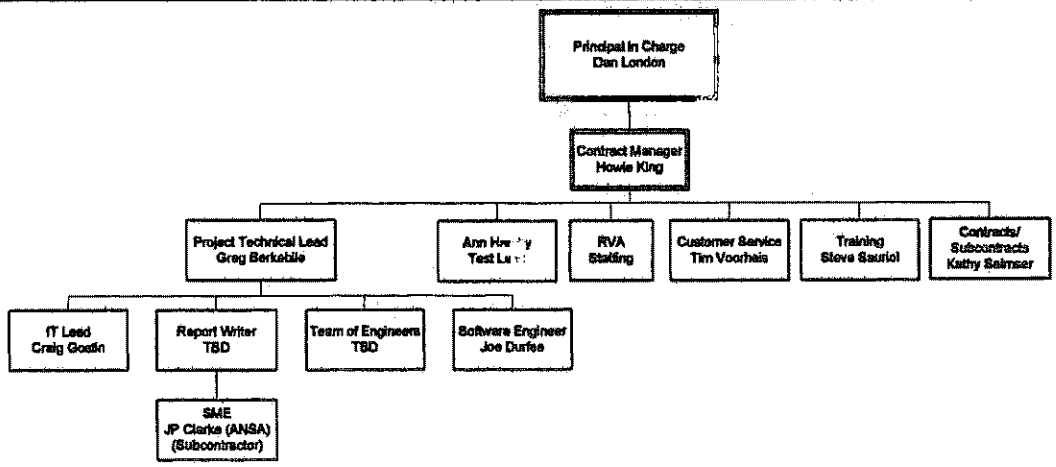
1. Requirements for Staffing/Staffing Plan

III. Requirements for Staffing

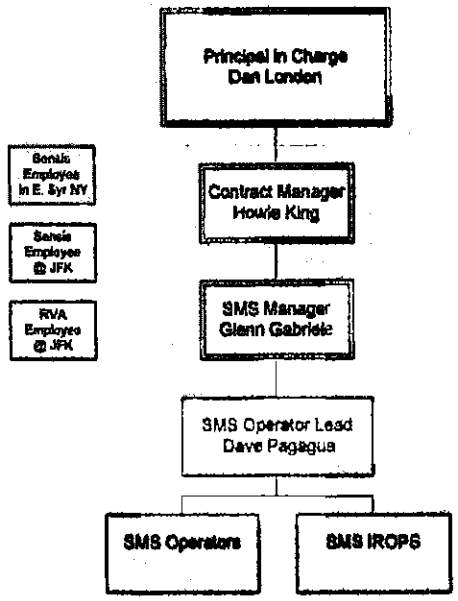
1.1 Staffing Overview

As the prime contractor, Sensis is responsible for all staffing requirements. Section F-3 - Management Proposal, provides a detailed description of the Aerobahn Product Team, the Implementation Team for this project and the ongoing Operational Team. A brief organization chart of the Implementation Team and Operational Team is provided below.

Implementation Team



Operational Team



1.2 Coordination Center Staffing

III. The contractor is required to provide Staffing as described herein and in the Contract Specific Terms and Conditions.

Staffing/Personnel are required to operate, interact, and maintain the System provided by the Contractor, therefore the proposed staffing level plan and Pricing Sheet provided by the Port Authority shall be included in the Contractor's proposal.

The proposal shall have a detailed layout describing the experience levels of the staff in relation, where applicable, to their knowledge of Air Traffic Operations in the Northeast Region and the National Airspace System.

The proposal shall reflect pricing for all staff necessary to host, operate, maintain and support the project, including an FCC licensed person who may operate a 'Metering Frequency" on site at JFK, and interface via radio with the Aircraft to communicate appropriate information if the Port Authority deems it necessary.

If the Port Authority decides to implement a procedure where the Contractor will communicate directly with Aircraft, it shall provide the Contractor with 30 days notice prior to the implementation of the 'Metering Frequency" option. The Port Authority reserves the right to invoke the option for various staffing levels to include or not include the FCC licensed radio operator.

Staffing will be necessary at all times demand typically exceeds capacity, between 0700-1000 and 1400-2300 EST, and during irregular operations such as a severe weather event. Staffing during Irregular Operations requires coordination with Airport Operations. Any increases or decreases in staff to support the operation shall require written approval by the Port Authority's Project Manager.

The key staffing requirements are those of the Metering Coordination Center. Sensis proposes to use Robinson Aviation (RVA), Inc., an aviation services company that specializes in air traffic control operations; communications engineering, installation, & maintenance; navigation and landing system engineering, installation & maintenance; aviation safety and CNS/ATM studies, and transportation security studies and planning.

RVA has been in business since 1986 and currently operates 93 air traffic control towers under the FAA Contract Tower (FCT) Program and two (2) Ramp Control Towers supporting the National Airspace System (NAS) with proven performance. RVA employs ramp control operators and over 521 air traffic controllers under the FCT program, engineers and technicians that are dedicated to satisfying customer requirements. RVA also administers the FAA Air Traffic Selection and Training (AT-SAT) examination, a pre-hire controller aptitude test, for the FAA.

1.2.1 Surface Management Systems Services

SMS Services will be provided at the JFK Airport by employing a SMS Lead Operator Lead, and four (4) SMS Operators. This basic number of operators may be supplemented by part-time operators to provide flexibility in position staffing and to provide for

supplemental work. Part-time positions provide efficiency for the operation, as well as contingency staff to and may be used to reduce the overall staffing in Phase B.

There will be one (1) operator on duty from 0700L-1000L and two (2) operators on duty from 1400L-2300L. The scheduled two (2) person shifts can be changed to different time frames based upon traffic flows/peaks and operational requirements as agreed upon with the Port Authority in coordination with FAA and other appropriate agencies/companies.

The SMS Lead Operator will maintain a close liaison with the FAA Operational Manager on duty and Airport Operations and will supervise the SMS Operator workforce and ensure safe, efficient and equitable performance of SMS services. Responsibilities of the SMS Lead Operator will include remaining operationally current on the positions of operation. After contract award, detailed services/standard operating procedures will be developed in concert with the Sensis, the Port Authority, the FAA and users. The procedures will be documented and provided to all parties of the agreement.

The SMS Lead Operator provides a monthly staffing plan to Sensis one (I) week in advance of the start of each calendar month. The schedule will include the names of all operators assigned o the SMS in the coming month, and show the dates they are scheduled to work and the shifts. He executes that plan using his more than 15 years of experience as a manager/supervisor. He will have a cell phone or beeper by which the Sensis Manager can contact him 365 days per year, 24 hours per day. He will attend User group meetings as needed during the year.

Surface Management Services provided, within the designated non-movement area, to aircraft are expected to include, but may not be limited to, maintaining close coordination with the FAA ATCT to insure ramp tower operations support and compliment the FAA's flow of aircraft on the airport, communicating as needed with airport users of the SMS. SMS Operator personnel will maintain status of all construction projects and other activity that may affect the status of ramp areas and other egress/ingress to ramps/taxiways. Recommend departure locations as requested by ramp controllers, adding ad hoc flights to the system as needed, assign taxi times and readjust as needed due to flight/taxi delays, coordinate with FAA New York facilities during periods of severe weather and severe weather avoidance plan (SWAP) events and work with NY TRACON when JFK is departing two runways and they are departure fix restricted.

1.2.2 Key Positions

1.2.2.1 SMS Operator

An SMS Operator shall be a highly qualified professional who will support the System in a tactical and pre-tactical nature, shall work on-site at JFK and shall be the primary System Operator during all times that the System is in operation. An SMS Operator shall have a thorough working knowledge of Air Traffic Management in the New York

Region, in particular, both knowledge of JFK airport operations and the impact of fix and route availability in relation to the health of the surface operation at JFK.

Each SMS Operator will be an experienced and skilled air traffic controller that has been previously certified by the FAA in a terminal facility or the individual will have considerable experience as a pilot, previous ramp tower operator or in a related aviation field. To the extent possible, local personnel that have previous experience at this or other large air carrier airports will be hired to operate the SMS. During Phase A, one (1) operator will be assigned to a shift from 0700 to 1000 daily. Two operators will be assigned to a shift from 1400 to 2300. The hours of double coverage may change based on requirements by the Port Authority and other signatory parties to the agreement. For Phase B we anticipate a reduction in staff for the 1400 to 2300 shift based upon enhancements to the SMS and utilization of part time operators. These positions will be located on Site at JFK.

1.2.2.2 SMS Lead Operator

RVA's Surface Management System, Operator Lead has an extensive aviation background and nearly 20 years of operations service experience as a Supervisor/Manager at the John F. Kennedy International (JFK) Airport and even more with the surrounding airspace. This position will be located on Site at JFK. His credentials include FAA Air Traffic Controller experience at JFK and the New York TRACON; Traffic Management Specialist at the TRACON, first line supervisor and Operations Manager at JFK. He completed the FAA Air Traffic Training Instructor Course and has a BA degree from Brooklyn College (see Appendix - Resumes). The knowledge, skills and hands on experience of the proposed SMSS will allow RVA to have an immediate ability to proceed with the procedures development and implementation required for this operation. He is FCC licensed and has extensive experience in operating the Ground Control frequency on site at JFK, and is fully capable of interfacing via radio with aircraft to communicate appropriate information if the Port Authority deems it necessary. The normal learning curve to gain local area knowledge, personnel familiarization and detailed knowledge of the airport/gate/ramp areas will not be required. RVA's proposed SMS Lead Operator has experience and detailed knowledge of the FAA personnel and other personnel within the Port Authority complex which will provide us the ability to be highly effective in minimum time.

1.2.2.3 Operator in Charge

When the SMS Lead Operator/Supervisor is not available he will designate an Operator in Charge (OIC) from the staff on duty and that person will perform the duties of the lead operator for the period of time the SMS Lead Operator is not present. The OIC duties will rotate among the operators and each will be trained on the OIC duties prior to being assigned to OIC.

1.2.3 Training and Certification

Each SMS Operator, regardless of previous training and experience, will be provided Orientation/Site Specific training from the RVA-developed training manual. Specific details contained in the manual will be finalized after award of the contract. This manual will contain, as a minimum:

(1) Airport Operations: Familiarization with the airport layout related to runways, taxiways, ramps, and all other areas on the aeronautical operating area (AOA) as well as with services provided at the Airports, and Airline locations;

(2) Airline Operations: Airline codes, Airport codes, the concept of code sharing flight numbers;

(3) Facility Communication: professional telephone conduct, airport terminology — phonetic alphabet, effective and appropriate oral and interpersonal communications, handling customer complaints, conflict resolution and dealing with irate customers;

(4) Familiarization with, and applicable procedures related to, required forms and reports;

(5) Appropriate Ethics and Conduct;

(6) Professional Appearance Standards;

(7) Appropriate Emergency Procedures and Notifications;

(8) Radio Usage, terminology and procedures; and

(9) Security Awareness.

RVA will provide specialized training to each operator on the Surface Management System operation and coordination with the users of the system to ensure that the operators use the technology to its full potential thereby increasing situational awareness and enabling efficient departure queue management. Initial training on the Surface Management System will be provided by Sensis and is scheduled to be completed prior to the start of Phase A on February 15, 2012.

Upon satisfactory completion of the academic training sessions, personnel in training will monitor/observe while a certified SMS Operator performs the job functions. After a period of observation, the trainee will perform the duties of the SMS Operator under the direct supervision of a certified SMS Operator. Upon recommendation of the trainer, the SMS Lead Operator will then complete a check-ride with the trainee, if the trainee's performance meets requirements; the trainee will be certified to independently perform the SMS operational position duties.

We will establish a minimum number of hours a person must train, based on the SMS Standard Operating Procedures manual, prior to being administered a written test on the training material and achievement of a satisfactory result. Personnel will then be assigned a position of operation under the direction of the SMS Lead Operator, who will monitor them for an established time frame to ensure their performance is certifiable. After an employee's initial certification is accomplished, periodic performance checks will be conducted and documented for all SMS Operators to ensure personnel performance meets professional standards and that they are providing safe and efficient service.

RVA personnel are indoctrinated, from the outset of their employment, in RVA's requirement to not only provide outstanding services but also to conduct themselves in a professional manner. If a complaint that an operator has displayed less than professional attitude is received; corrective action is taken immediately and feedback is provided to the person initiating the concern. Appearance is also a factor of professionalism, and RVA personnel will dress accordingly.

1.2.4 RVA Focus on Customer Service

One of the reasons that Sensis has selected RVA is that their approach to customer relations is a philosophy that permeates throughout the company and begins with the Chief Executive Officer, filtering down to every employee. The motto "do the job right the first time, every time" is accompanied by teaching the methodology of developing excellent relations with clients and other contractors, and in the case of working in operations, with all users and parties who are affected by the service. Each operator employed by RVA understands the history of developing and promoting the best possible working relationships. In the case of air traffic and ramp towers RVA emphasizes fostering associations with airport management, FAA staff, air carrier and terminal operators, and flight plan service providers. This approach encourages problem identification, informal investigation (in most cases) and prompt solution and resolution to most issues that arise. One demonstration of the benefits of this corporate principle can be seen in the following quote, taken from a letter received by RVA's Ramp Tower Manager at the Seattle Tacoma International Airport (SeaTac) Ramp Control Tower (Seattle Ramp Tower (SRT):

> *"Paul,*
>
> *Please accept my sincere appreciation to the efforts you and all the RVA staff contributed to the success of the Ramp Construction phase of this summer's airfield construction project. Not only were RVA staff instrumental in the conduct of daily movements of aircraft around the ramp construction sites, but your participation and input in the pre-construction*

coordination helped immensely in assuring a safe project and an efficient flow of aircraft despite the amended routes and procedures.

Sincerely,
Patrick Clancy
Manager Airport Certification
Airport Operations, Seattle-Tacoma International Airport"

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1. Functional Requirements

1.1 General Description of Services

The Contractor shall provide the Services to the Port Authority as described herein this Scope of Work. The essence of the work is to provide a Surface Management Solution with predictive capability enabling efficient queue management and sequencing on an allocation basis, and conflict alerting for arrival aircraft, operating at JFK. The allocation method shall be determined and approved by the Port Authority. The proposed solution shall take into account current and forecasted FAA, airfield, capacity and weather restrictions and combine with rationing principles to issue appropriate taxi times for departing aircraft. The intent of such procedures is to enable efficient management of flights by maximizing departure opportunities through supply of appropriate and sufficient aircraft to the departure queue. Additionally, the System shall allocate taxi times that reflect current and forecasted constraints to maintain departure queue lengths to multiple runways, as deemed appropriate by the Port Authority. This shall enable departing aircraft to minimize the amount of time spent on the taxi-out by absorbing most of the departure delay at the gate, or on other areas of the airfield, instead of absorbing it in the departure queue. The underlying system will also provide strategic, pre-tactical and tactical efficiency, post operations metrics and performance analysis of surface operations. The Service shall focus on improving overall safety, efficiency and predictability of surface and surrounding airspace by providing the necessary information to Users for the benefit of the entire airport and the national air traffic system.

The Users include but are not limited to The Port Authority of NY & NJ, Federal Aviation Administration (FAA), and other entities that utilize the Port Authority Airports to conduct business such as Airlines, Air Cargo Operators, Business and General Aviation Operators, Military, Ground Handling Companies, Flight Plan Service Providers and any other Stakeholder deemed appropriate by the Port Authority.

The Services provided through the System shall support, at a minimum, the following processes and fields:

Strategic, pre-tactical and tactical traffic flow management through allocations of taxi times

Pre-tactical and tactical departure management for merging into an en route stream or to a common departure fix(es) from multiple runway configurations;

Pre-tactical and tactical aircraft sequencing, scheduling and runway allocations to meet airport arrival and departure operating constraints; this method to achieve this function must be proposed by the Contractor and must support the needs FAA traffic management initiatives, weather constraints and other operational constraints. The proposed method is subject to Port Authority approval.

Provide situational awareness through real-time surface surveillance in movement and non-movement areas;

Fuel and emissions impact modeling and reporting;

Operational and post operations metrics and performance analysis and prediction summaries.

Gate conflict forecasting and alerting

Surface saturation prediction

The Sensis Aerobahn SMS Service is a multi-faceted tool for aggregating surveillance and flight data from a variety of sources and presenting it to the airport, airline, or ATM operator so as to provide real-time situational awareness, operations metrics, and historical playback and reporting (Figure 1). Further, Aerobahn makes predictions concerning future operations and alerts users to operations anomalies. Finally, Aerobahn provides collaborative decision-making tools to streamline departure flows and, in general, make operations management across the airport more efficient.

For situational awareness, Aerobahn offers a full-featured Map Display that depicts in real-time aircraft and vehicles on a detailed map of the airport. From this display, users can choose individual targets and view details about the aircraft, the flight, and scheduled, estimated, and actual movement times. They can configure custom alerts that will trigger and notify the user when events of particular interest occur. Tools are also available to view lists of flights both in tabular form and on a timeline. Finally, Aerobahn makes weather and NOTAM data readily available for reference.

To expand the usefulness of this situational awareness, collaborative tools are also provided. A built-in messaging tool allows users to carry on conversations either on a one-time ad hoc basis or continuously on radio-like channels that can be monitored by large groups of users. A new radio tool allows users to select local aviation frequencies and listen in on radio transmissions between controllers and aircraft. Further users can share reports, alerts, and virtually any other user-created products with other users within the application.

In the background, Aerobahn tracks aircraft movements and analyzes the data to produce statistics on airport operations. Some of these include arrival and departure rates, runway usage, taxi delay, deice pad usage, taxi times, and the impact of operations on fuel usage and emissions. All these statistics are readily accessible in easy-to-read tables and graphs.

With all this data available, Aerobahn has the ability to look ahead and forecast the activity of a particular flight, and thus the activity of the entire airport. The application provides predicted routes and waypoint times for each flight, even to the point of predicting potential problems such as hold-outs and gate conflicts. On an aggregate level, it provides tools that show the expected arrival and departure demand on the airport and gives users an idea of how soon the airport will reach a tipping point, for instance where overall arrivals start exceeding departures at a problematic rate.

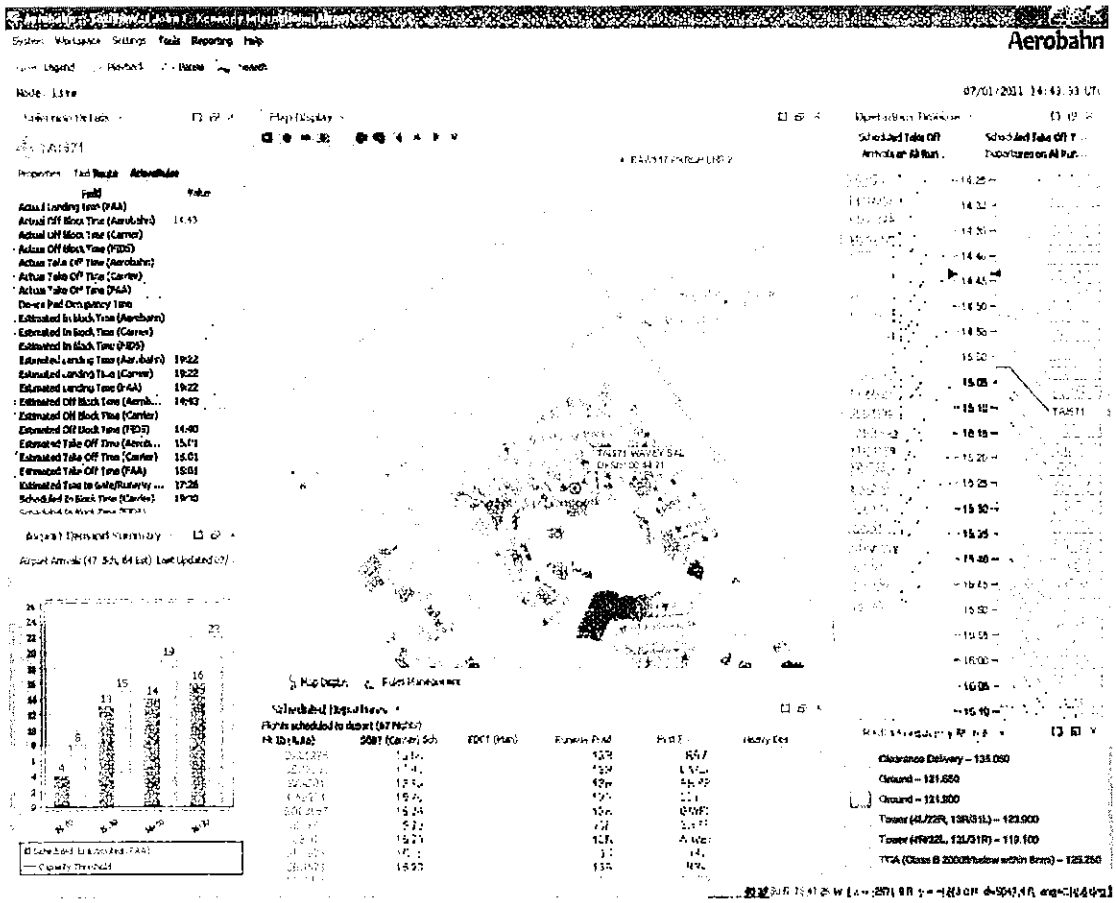
Aerobahn is also useful for looking back at historical events and statistics on past operations. Users can call up reports detailing individual flight operations or statistics summarizing airport operations or usage (such as gate or runway occupancy). From these reports, the user can drill down to a specific moment in time and watch a playback of the airport activity, complete with the audio from radio transmissions.

For the Port Authority, Sensis has brought Aerobahn to an unprecedented level of maturity by adding highly sophisticated departure metering algorithms. This automated

functionality, employed primarily during constrained operations, produces a list of rationed slots divided fairly among the airlines; assigns scheduled flights to the slots and provides optimal push-back times; and sequences flights to maximize the use of each runway. Throughout this process SMS or airline operators can manually intervene to customize the slot assignments as needed.

The sections below describe this functionality in detail.

Figure 1 Aerobahn SMS Service



1.2 Description of Work

The Work requires the design, development, installation, hosting, operation, administration, maintenance and management of a System, as well as training and supplying an ongoing Help Desk support to the Users, for a predictive surface management capability, which shall calculate, at a minimum, forecasted operations for flights, including off block and in block times, runway times, spot times and taxi times. Using these predictions, the Service shall provide a display of predicted runway queues along with the anticipated delays for each queue. Such features shall

support not only tactical control of surface operations to result in optimal queuing of aircraft to ensure constant pressure on the runway when demand exists. The System shall also support strategic surface planning and forecasting for the Users who include, but are not limited to various department heads and staff from The Port Authority of NY & NJ, the FAA, Airlines, Air Cargo Operators, Business and General Aviation Operators, Military, Ground Handling Companies, Flight Plan Service Providers and any other Stakcholder deemed appropriate by the Port Authority.

The Service shall enable active management of surface gridlock and terminal/gate congestion through predicting surface saturation and providing alerts to the Users. The gate terminal/gate conflict alert shall be configurable to support a variety of User work processes. Through surface saturation management, the Service shall support the Users during development and execution of pre-tactical plans to maintain the number of flights at the airport within manageable bounds. The Service shall be configurable to allow for the design of an airport, airline and/or terminal-specific flow rate program, tailored to the anticipated and predicted surface problem. Using specified parameters, the service shall assign recommended aircraft arrival and departure times to balance the distribution of flights on the surface and alleviate predicted congestion issues.

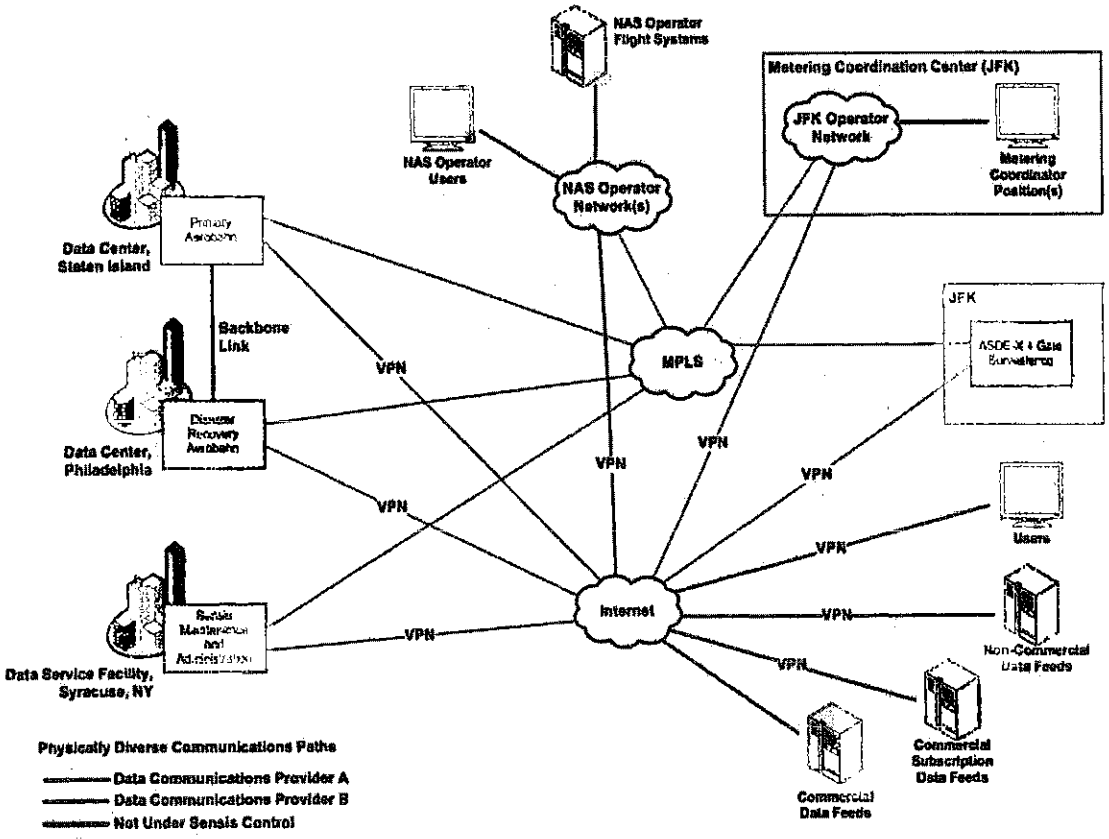
The existing Aerobahn platform; which provides situational awareness, operational analysis, and tactical and strategic prediction; augmented with the integrated, full-featured departure metering capability will provide the Port Authority and its stakeholders the ability to manage surface operations to an unprecedented level of efficiency. By providing up to the minute awareness of queue lengths, movement area congestion, and taxi delays; by holding aircraft at the gate rather than on the movement area to reduce congestion and fuel consumption, by providing continuously updating airport demand and tipping point predictions, and by alerting on critical road-block events such as gate conflicts and taxiway bottlenecks, Aerobahn will become, not only the eyes and ears of the airport management community, but a trusted analyst and advisor as well.

1.2.1 Hosting the System

The Contractor shall host the System and its components in a protected, secure environment that is not on Port Authority property, subject to Port Authority approval, and in compliance with the requirements stated in Section V. B. Security Requirements. The System shall be built using a fault tolerant architecture in compliance with the requirements stated in Section V. C. System Architecture, and the backup or failover servers and components shall be installed in a diversely located data center to support disaster recovery and protect the System, and prevent any disruption of Services due to a catastrophic event in the primary data center.

The Aerobahn SMS Service architecture depicted in Figure 2 features multiple levels of redundancy, industry standard security, and ubiquitous fault monitoring. Further, the system is maintained and administered by engineers and customer service professionals working side-by-side with the engineers who designed it.

Figure 2 Aerobahn SMS Service Architecture



While the system is administered from Sensis headquarters in Syracuse, the hardware and software are located in two geographically separate facilities for rapid disaster recovery. The software runs on virtual servers and the data is stored using network attached storage for self-redundant, instant fail-over operations. The communications between the host facilities, surveillance system, and the client networks are high-bandwidth, redundant, and protected, either through encryption or dedicated communication lines.

Additionally, Sensis adheres to all applicable industry best practices for security and web-based application hosting in its administration of Aerobahn.

Full details are provided in Section V.

1.3 Functional Requirements of Initial Implementation-Phase A

The requirements listed below represent, at a minimum, the Services that shall be provided by the Contractor as part of the Initial Implementation, in accordance with the implementation phasing stated in Attachment C, Section II.A.2. entitled, Implementation Schedule. The proposed methods to achieve this functionality are subject to approval by the Port Authority.

Sensis proposes to address the requirements in RFP Attachment C, Section IV.C as delineated in the following sections. These features and functionality will be provided during Phase A of system deployment.

1.3.1 Airline Schedules (C19)

19. The system shall automatically retrieve published airline schedules from a Port Authority approved source for 48 hours in advance of the current time and should save any changes i.e. cancellations, time changes, etc.) input by the Users. The Airline schedules shall be displayed in an orderly manner, based on the scheduled time of departure.

The Aerobahn Platform is an integration platform, designed to tie together disparate systems to capture the complete airport context. Aerobahn leverages publicly available data sources and will also interface with any number of proprietary systems in order to obtain flight information from the Port of New York and New Jersey and its stakeholders. The addition of proprietary data enhances existing product features by creating a more robust picture of airside operations. Data elements that can be incorporated into Aerobahn include airline schedules, flight status, gate assignments, crew information, irregular operations information, priority flight indicators, and many others. Access to proprietary, competitive data elements will be restricted to ensure that only the owner of a data element will be able to see that information.

Aerobahn accesses airline schedule data at least 48 hours in advance from the following sources in priority order:

Figure 3 Airline Scedule Data Source Access Order

Data	Source
Aggregate Demand List	CDM Hubsite - Volpe
Airline flight data	Airlines (direct feed)
OAG	OAG Aviation
FIDS	FIDS
FlightStats	FlightStats

Currently, Aerobahn at JFK makes use of the direct airline feeds, FIDS, and FlightStats for flight schedule information. Sensis acknowledges that the data required for departure metering needs to have a more complete coverage of every airline and flight and is therefore already in the process of enhancing Aerobahn to incorporate the Aggregate Demand List from the FAA's CDMNet and a dynamic OAG data feed. These new data sources combined with Aerobahn's advanced data correlation and prioritization algorithms, will fill any of the current gaps in Aerobahn data and ensure Sensis is able to

provide the most accurate and up to date and detailed flight schedule information available.

What on the surface seems like a simple problem is actually incredibly complex due to the large number of varied data sources with conflicting and overlapping information. Nobody in the industry has as much experience integrating and coalescing real-time flight data feeds at an airport than Sensis. Having dealt with a large number of airports, airlines, and airport systems, the actually data delivered never matches initial expectations and requires a long time and a lot of work to handle each intricacy. This is yet another area where Sensis' expertise, and direct JFK experience, will reduce risk and shorten the timeline for success.

With the addition of departure metering, Aerobahn will also allow users to manually add new flights, such as General Aviation, or edit schedule information in real-time. The SMS Operator staff will be able to handle pop-up GA flights quickly and easily, making sure that they too fit smoothly into the metering process.

1.3.2 Departure Management Capability (C1,2,3,4,5,12,13,20,21,24)

1. Departure management capability utilizing rationing principles

2. Allocate "call-for-taxi" times (CFT's) based on set rules and protocols using rationing principles and calculation under the guidance of the Port Authority

3. Automatically populate scheduled flight information through a Port Authority approved source, such as ETMS (Enhanced Traffic Management System) into the departure management capability of the System. Additionally, the Service shall have the capability to manually input and add flights, which are not automatically populated. Such type flights may include non-scheduled, ad hoc, ferry flights and general aviation flights.

4. Automatically populate a "call-for-taxi" time based on Port Authority approved parameters.

5. As conditions and demand require, monitor and process substitution requests for eligible flights based on Rationing principles and other variables deemed appropriate by the Port Authority

12. Recommend departure delay parking locations as requested by ramp controllers ("metering" locations are subject to approval by the Port Authority). An example of the metering locations is provided in Exhibit 7, Available Holding Spots Overall. The "metering locations" provided in Exhibit 7 are subject to change.

13. If departure delay is taken at the gate, movement area metering location, or other non-movement area metering location, continue to actively manage flights in the program

20. The Users shall have the capability to input a time reflecting the earliest time that an aircraft can be ready to taxi for departure. The System shall receive this information and allocate taxi times respectively.

21. The Users shall have the capability to swap flights under their control to self-prioritize based on the rationing principles set forth.

24. The system shall provide the capability to add flights to the schedule. Examples of such flights

include but are not limited to non-scheduled, ad hoc, ferry flights and general aviation flights.

In Phase A, Sensis will deliver new Aerobahn SMS features to support a fully functional departure metering program run by Robinson Aviation's SMS Operators. The Phase A solution implements *Count Based Metering* similar to the process that is in place today at JFK, in which departures are divided into time bins or buckets and each airline or terminal group are rationed a percentage of the allowed flights in that period. The slot rationing algorithm utilizes planned and observed runway configurations and throughput rates to determine the number of departures that can be supported in each interval in order to maintain the desired queue length. Based on this rate, airlines or terminal groups are allocated a percentage of this reduced rate (assuming it is a capacity constrained period) matching the percentage they were responsible for in the original schedule. Carriers with a very low number of flights can be pooled to ensure they receive adequate representation.

After the equitable rationing of departure slots to carriers or terminal groups, flights are automatically assigned to the time bins in the order they were scheduled. Updated Target Off Block Times (TOBTs) input by the carrier manually or through a direct data feed are also accounted for, ensuring that flights are not assigned departure times they cannot achieve. All metering is done at the movement area and the time bin refers to the allocated Target Movement Area Time (TMAT) or Call-for-Taxi (CFT). The term TMAT is predominately used in this document to ensure consistency with the FAA's Surface CDM Working Group and a growing industry acceptance of the term. The delivered product will use whatever term the Port Authority chooses. The automatic assignment of flights to time bins is done as a convenience to reduce the amount of manual input needed; adjustments can easily be made by the SMS Operator or authorized aircraft operator users through a simple drag-and-drop interface.

Even though the proposed Phase A solution utilizes aggregate buckets, Aerobahn will still calculate a flight specific TMAT time for every flight. This provides significant benefit as it makes the time available in Aerobahn's many real-time tools and rules and builds the foundation for Sensis' more accurate flight sequencing in Phase B. Furthermore, Sensis Phase A solution utilizes the development and collaboration Sensis participated in with the FAA, Delta Airlines, and industry partners in Memphis as part of the Collaborative Departure Queue Management (CDQM) project. In review, the proposed Phase A solution:

- Incorporates Sensis' latest rationing algorithms to ensure equitable distribution within the buckets;
- Utilizes metering by buckets, which is the currently employed system to minimize the training and transition pain;

- Utilizes the already fielded FOSA departure metering interface, which has received favorable feedback from Delta Airlines, to reduce risk and improve likelihood of quick success;
- Maintains all crucial components of the Port Authority's current departure metering program with the additional benefits of:
    - Integrated conformance monitoring
    - Integrated situational awareness (metering, communications, and graphical displays are unified and consistent)
    - Improved automated mechanism for requesting and assigning metering points, enabling more frequent and effective use of metering points
    - Metering point tracking
    - Metering by runway instead of airport wide
    - Playback and reporting on metering assignments and performance

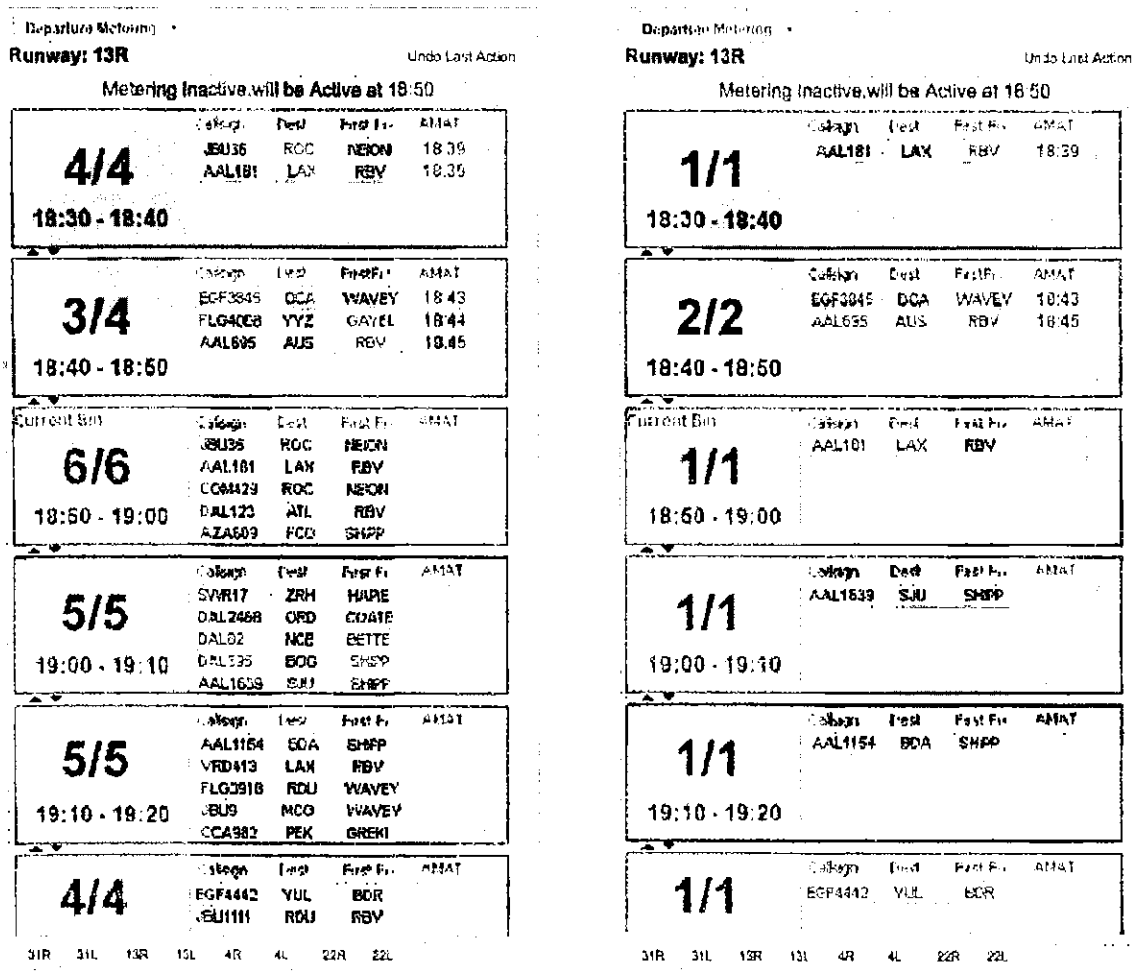
1.3.2.1 Phase A Departure Management Process and Tools

The primary Aerobahn Tool used in Phase A Departure Metering divides the day into a configurable number of departure bins for each runway. The number of bins is determined by the set bin length, e.g., 10 minutes. Looking ahead a configurable amount of time it applies the chosen rationing algorithm which assesses the schedule and assigns flight counts to each successive bin in such a way as to fairly distribute the available slots among the various carriers. Aerobahn Departure Metering is designed such that various rationing algorithms may be substituted for optimum performance. The rationing process takes into account the projected departure rate for the runway, desired (configurable) queue length (or queue wait time), and the actual observed queue length, to determine how many flights to assign to each successive bin.

Once each bin is allocated its flight counts, the algorithm looks at all the flights waiting for departure, and automatically assigns those with the earliest schedule time to the bins for each carrier.

Figure 4 depicts a series of bins with flights from various carriers assigned. The display on the left is the view the SMS Operator sees, and the view on the right is that to which a specific airline or terminal group coordinator would access.

Figure 4 Departure Metering SMS Operator (left) and Airline Operator (right) Interfaces (Concept)



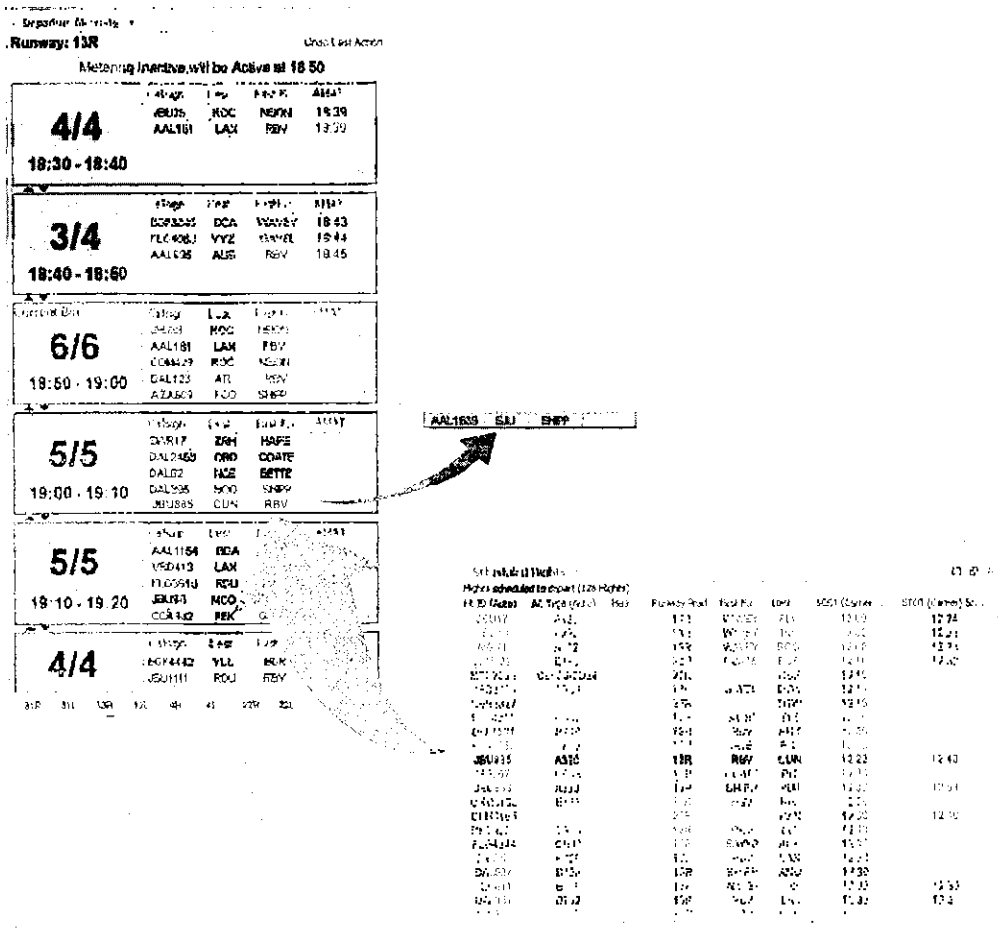
At the top of each display is the associated runway. The displays are split into a number of horizontal boxes, each box representing a time bin. Each bin is labeled with its start and end times; bins from the past and future are differentiated by color. The large pair of numbers in each bin represents the number of flights assigned and the number of flights allocated to that bin. In the figure on the left, the numbers are the total for all carriers; on the right, they are for one carrier only. Finally, the flights assigned to each bin are listed.

For Phase A of departure metering, the call-for-taxi times are the bin start times. Airline or terminal operators can monitor the metering displays for the various runways and time aircraft gate departures accordingly.

Once the flights are assigned, operators can use the mouse to drag-and-drop flights between bins to manually adjust runway rationing. The SMS Operator has the capability to move any flight and can also overload a bin with more flights than are allocated, though in that case, the bin color will change to alert the user of the violation. Thus the recommendations of the tool may be overridden as circumstances and human judgment

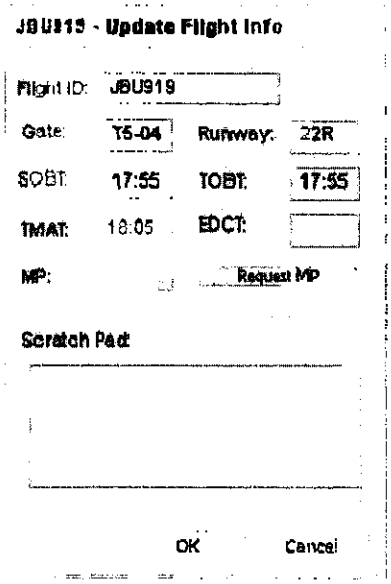
dictates. Airline or terminal operators are not allowed to overload a bin, however operators at either level may drag flights from a list of scheduled flights to replace flights in the any bin, including flights that were added manually, such as ad hoc or general aviation flights (see Figure 5).

Figure 5 Flight Substitution (Concept)



In Phase A, airline or terminal operators will be able to request Metering Points if a departure is occupying a needed gate. This is done simply by right clicking on a flight in any of the real-time tools and selecting the appropriate context menu which will bring up the Update Flight Info Dialog, Figure 6. By again integrating more data directly into the Aerobahn SMS, that information can be leveraged for compliance monitoring.

Figure 6 Dialog to Update Flight Info and Request Metering Point



The Aerobahn SMS System determines aircraft positions from the airport surveillance and tracks the movements of individual flights by defining geometrical regions on the airport surfaces and noting when each aircraft enter and leave each region. The inherent capability to identify and track aircraft on the surface of the airport makes it easy to monitor metering compliance since each departure is assigned a specific TMAT time. Once a flight has departed, Aerobahn calculates the time difference between the TMAT and the actual time the aircraft reached the spot. This deviation (if any) is added to the flight information for each flight. It can then be used by alerts to tag a non-compliant flight visually or aggregated for display and logged for reporting.

The SMS Operator, staffed by Sensis, monitors the airport situation via the Aerobahn display and, taking into account current and predicted taxi times, surface congestion, runway assignments, metering times, and other factors, makes the necessary modifications to bin rationing and flight assignments to ensure the airport runs as smoothly as possible. Further, the operator keeps attuned to metering point availability and responds to operator requests for metering point recommendations.

The coordination staff provided by Sensis is experienced with surface operations in general and the JFK environment in particular. Using the knowledge and intuition gained through this experience in conjunction with the powerful departure metering tools built into Aerobahn, they make the difference during irregular operations between an airport with improved performance, and an airport with optimum performance.

1.3.3 Chat (C6)

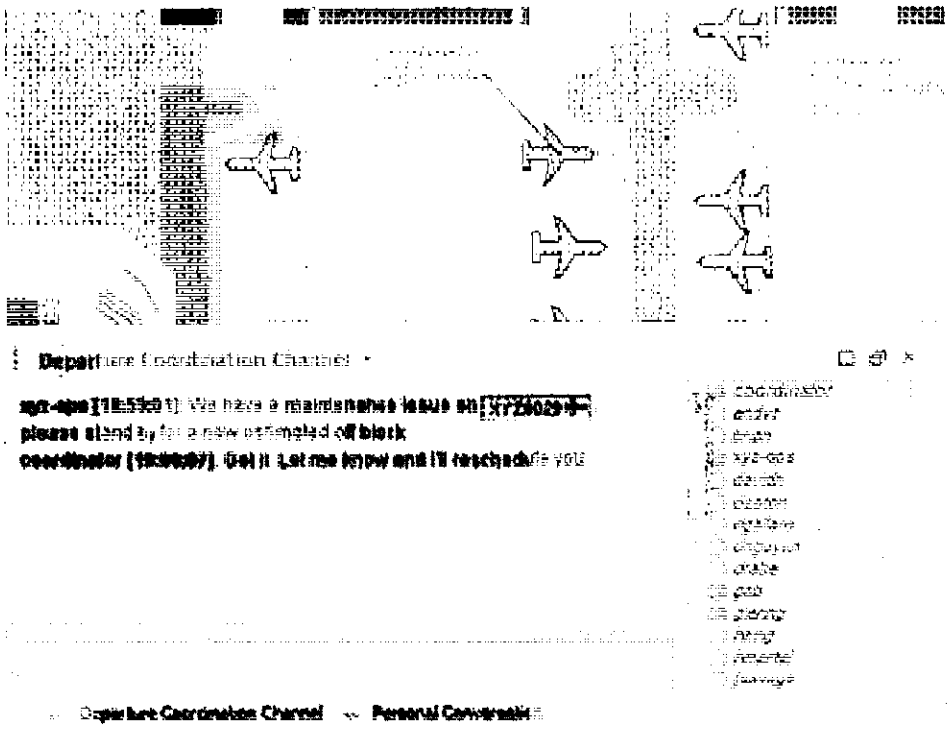
6. Provide an interface enabling instant communication, textual and otherwise, with all parties (i.e. a chat function) for information sharing or another Port Authority approved method

The Aerobahn Integrated Chat System is a set of communication tools that allow users to converse directly within Aerobahn. Supporting private conversations, public group discussions, a secure permissioning scheme, full auditing capabilities, and drag and drop flight call-outs, the Aerobahn Chat System will enable the Port Authority and airport stakeholders to collaborate efficiently and effectively. Within Aerobahn, the existing global chat room used for departure metering discussions today can easily be replicated. Additional chat rooms or private conversations can also be setup to enable more controlled discussions amongst a smaller audience. Regardless, all communications are recorded and fully auditable by authorized users. The Aerobahn Integrated Chat System also ties together shared situational awareness and alerting so that users can easily highlight flights for discussion and take action when consensus is reached.

These tools (Figure 7) enable users to communicate with other users in a temporary Chat Conference or as part of an ongoing Chat Channel. Any user can initiate a Chat Conference at any time simply by the selecting the name(s) or one or more other users from a list. The conference members type messages which can be instantly seen by all members of the conference. Conferences are useful for communicating amongst a small group of people on issues that arise spontaneously.

Application administrators configure chat channels by selecting member groups and users and assigning the channel a name. Any member may sign in to the Chat Channel at any time and view and contribute to the ongoing discussion. Channels benefit users who want to maintain an ongoing discussion on a topic or group of related topics relevant to all the channel members.

Figure 7 Aerobahn Chat



1.3.4 Traffic Display (C15,16,18)

15. The System shall provide the capability to view live, current data and archived, warehoused data, both on separate screen displays and in reports.

16. Provide live flight tracking of inbound and outbound flights from the surface to 10,000 feet and within a 100-mile radius of the airport for 15 Port Authority Users.

18. Provide a Graphical User Interface displaying surface surveillance. This feature shall display real-time information and have historical playback capability

One of the key features of Aerobahn is the ability to view surface traffic live in real-time and historically in playback and reports.

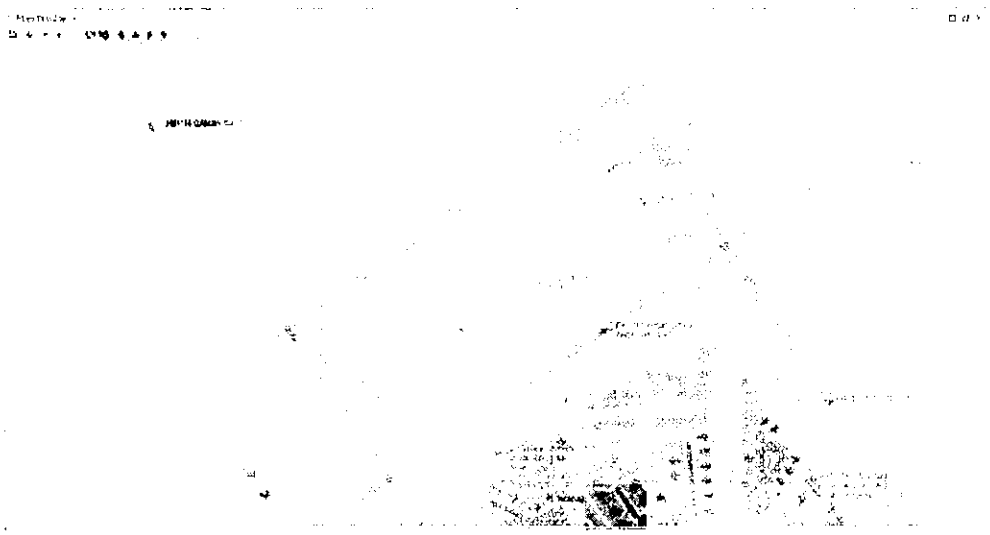
The Aerobahn Map Display (Figure 8) depicts the airport surface in fine detail, and displays aircraft and non-aircraft vehicles in their current positions. Positional information is gleaned from the Airport Surface Detection Equipment – X Band (ASDE-X) system at JFK and tagged with flight information NAS operators, the FAA, and various commercial providers.

Map Display can also depict past activity at the airport through the Playback tool. Playback allows users to select a date and time in the past and play the data as though it were happening live. Playback may be run at up to 10x speed. For example, immediately

after a return to gate event occurs, a single button press allows the user to see the airport configuration and all aircraft taxiing on the surface when the return to gate occurred, along with corresponding flight number and schedule information. The sophisticated playback mechanism allows users to review situations in detail, to more clearly understand exactly what transpired with the goal to objectively reach consensus on potential solutions for resolving problems. The playback feature includes the capability to adjust the speed of a playback from real-time (1x) to ten times the original speed (10x) and to select the aircraft to visually highlight. This mechanism integrates seamlessly with OpsView tabular flight reports such as the Taxi Time Report. Flight event times may be selected from within OpsView for playback within TaxiView. See Section 1.4.1.8 for details.

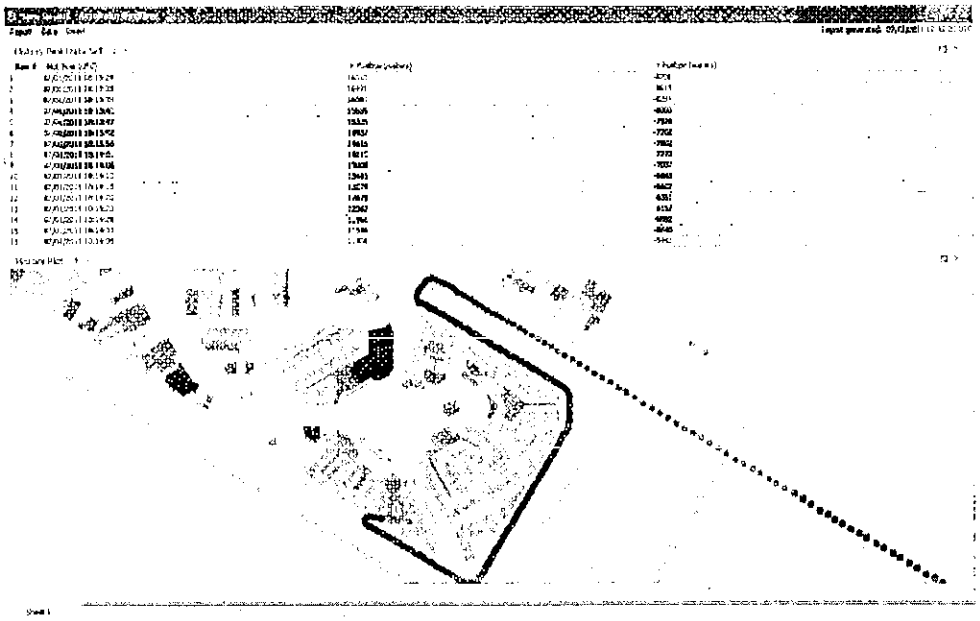
A detailed description of Map Display is provided in Section 1.4.4.3 and 1.4.4.4.

Figure 8 Map Display Example



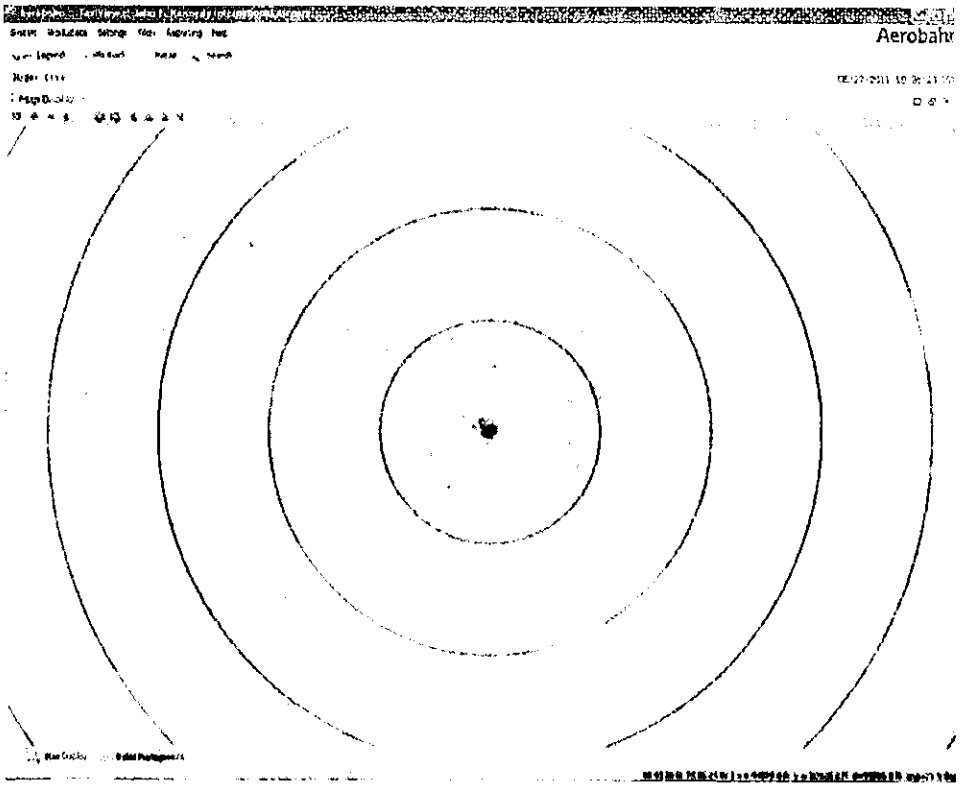
Positional detail for individual flights may also be obtained using the Location History report. By entering a timeframe and a callsign, a user can see a map-based plot of the entire movement history of a particular flight (Figure 9).

Figure 9 History Plot Report (Concept)



In addition to tracking aircraft on the surface of JFK, Users will also be able to zoom out to 100 nautical miles and see aircraft arriving at JFK at altitudes up to 10,000 feet (e.g. Figure 10). Note, flight updates at this high-level come ultimately from TFMS and are delayed up to one minute.

Figure 10 Aerobahn High Level Zoom



1.3.5 Flight Alerting (C10,17)

10. Monitor aircraft that are experiencing excessive time off the gate or stand and provide configurable alerts to notify the flight operator or other approved user of the flight status.

17. Automate alerts for critical events such as: aircraft arriving at key locations both Enroute and/or on the ground (such as a metering location or arrival fix), arrival aircraft assigned to a gate that is currently occupied, and when the taxi time of an aircraft exceeds a user-defined number of minutes. Users shall select the method of notification, to include, but not limited to: on screen display highlighting the aircraft that triggered the alert condition, audible workstation alarm and electronic methods such as email, text message, etc.) to an individual or groups.

Sensis engineers recently added a fantastic new feature to Aerobahn allowing users to levy operational criteria on the live data to highlight aircraft of interest and trigger alerts, and notifications on critical events. This feature, the Dynamic Rules Engine gives users the ability to configure rules consisting of virtually any set of criteria on virtually any flight-centric data processed by Aerobahn. The user simply selects a series of flight data elements and levies criteria on each. Figure 11 is a simple example:

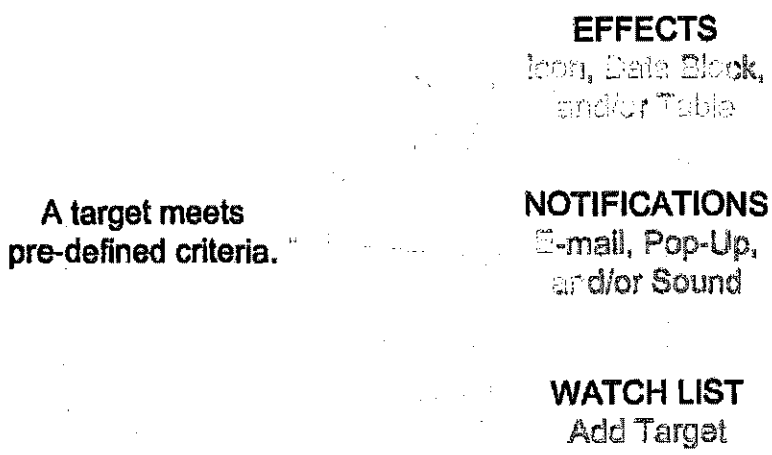
Figure 11 Simple Rule Example

```
Criteria
  Direction is Outbound. and
  Is currently in a region of type Runway Departure Queue now.
Actions
  Add Filled Circle decoration
  Add to watch list In Dep Queue
```

In this case, the rule looks for all Outbound flights that are currently in a Runway Departure Queue region of interest. For each it finds, it adds a filled circle to the aircraft icon, and adds the flight to a watch list.

When one or more flights meet the rule criteria, the rule triggers and alerts users. A triggered rule can cause a target's attributes to be modified by visual effects, such as a change in icon color, an icon decoration (circle, start), or a change in data block contents or color; notifications, such as an email, cell-phone text, or audible alarm; or additions to a watch list (a list of flights all meeting the same specified criteria).

Figure 12 Dynamic Rules Operations Concept



Once a rule is configured, it is saved as part of the user's preferences. Additionally, a user may share a rule with others.

Since all rules (alerts) are separately configured, each can drive different actions and each can be toggled on and off depending on the operational needs of the time and the user. The permutations of conditions and alerts are almost limitless.

If the surveillance and flight data within Aerobahn are the backbone of its surface

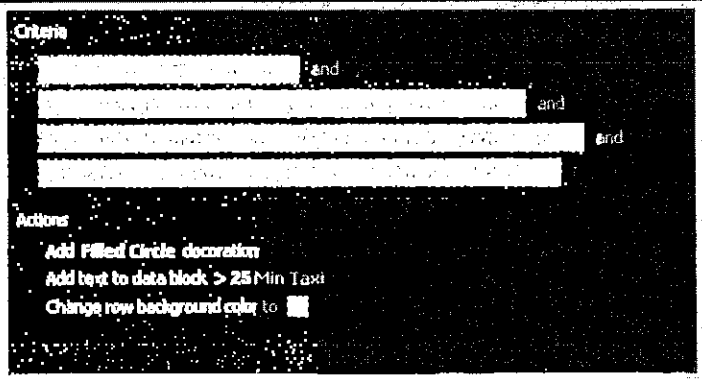
management capability, Dynamic Rules are the muscles. By properly defining rules, airport operators can completely characterize the surface traffic so that, at a glance, the status of every aircraft is known and unusual circumstances or events are highlighted. This at-a-glance information presentation relieves operators from having to keep the details of the surface situation in their heads and allows them to focus on the task at hand. Further, Aerobahn's alert notifications bring urgent situations to the forefront even when the operator's attention is distracted.

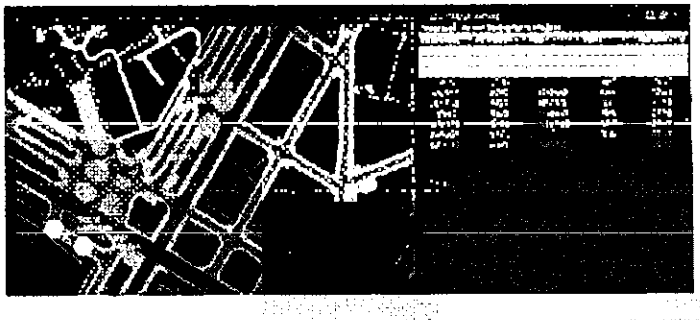
To provide additional understanding of this valuable concept, more alert examples are presented below: Excessive time off gate (before take-off), arriving aircraft entering an arrival approach corridor (while still in the air), arrival aircraft with its gate occupied, and excessive inbound aircraft. Please note that all these examples are implemented in the Aerobahn System and available to users today.

1.3.5.1 Excessive Time off Gate Example

Figure 13 provides details on an example on how Aerobahn's Dyanmic Rules can highlight aircraft that have a greater than 25 min taxi time. (Please note that the 25 min is for example purposes only and the users have complete flexibility to select any desired time. Typical users will establish similar alerts at 60, 90, and 120 Min to manage DOT long on board rules).

Figure 13 Excessive Time Off Gate Alert

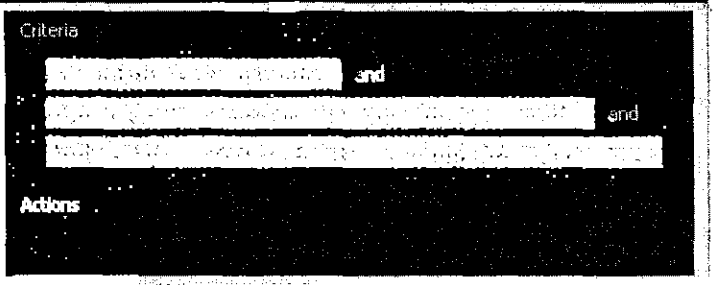
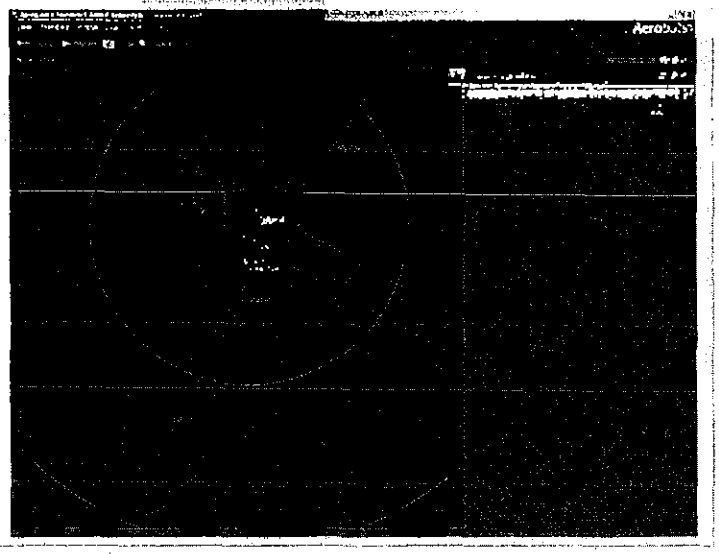
Step	Description	Example
Establish a rule to identify and create a list of aircraft in the taxi out phase	Use drop down menus to define criteria Dynamic Rules uses to select aircraft	
Establish a rule to highlight aircraft that in this case exceed a 25 min taxi	In this case the previous rule was copied and additional criteria was added: *Taxi Time (Auto) is greater than 25 minutes*	
Select actions	In this case actions were chosen to put a circle around the aircraft icon, add the text, **" < 25 Min Taxi", and highlight rows in** the list	

Step	Description	Example
Other options available – not chosen in this example	Some available options were to create a pop-up window, send a SMS message, send a email message, or populate a watch list. A watchlist stores all the targets meeting the criteria in the database for future reporting.	
Results	In this example of a TaxiView workspace there is a list of all Aircraft Taxiing Out with their ID, Type, Reg Number, Destination, and Current Taxi Out Time. Additionally all aircraft that have > 25 min Taxi Out time are highlighted.	

1.3.5.2 Arriving Aircraft in an Arrival Approach Corridor Example

In the Figure 14 example below, a list will be created to identify arriving aircraft that are in the approach corridor of any runway.

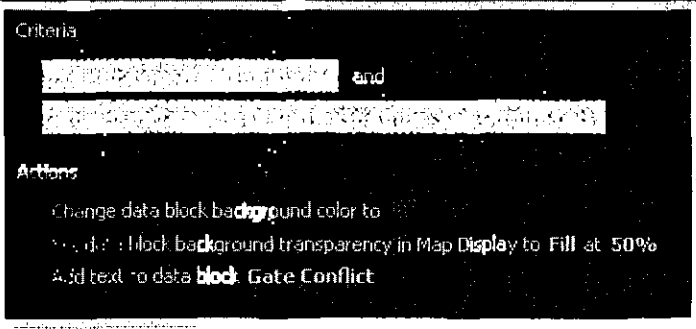
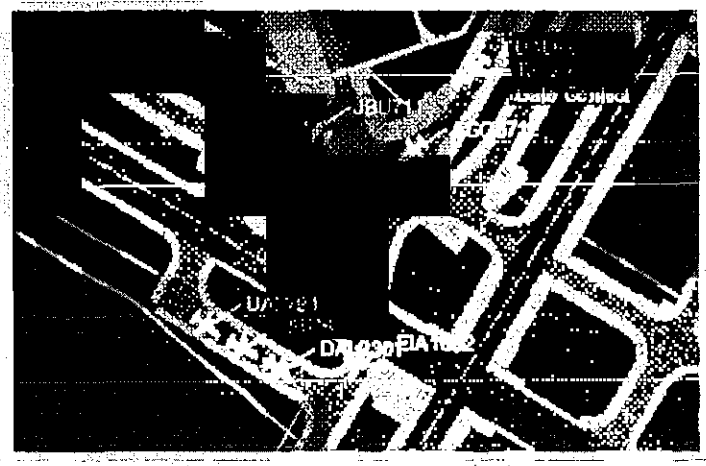
Figure 14 Arriving Aircraft in an Approach Corridor Alert

Step	Description	Example
Establish a rule to identify and create a list of aircraft in the approach corridor	Use drop down menus to define the criteria that Dynamic Rules uses to select aircraft	
Results	The approach corridor regions have been exposed to show two occupying aircraft graphically. They also appear on the Watchlist to the right.	

1.3.5.3 Arriving Gate Occupied Example

In the Figure 15 example below, all arriving aircraft that have their assigned gates occupied with another aircraft will be highlighted in TaxiView.

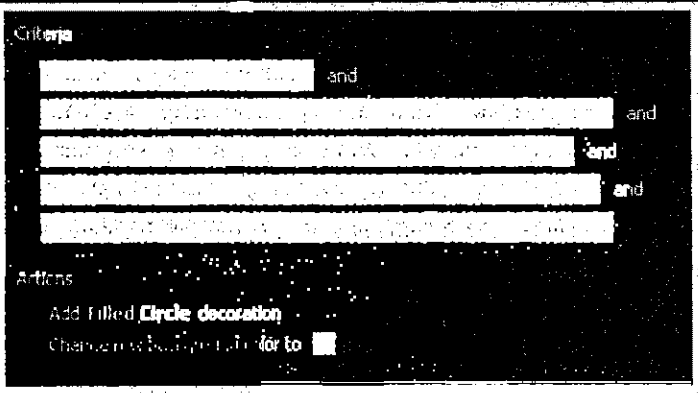
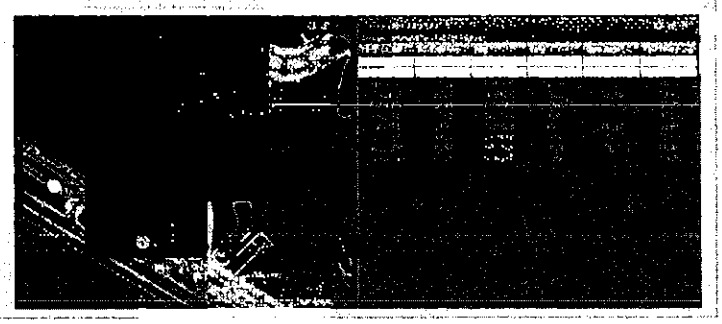
Figure 15 Arriving Gate Occupied Alert

Step	Description	Example
Establish a Rule to Identify Arriving Aircraft whose gate is occupied.	Use **drop down menus to define the criteria that Dynamic Rules uses to select aircraft**	
Results	A magenta box in the background of the datablock with the text *Gate Conflict* Added	

1.3.5.4 Excessive Inbound Taxi

In the Figure 16 example below, the excessive inbound taxi alerts are constructed in a similar way to the excessive Out Bound Taxi.

Figure 16 Excessive Inbound Taxi Alert

Step	Description	Example
Establish a Rule to Identify and Create a List of Aircraft in the Taxi In Phase, where the taxi time is greater than 25 minutes	Use drop down menus to define the criteria that Dynamic Rules uses to select aircraft	
Results	A workspace that has both conflict alerts and excessive inbound Taxi Alerts. Also, rows in the inbound taxi list are highlighted when the taxi time exceeds 25 min	

1.3.5.5 Additional Alerting

In addition to a powerful Dynamic Alerting Engine, Sensis brings world-class operational expertise in helping our customers make the best use of the engine to solve real problems. The following table (Figure 17) is a snap shot of some applications for Dynamic Rules.

Figure 17 Typical Applications for Dynamic Rules

Long On Board Delay Alerts	
Name	Description
Long On Board Arrivals (60,90,120)	Alert station operations when a plane has greater than a (60,90,120) min taxi-in time and less than (90,120)
Long On Board Departures (60,90,120)	Alert station operations when a plane has greater than a (60,90,120) min taxi-in time and less than (90,120)
General Operational Alerts	
Name	**Description**
A14 Arrival Management	Alerts when an aircraft is on the ground and is between A0 and A15
Critical Arriving Flights	Alerts on arriving flights in a critical flight list
Critical Departing Flights	Alerts on departing flights in a critical flight list
Gate Conflict Alerting	An Arriving aircraft is under surveillance and its planned gate is occupied

Large PAX Connect Alert	Arrivals with large # of connects that is behind schedule.
Departing Aircraft in "Penalty Box"	Alerts and Lists when an AC is in a Departing "Penalty Box"
Arriving Aircraft in "Penalty Box"	Alerts and Lists when an AC is in a Arrival "Penalty Box"
Late updating Arrival Schedule	Alerts when a plane has not yet arrived past its latest estimated time
Late updating Departure Schedule	Alerts when an aircraft is at the gate pasts its scheduled departure time, a new departure time is needed
Crew Time Out	Alerts when a Crew is about to time out
Ramp Control Alerts/Rules/Lists	
Name	Description
Arrivals List	List of Arrivals within a XX Min Window
Arrivals Under Surveillance/Not Landed	Lists of Aircraft that are expected to land shortly
Taxi In Lists	List of Aircraft Taxiing In
Movement Area to Ramp Arrivals	Watch List for Aircraft Holding in the Movement area waiting to cross into the Ramp Area.
Arrivals in Ramp	Aircraft enters the ramp area and In Block Msg not received
Aircraft Parked at Gates List	List of all aircraft parked at Gates
Aircraft Near Departure Time	Departures within X minutes of current time – lists with highlight colors
PAX Loading List/Indicators	Departure Lists can be created or elements of lists highlighted when that AC begins boarding
Runway Indications	AC in the gates can be highlighted to show which runway they are headed towards
Gate Holds	Ramp Operator Puts an aircraft into a hold state
Released for Departure Lists	List and Indications when a plane is released by Ramp Control
Departures in Ramp	Watch List triggered when a plane Blocks off the gate and ends when it enters the movement area.
Departures in the Movement Area	List of Departing Aircraft in the Movement Area
Departure Zone Filters	AC can be filtered by Gates to allow a ramp controller to have detail on a subset of all Aircraft
Arrival Zone Filters	AC can be filtered by Arrivals Gates to allow a ramp controller to have detail on a subset of all Aircraft
Screen Control Rules	
Name	Description
Turn off Data blocks in the Ramp Area	Turn off Data blocks in the Ramp Area
Turn off Data blocks in the Gate Area	Turn off Data blocks in the Gate Area
Delcing Rules	
Name	Description
Aircraft in De-ice Queue	Lists of AC in a De-icing Queue
Aircraft in De-ice Pad	Lists of AC on a De-icing Pad

Aircraft Exiting Pad - Waiting for Clearance	Lists of AC leaving a De-icing Pad
FAA Alerts/Communications	
Name	Description
Ramp to Center Re-Route	Indication that a departed flight needs to be re-routed by the FAA
Center to ATC Tower Re-Route	Indication that a departed flight has been re-routed by the Center, needing confirmation from the ATC Tower
ATC Tower Confirmation	Indication that the ATC Tower had confirmed a re-routed flight
PAX Loaded List	List in the FAA ATC Tower/Center/TRACON that a flight has stated boarding
EDCT Indication	Indication that a flight as an EDCT Time
[illegible]	
Name	[illegible]
Missing Out, On, Off, In Events	OOOI events can be compared to Surveillance and alerted/listed
Weights and Balance	Alerts on when a plane is missing its Weights and Balance x min before departure

1.3.6 Airport Status and Summary Display (C8,9,11,32)

8. Monitor status of departure queues by runway and departure fix, and current taxi-out times, then predict and mitigate imbalances prior to development

9. Provide a graphical, dynamic, user-friendly snap shot indicating the actual and forecasted departure demand of the airport. This graphic shall include current and forecasted, configurable delay criteria

11. Provide carriers access to current taxi delays. This is to assist in gate planning decisions regarding whether to take departure delays at the gate or in a metering location

32. Issue Daily Summaries of the operation including the following information: weather, runway configuration, ATC programs, hourly snapshots of the number of aircraft in the departure queue(s), hourly stats (i.e. number of actual departures and arrivals vs. the three-month average), list of non-compliant aircraft, and Summary of the operation.

Aerobahn today already provides a very rich set of tools to monitor and alert on a huge array of airport conditions, including the status of departure queues and taxi times. By combining the functionality of the Aerobahn Dynamic Rule Engine, as described in the previous section, with Watch Lists and Watch List Graphs, nearly any set of flight states or matching criteria can be identified visually on the base Map Display, grouped for inclusion in a tabular list, or aggregated for real-time statistics gathering and display within a continuously updated graph.

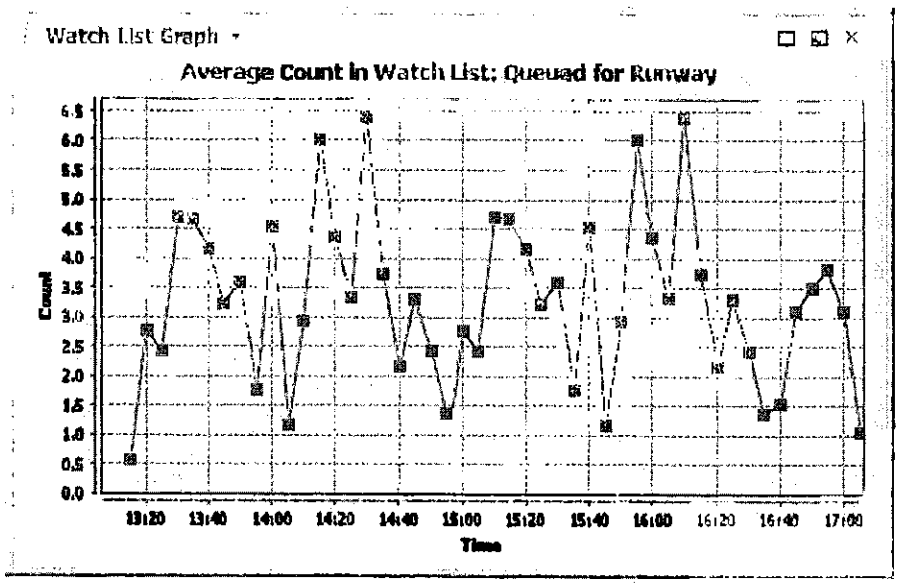
The general process for this sort of monitoring involves first defining a Dynamic Rule that can identify the flights in question. Dynamic Rules can be defined on the fly by individuals, ahead of time by authorized users at the system or group level, or Sensis' renowned support and operations staff can assist in constructing the required rule. In

order to monitor aircraft queued for departure, a very simple rule similar to the following could be defined:

```
Is currently in runway queue for any runway
```

Once the rule criteria are defined, an action can be set to populate a Watch List whenever a flight meets the criteria. From there, the Watch List Viewer or Watch List Graph can then display those flights or aggregate statistics for them. The Watch List Graph, as depicted in Figure 18, can show the average count of aircraft in any watch list, or the average duration. In the example being discussed, this would show the total number of aircraft queued for any runway, or the average queue time for any runway. As with most Aerobahn real-time tools, the Watch List Graph provides numerous customization options allowing users to determine what time buckets are used and how far back to display data for.

Figure 18 Watch List Graph - Queued for Runway



Utilizing Dynamic Rules and a Watch List Graph to display total runway queue depths is just one simple example. The rule criteria used could easily be modified to separate out the data for each individual runway or by departure fix:

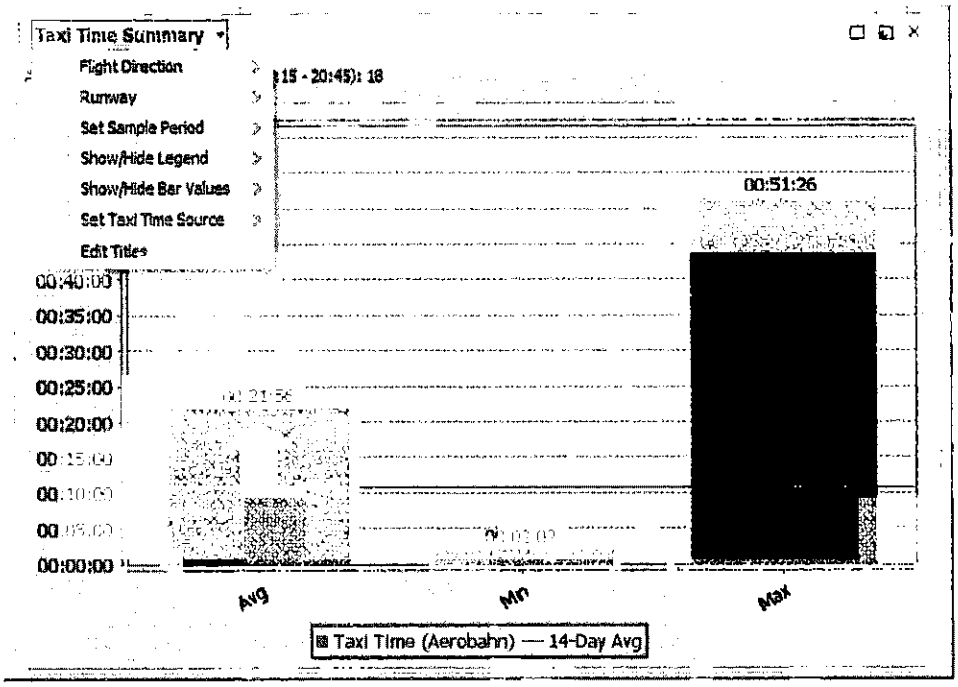
```
Is currently in runway queue for 31L
```

The flexibility and power of Aerobahn's rule system provides enormous versatility to its users. The Sensis team will work with the Port Authority and other users to determine

how the System can best be configured for their needs and will assist in building the necessary rules and workspaces.

Apart from the customizable rules and watch lists, Aerobahn also provides a thorough set of standardized tools to monitor real-time conditions generating the most interest. Among these is the Taxi Time Summary tool which provides dynamic status of taxi times across the airport or broken down by runway and flight direction (Figure 19).

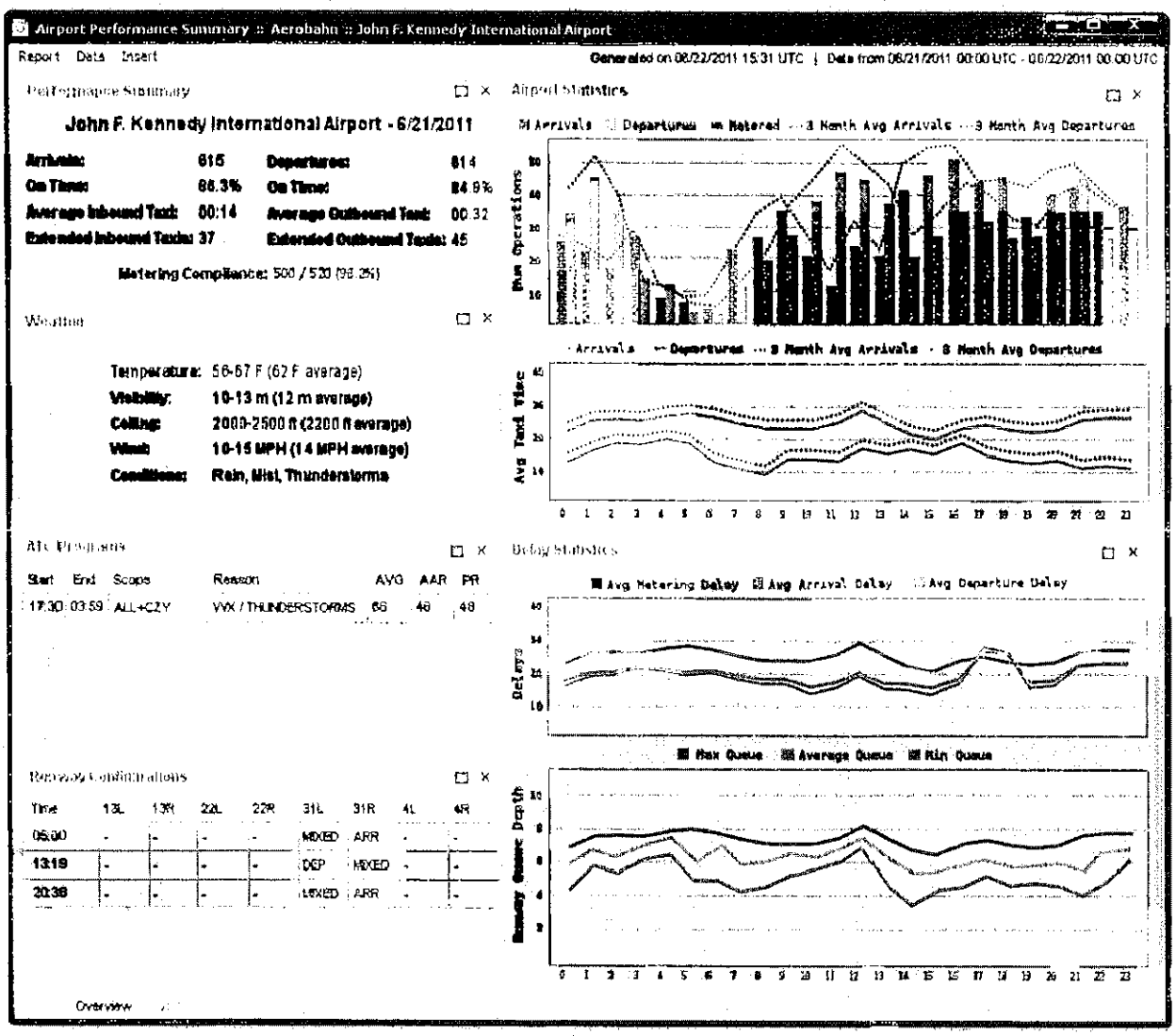
Figure 19 Taxi Time Summary Tool



Beyond the existing features that support the Port Authority's airport status and summary needs, Sensis will be enhancing Aerobahn with a new user friendly performance report and corresponding real-time tools. The Airport Performance Summary Report (Figure 20) will provide the Port Authority a high quality dashboard of key performance indicators and metrics, including:

- Operation Counts
- Airport Throughput
- On-time Performance
- Taxi time Performance
- Delay Performance
- Departure Metering Impact
- Runway Queue Depths
- Weather Summary
- ATC Programs
- Runway Configurations

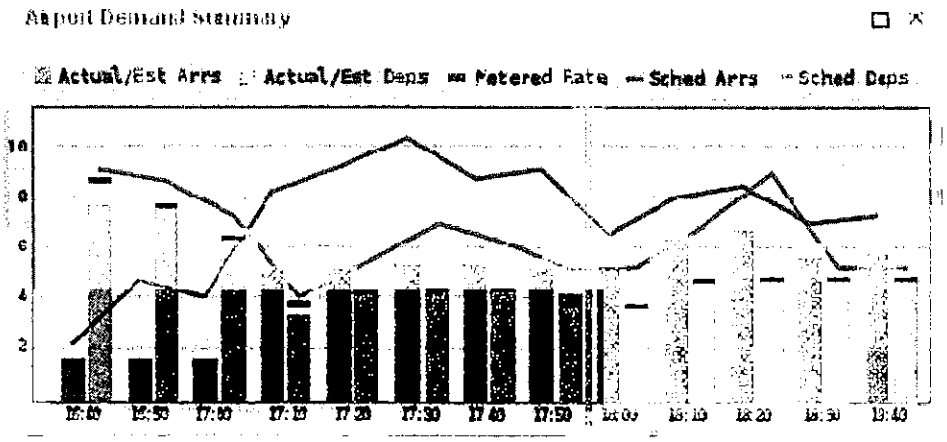
Figure 20 Airport Performance Summary



The major components in the Airport Performance Summary report will also be made available as dynamic real-time tools that are fully integrated into Aerobahn real-time workspaces. When viewed in real-time, the historical statistics will also be combined with future projections, allowing forecasted values to be monitored and compared against historical averages and schedule data.

The updated Airport Demand Summary tool depicted in Figure 21 is an example.

Figure 21 Updated Airport Demand Summary Tool (Concept)



1.3.7 Data Archival and Reporting (C14,22)

14. Data and shared information shall be warehoused and made easily accessible and available for retrieval, analysis and playback

22. Warehouse and make easily accessible data and shared information as presented in the Metrics section of this document, to produce approved, appropriately designed reports.

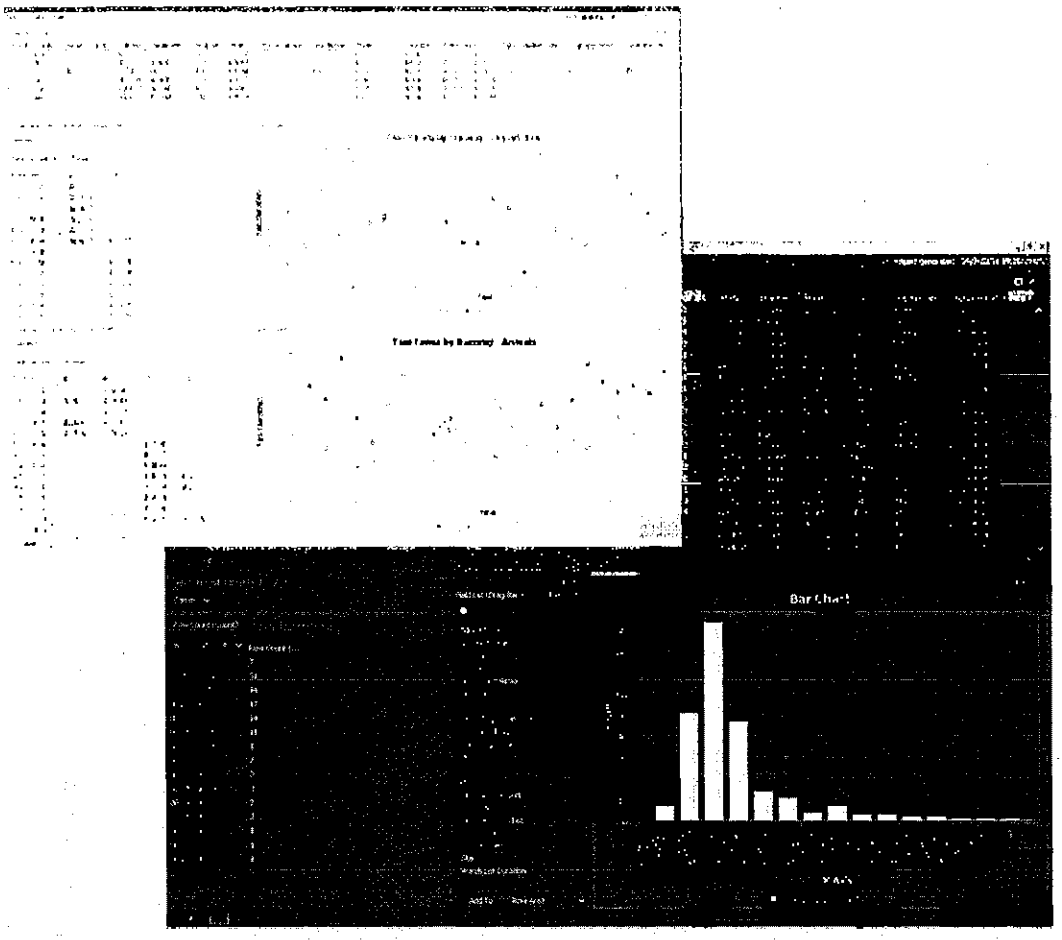
One of the key strengths of Aerobahn is its OpsView advanced data warehouse and report generation capabilities (Figure 22). OpsView extracts data from Aerobahn's relational database. Since all of the data is shared on the common platform, all users will have the ability to run the same reports and share reports with other users.

OpsView provides the following capabilities to stakeholders at JFK:

- A detailed view of the usage of airport resources, enabling verification of corresponding fees and justification of investment to add resources, such as new gates, maintenance facilities, and taxiways
- Insight into how resources and procedures are applied to manage irregular operations
- Identification of trends and recurring operational problems

- Ability to better forecast the impact of future operational events

Figure 22 OpsView Screens



OpsView provides users with real-time data query and reporting capabilities, all from a web-based portal. Users have the ability to create textual and graphical reports from a database which contains 5 years of data, and have the flexibility to create, save, execute, and download comprehensive reports about the surface operation and utilization of limited airport resources. Users can obtain comprehensive statistics about gate occupancy, number of holdouts by fleet type, time of day, and concourse, average amount of time an inbound aircraft waits for a gate, taxiway occupancy, and runway occupancy. Users define the sorting criteria for each report, which facilitates productive discussions about the day's operation, enabling the positive or negative justification of future investments that may be required to continuously improve the passenger experience at JFK.

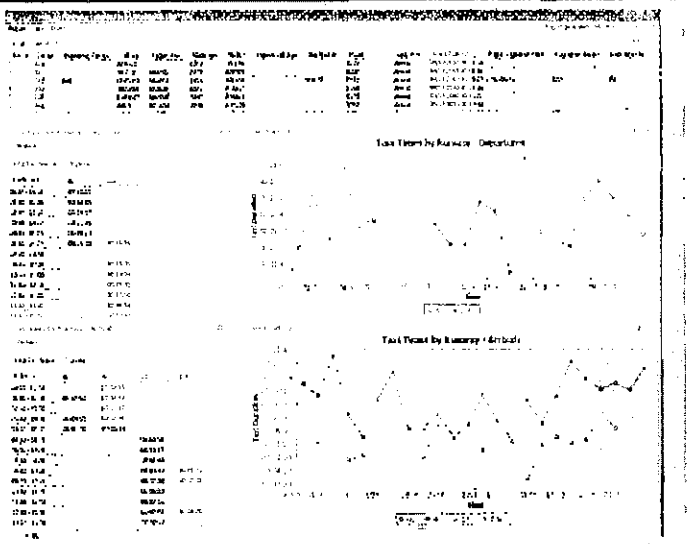
In addition to the ability to generate reports "on demand," OpsView maintains a powerful scheduling capability that allows users to schedule the automatic generation of daily,

weekly monthly, quarterly, and yearly operational reports. The user who scheduled an OpsView report has the ability to configure the system to automatically notify interested parties via email when the report has been created and is available for review or download.

Sensis has learned that it is impossible to pre-determine every report that users will require. As such, Sensis has developed the most robust and time-tested surface reporting tool available. This means that users can create, save, and share reports exactly to their needs without having to come to Sensis to write new code to create reports in different formats. This reduces overall cost of ownership while maximizing the value of Aerobahn.

Figure 23 describes the various features of Aerobahn Reporting.

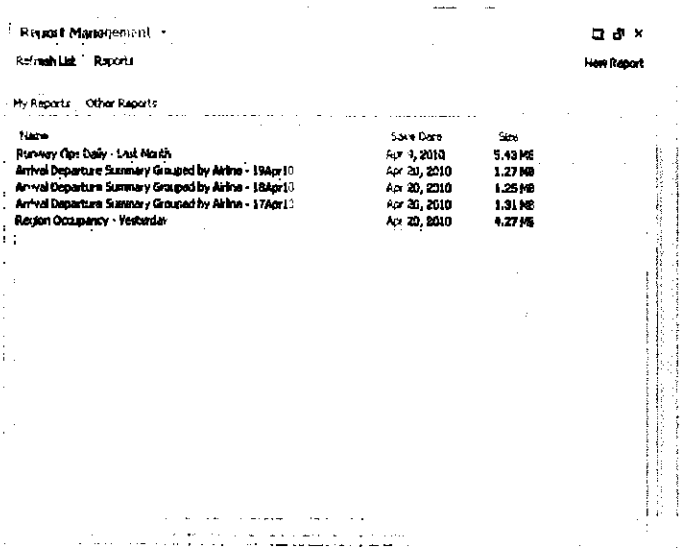
Figure 23 Aerobahn Reporting Features

Feature	Description/Use	Example
Reports	Reports consist of sets of data containing details of flights, region occupancies, position history or operations counts, and any pivot tables and graphs derived from the data sets. User can select from pre-configured standard reports or custom-design a new one.	

Reports Management

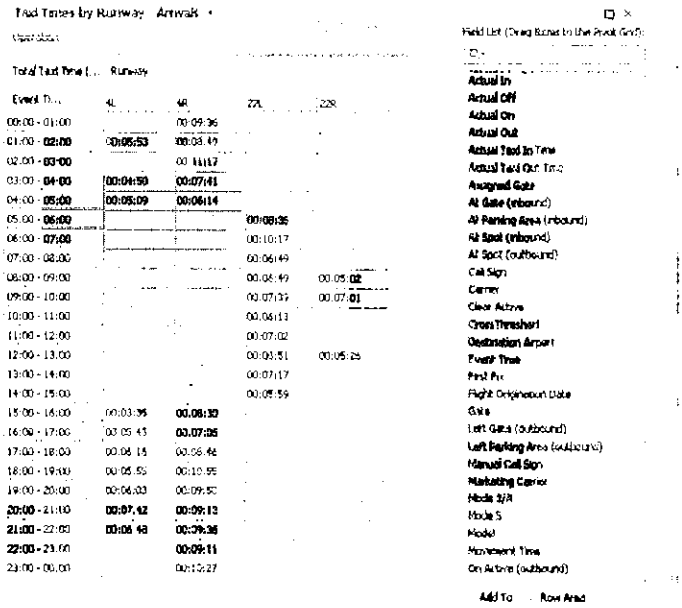
Report Manager allows user to view list of saved reports, report types, quick reports, and report schedules. User can load, share, rename or delete any report.

Central management tool can be added to any Aerobahn workspace for immediate access.



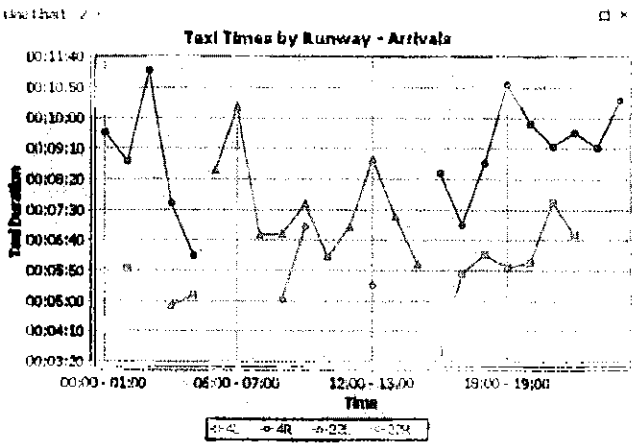
Pivot Tables

Users can create pivot tables similar to those in MS Excel to aggregate data into useful summaries.



Graphs

Graphs display tabular data in an intuitive, easy to digest format. Users can create bar, line, and pie charts. Further, the History Plot can illustrate the path of a given flight.



Hot Link Launch Into Real-Time Monitoring

Every time reference in an Aerobahn report is a hot link to the real-time display. A simple click of that hotlink, Playback is launched with the playback dialog set to that exact time. This way users can mine for anomalous events such as excessive time in "penalty box" an then immediately go back to a visual representation of the start of that event.

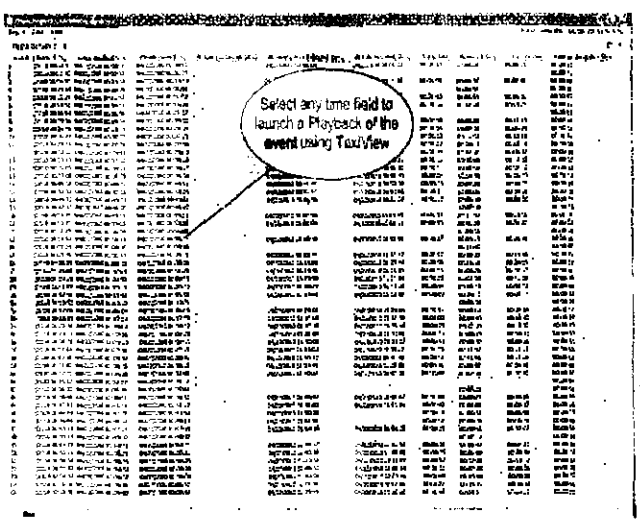
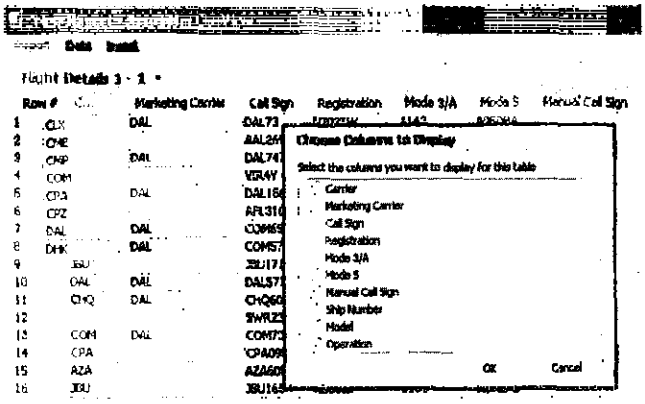


Table **Set-up**

Every table in Aerobahn reporting is configurable to suit the user's needs. This allows users to quickly get to the content needed to improve operations.

In addition to being able to choose what columns to display, users can sort on any data field (column) and filter rows by specifying a single value, or a limited set of values for a given data field

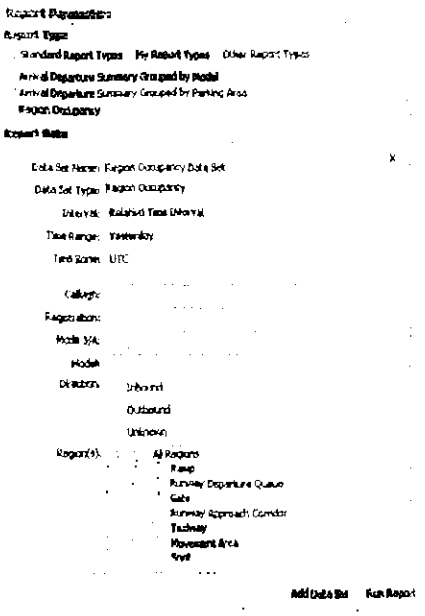


Robust Filters

The ability to filter and sort the data by parameters such as:

- Time of Day
- Call Sign
- Airline
- Runway
- Inbound/Outbound

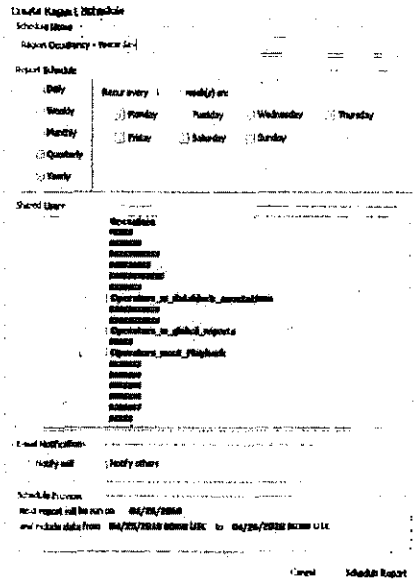
This filtering allows users to access the metrics that have the most relevance to their interests. For example a deicing report can be created focusing just on the de-ice pads and other relevant regions.



Report Scheduling

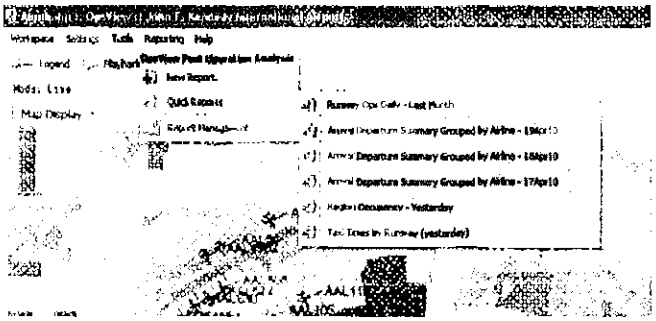
Allows flexible report scheduling on a daily, weekly, monthly, quarterly, or yearly basis.

Allows airport stakeholders to use a single source of accurate, timely data to develop metrics for quantifiable measurement of the performance of the airport airside operation and share them with other users.



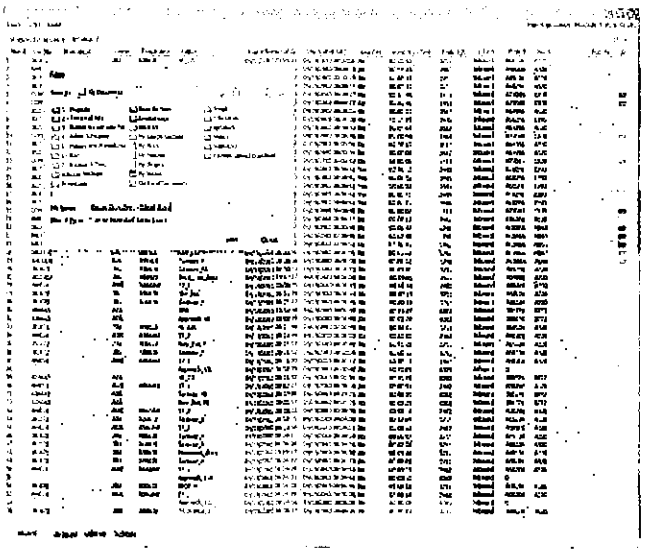
Quick Reports

Provides fast and easy access to favorite saved reports and report types.



Data Export

Allows data to be exported into other programs such as MS Excel and MS Access. This allows users to manipulate data further or merge with other sources outside of Aerobahn to provide even greater operational insight.



1.3.8 Data Element Terminology (C31)

31. Terminology and nomenclature used to describe the data elements in the Service shall support interoperability with current Surface Management Systems to the extent practical and shall be approved by the Port Authority.

Sensis takes great care to ensure the terminology in Aerobahn is consistent with that used in current air traffic control and airport operations. Aerobahn has been used in the airport operations community for over six years. During that time, Sensis designers have continually sought feedback and made improvements to the user interface, including terminology and word choice. Sensis welcomes feedback on this and any other factor which will make the tool more usable and useful.

1.3.9 Operational Support (C7)

7. Gain knowledge of and distribute the forecasted operational plan for the airport, airspace, expected arrival and departure rates and runway usage, expected/known delays, weather forecast, and challenges either by participation in strategic teleconference with the FAA or an approved equivalent source.

The Sensis and Robinson Aviation SMS operations staff in the Kennedy Metering Control Center will participate in daily calls with the FAA and other airport stakeholders to stay up to date on all of the latest operational plans. Expected runway usage, operation rates, and airport status will be entered into the Aerobahn SMS for consideration when rationing departure slots and predicting airport demand and individual flight taxi performance. Aerobahn will also propagate this information in its various real-time tools, and aggregate it for inclusion in daily performance summaries.

1.3.10 Administration and Customer Support (C25,26,27,28,29,30)

25. Support and Maintain adherence to the Code of Conduct established by the Port Authority

26. Conduct quarterly meetings to review said Code of Conduct and support changes.

27. Attend, participate in and support User interface meetings on a bi-weekly basis at JFK.

28. Provide 24 x 7 User support to provide information regarding system functionality and troubleshooting

29. Administer new Users.

30. Track and report service irregularities to the Port Authority and Port Authority authorized recipients. Describe the process for reporting, tracking and resolving problems encountered by Users.

Code of Conduct adherence, user-interface meetings, user support, and service irregularity tracking are addressed in Section F-3 Management Proposal.

1.3.11 Third-Party Tool Support (C23)

23. Use any other supporting tools provided for use by the PANYNJ, FAA, Air Carriers, Terminal Operators or other Users deemed appropriate by the Port Authority.

Sensis will use any tools provided by the Port Authority on request.

1.4 Functional Requirements of Enhanced System and Services-Phase B

In addition to the above Functional Requirements of Initial Implementation, the requirements listed below represent, at a minimum, the enhanced functionalities and capabilities that shall be provided by the Contractor in accordance with the implementation phasing stated in Attachment C, Section II. A. Implementation Schedule. The proposed methods to achieve the required functionality are subject to approval by the Port Authority.

1.4.1 General Requirements for Enhanced Operation

1.4.1.1 Flight Data Display (D1p)

p. System must be capable of displaying predictive aircraft taxi times, to include, but not limited to:

i. From runway touchdown to the ramp;

ii. From the ramp to the gate;

iii. From the gate to the taxiway;

iv. From the taxiway to departure;

v. Display aircraft taxi times, to include, but not limited to;

vi. From the gate to the taxiway

vii. From the taxiway to the metering location, hard stand dc-icing pads From the metering location, hard stand or dc-icing pads to departure

viii. From the gate to departure (For example, the system should provide estimated taxi times (from the gate to departure (wheels-up)) for aircraft ready to push back from the gate.

ix. Provide monitoring and reporting of aircraft that occupy or travel through a defined Region of Interest (ROI). Examples of ROIs include airport taxiways, runways, holding areas, parking areas, approach corridors, gates, concourses of gates, and other definable sections of movement and non-movement areas.

1.4.1.2 Flight Alerting (D1b)

b. Provide alert notifications that correspond to specific operational events.

The Dynamic Rules functionality of Aerobahn is fully capable of providing alerts and notification on all operational events specified by the Port Authority and much more. It

is completely flexible in that it allows users to apply a wide variety of criteria to virtually any flight data available within Aerobahn. Section 1.3.5 contains details and examples of this highly beneficial feature.

1.4.1.3 Airport Status and Summary Display (D1f,1k,1n)

f. Contractor shall develop a performance measure, "Scorecard" to facilitate assessment of overall airport operational performance and the performance of individual Users. This Scorecard shall assess accuracy and timeliness of shared data and performance including routine compliance measurement/analysis. The format and content of this Scorecard shall be proposed by the Contractor and approved by the Port Authority.

k. Estimate departure delay time during irregular operations such as dc-icing.

n. Provide a status window graphically displaying delay length in time and/or number of aircraft for each runway. This display is to provide an accurate snapshot of the departure demand at the airport.

As covered in Section 1.3.6, Airport Status and Summary Display (C8,9,11,32), the Aerobahn SMS already supports a large portion of the Port Authority's requirements around airport status monitoring. The Aerobahn feature set in this area will be expanded in Phase A and again in Phase B to round out the provided capabilities. The new features for Phase B primarily consist of completing real-time implementations of the Airport Performance Summary tools that include forecasted values (as opposed to just historical information), and the addition of a Departure Metering Scorecard report and real-time conformance monitoring tool.

The following two images illustrate how the real-time versions of the Delay Summary (Figure 24) and Runway Queue Depth Monitor (Figure 25) component of the Airport Performance Summary will function. The Delay Summary Tool provides status on schedule delays, that is actual performance of flights against airline schedules, and metering delay, the impact of departure metering on flights as calculated by the amount each flight was held after it was scheduled to depart. The technical implementation for calculating metering delay is different depending on if *Count Based Metering* or *Time Based Metering* (using specific TMATs or CFTs) is used and Sensis has already devised an intelligent mechanism to accurately capture both. The Port Authority will have the opportunity to weigh in on the final implementation, as will be the case in many of the detail areas relating to departure metering. This will ultimately ensure that the delivered solution meets the needs of the Port Authority and the other airport stakeholders.

Figure 24 Delay Summary Tool (Concept)

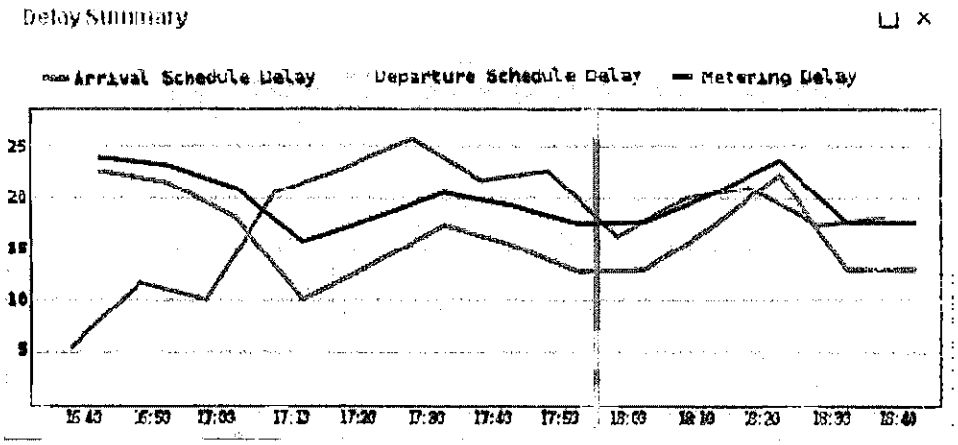
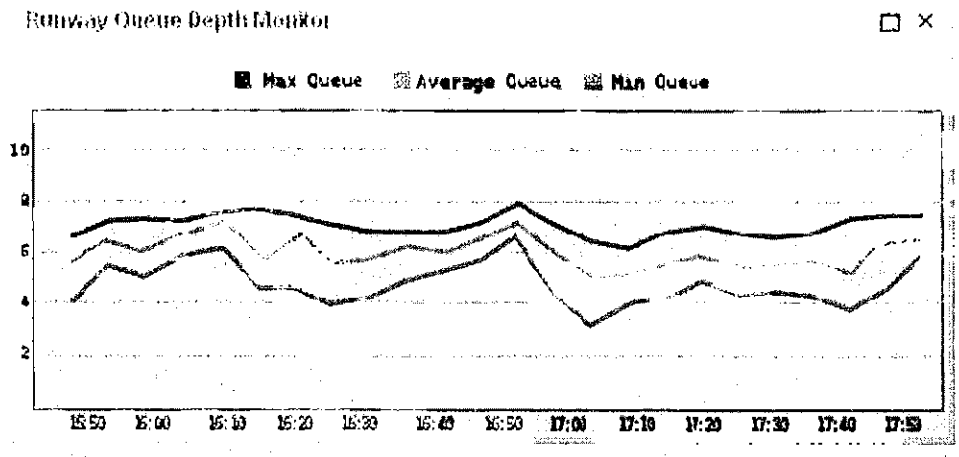
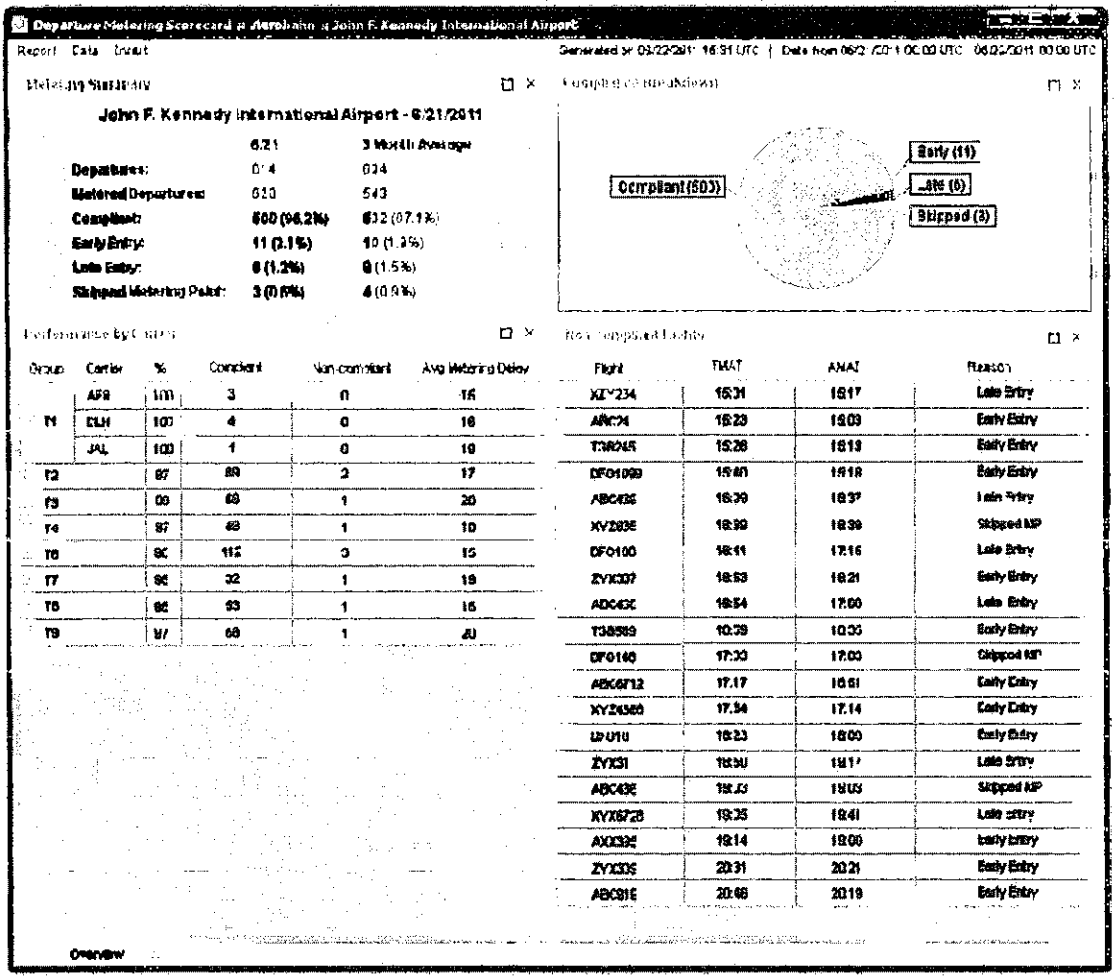


Figure 25 Runway Queue Depth Monitor (Concept)



The Departure Metering Scorecard report (Figure 26) provides a user-friendly and concise overview of how departure metering is performed each day. It contrasts key performance indicators against three month averages and breaks down performance by terminal, carrier, and specific flight. Again though, any specific data that is needed and not depicted in the concept below can be incorporated after further discussions with the Port Authority and users.

Figure 26 Departure Metering Scorecard (Concept)



1.4.1.4 Capacity and Demand Forecasting and Alerting (D1a,1c)

a. Forecast airport capacity and demand information for the JFK operation and surrounding airspace in a rolling time window, for a minimum of four hours ahead.

c. Automatically alert Users when there is an expected imbalance between capacity and demand for both arrival and departure traffic. User shall have the ability to configure whether the alert is visual, aural or both.

The Aerobahn Demand Summary Tool is currently deployed at JFK and provides a graphical view of upcoming demand at the airport. As described earlier in Section 1.3.6, this Tool will be enhanced in its user interface and data capabilities. The improved Tool will combine recent performance with rolling anticipated demands and allow for configurable thresholds to indicate potential imbalances or problem ranges. Users will have the ability to configure the displayed time range, allowing 4 hours in the future to be displayed, along with which particular data sets are shown. The graph will support

display of the:

- Number of actual or forecasted arrivals
- Number of actual or departures
- Total number of actual or forecasted operations
- Scheduled number of arrivals
- Scheduled number of departures
- Scheduled number of total operations
- 3 month average number of arrivals
- 3 month average number of departures
- 3 month average number of total operations
- Metered departure rate

The following two images illustrate how the Airport Demand Summary can be configured to show capacity and forecast demands in the most appropriate way for each user.

Figure 27 Airport Demand Summary with Configured Thresholds

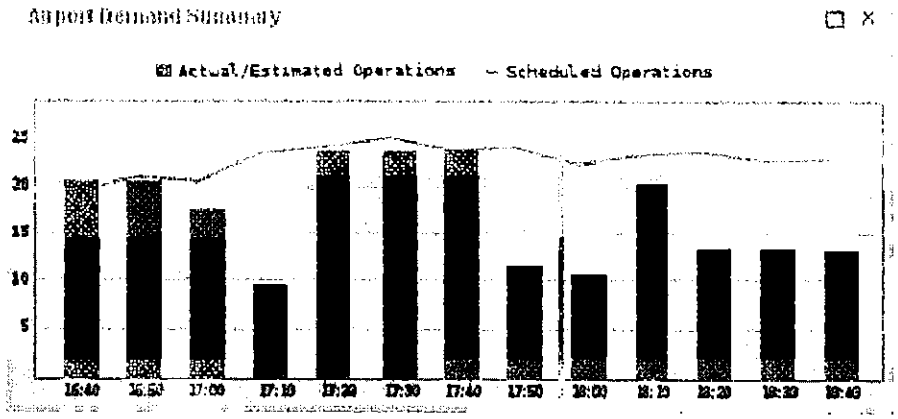
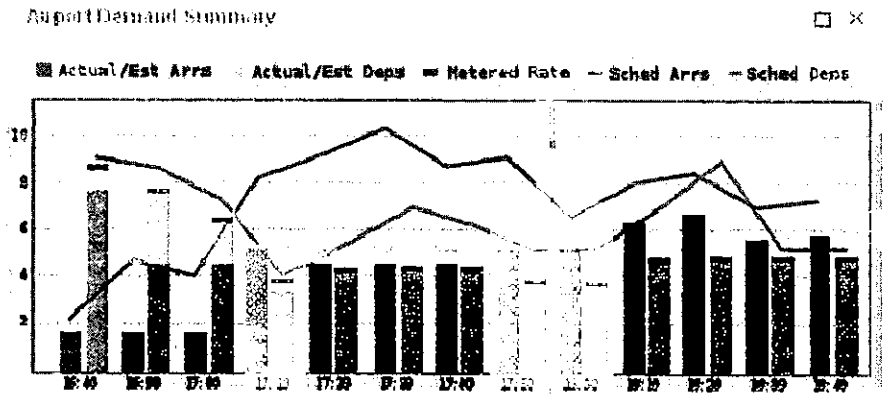


Figure 28 Airport Demand Summary with Arrivals and Departures



Supported by the same advanced flight forecast predictions, the Aerobahn Dynamic Rule Engine will be expanded to support airport level rules to provide notifications on demand forecasts. In the same way users can define rules to indentify situations with flights, they will now be able to define rules that trigger email, visual, or audible notifications when airport demand exceeds or is projected to exceed a specified rate or dynamic capacity limit. For example, a rule will be able to be defined to present a pop-up alert if the projected arrival rate exceeds the scheduled arrival rate within the next 4 hours.

1.4.1.5 Departure Management Capability – Final (D11,1o)

1. The system shall have a feature that allows metering to individual runways and departure fixes to optimize aircraft sequencing to best meet the demands and priorities of FAA programs, as well as airfield and airspace constraints and opportunities

o. Enable the Users to swap their own flights provided the change is within the agreed upon rationing principles set forth.

The final departure metering and sequencing functionality delivered with Phase B provides significant enhancements relative to both the proposed Phase A functionality

and the current metering program in place today. Sensis' Phase B Departure Management Capability:

- Rations the scheduled flights to individual slot times (target movement area times (TMATs)) rather than aggregated bins, enabling more precise control of the queue length and reduced taxi time;
    - Note again that TMATs are equivalent to call-for-taxi times (CFTs). TMAT is used because it is the term chosen by the FAA's Surface CDM Working group and is gaining adoption as an industry standard.
- Improves the departure sequence to maximize efficient use of each runway, increasing throughput and reducing delay;
- Performs more tasks automatically, freeing the SMS Operator and other users to execute efficiently and respond to unusual situations, which will result in more sustainable efficiency gains even during IROPS;
- Allows aircraft operators to perform autonomous flight swaps and reprioritizations within their own rationed slots;
- Augments system conformance monitoring and compliance reporting capabilities to take advantage of surveillance processing and Aerobahn's Dynamic Rule Engine.

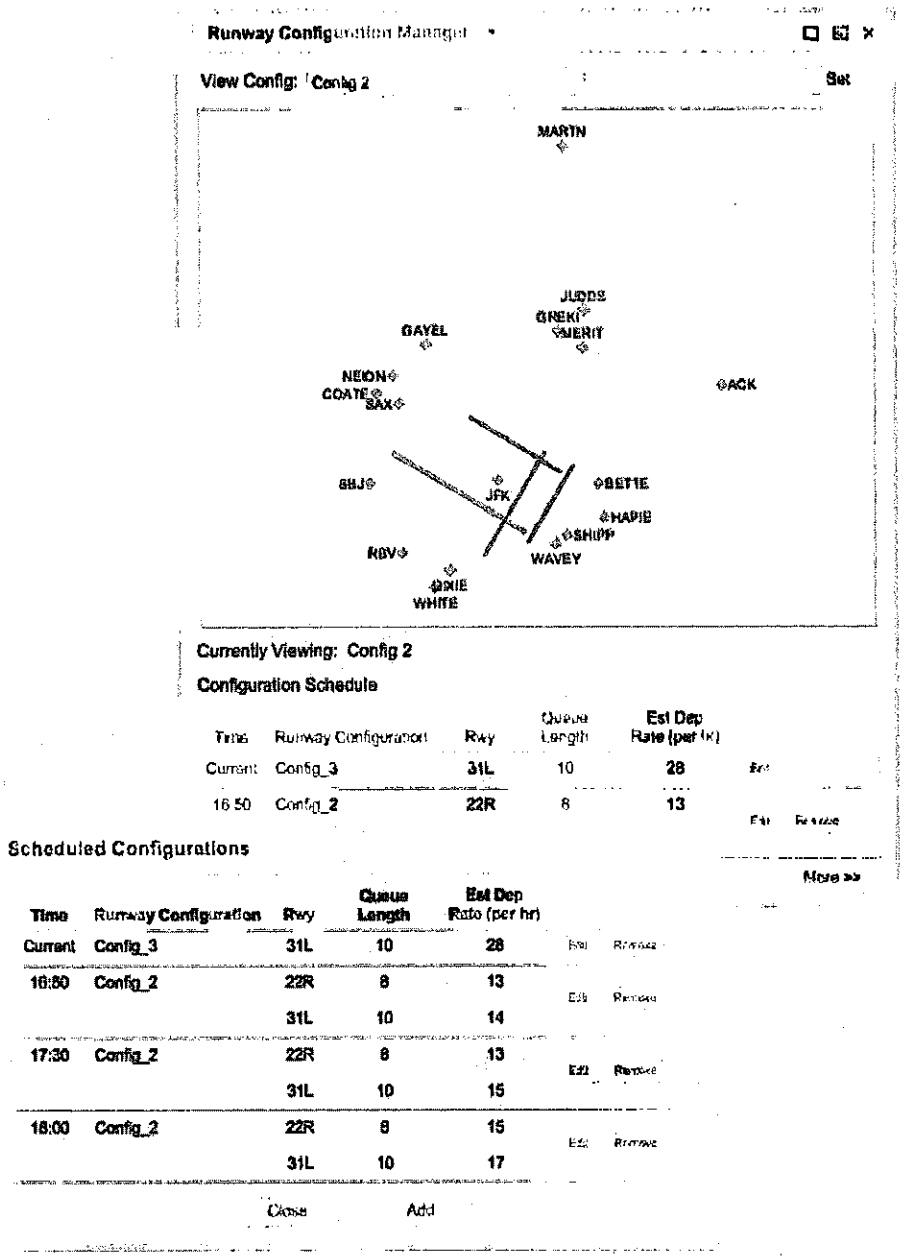
1.4.1.5.1 Phase B Departure Management Process and Tools

The primary participants in the metering process are the SMS Operator, and the NAS Operator users responsible for aircraft movement in the ramp. From their perspective, the Aerobahn departure metering functionality automatically determines, for each flight, a TMAT release time and expected take-off time. The TMAT is the explicit time when the flight should be at the spot ready to enter the movement area; this is often referred to as the call-for-taxi time. The TMAT times are determined so as to maintain a short queue at each active departure runway, holding any additional aircraft in a virtual queue in the ramp or at the gate. These times are displayed in the Aerobahn SMS and are accessible in any table, timeline, or data block showing flight properties. As all of these computations are performed automatically and updated based on the latest schedule and surveillance data, the responsibilities of the SMS Operator and ramp controllers are limited to monitoring the system, entering any required updates or priorities, directing flights to meet the prescribed TMAT times, and handling unusual situations.

One of the main responsibilities of the SMS Operator is to monitor and update the runway configuration and expected departure capacity. The SMS Operator will be in frequent contact with ATC personnel regarding the current configuration and any planned changes. The current and planned configurations are entered into the Aerobahn system through the interface shown in Figure 29. This configuration information includes information on the departure fixes assigned to each runway, if multiple runways are in

use, and is used to automatically determine the runway for each flight (though this may be manually overridden for individual flights). In addition to discovering which runways are in use, the SMS Operator configures the expected departure rate on each. Robinson Aviation and its SMS Operators will communicate with the FAA to stay apprised of configuration and throughput plans.

Figure 29 Runway Configuration Tool



In coordination with the Port Authority and the FAA, the SMS Operator will determine the desired queue length for each active departure runway. This may be specified as either a desired number of aircraft in the queue, or a desired amount of time for each

aircraft to spend in the queue. Either way, the SMS Operator chooses the queue length to maintain a short queue just long enough to avoid starving the runway. Aerobahn then actively monitors real runway throughput rates and dynamically adjusts metering to maintain strict adherence to the target departure queue depth.

Based on the expected departure rates, original and updated flight schedules, surveillance data, and user preferences, the Aerobahn system calculates the following set of times for each flight:

- Target Take-off Time (TTOT): The expected wheels-up time
- Target Movement Area Time (TMAT): The prescribed time when the flight should be at the spot and call ATC for permission to enter the movement area
- Recommended Off-Block Time (ROBT): The recommended time when the flight should leave the gate in order to achieve the TMAT

Of these three times (TTOT, TMAT, and ROBT), only the TMAT will be monitored for compliance. While the TMAT is specified as a precise time, a flight is considered compliant with its TMAT if it is within a defined compliance time window before and after the TMAT. The ROBT is provided as a convenience to the ramp controller in order to improve the ability to meet TMAT times. The TTOT is the predicted take-off time given the flight's predicted position in the take-off sequence and the expected departure rate. However, actual take-off time may differ from the TTOT depending on future conditions and the actions of ATC.

The Aerobahn SMS Service's calculated times are constantly updated based on the latest schedule and surveillance data. In particular, if the queue moves faster or slower than expected, the system automatically adjusts TMAT times for the subsequent period, sending aircraft to the queue earlier or later in order to keep the queue length steady. However, in order to provide carriers with a stable target, the TMAT is frozen when it is close to the current time. This freeze window, if set to 30 minutes, limits automatic change of any TMAT within 30 minutes of the current time, i.e. TMAT is frozen and will not change without manual user intervention.

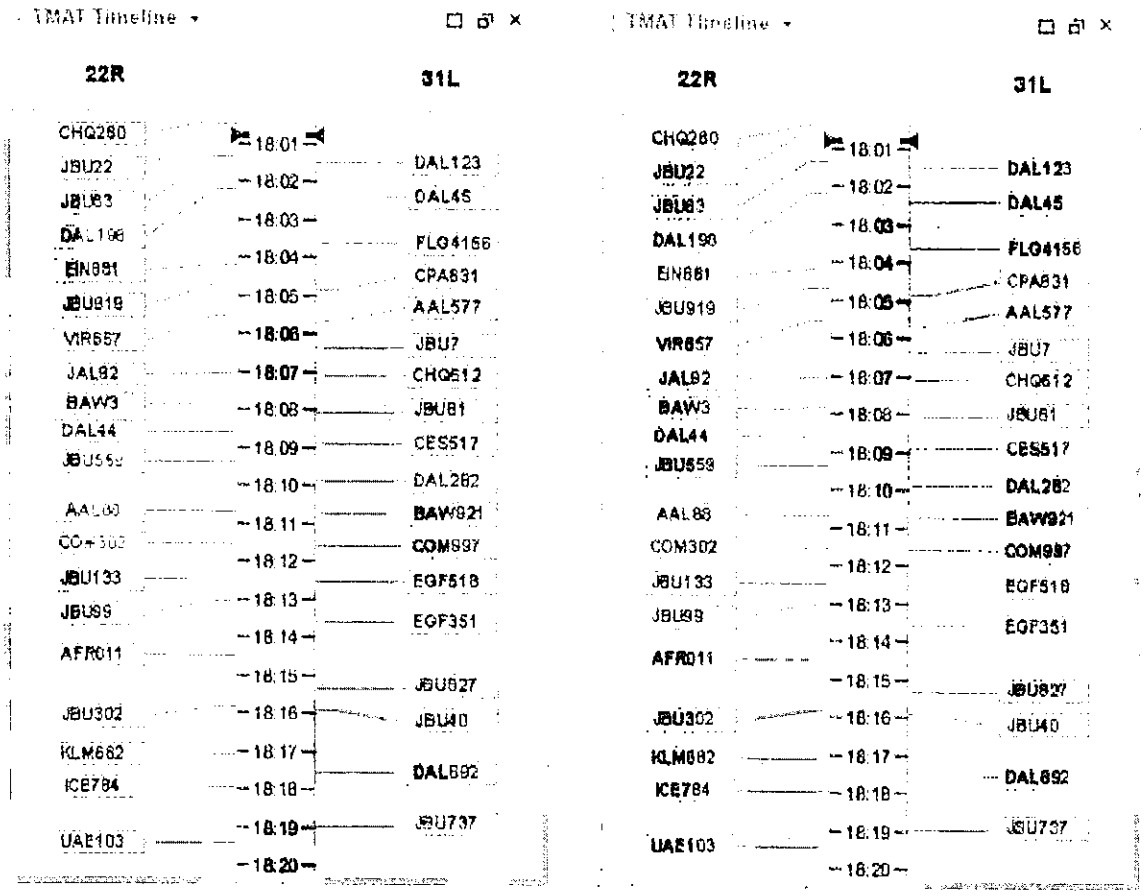
The airline input into the Aerobahn SMS Service is made by NAS Operator users responsible for aircraft movement. In this case the airline or airport ramp personnel are responsible for entering flight updates and preferences into the Aerobahn SMS. The first key information element for each flight managed by the ramp personnel is the earliest possible time when that flight will be ready to leave the gate, the Target Off Block Time (TOBT). By default the TOBT is assumed to be the original Scheduled Off Block Time (SOBT). However, if a flight is delayed for any reason and the carrier chooses to delay loading of the aircraft, the carrier must enter an updated estimate for the TOBT or provide it via an automated data feed. The Aerobahn SMS Service then ensures that its prescribed times do not require the flight to leave the gate before the TOBT. Regardless of any changes to a flight's TOBT, it is still prioritized in the departure sequence based on its original SOBT. This ensures that carriers do not suffer a "double penalty" from

entering a delay into the system.

The TOBT should be maintained at all times as the earliest possible time that a flight could leave the gate, even if it does not plan to leave the gate until a later time. As time passes, the TMAT should be updated as appropriate. This benefits the carrier because it ensures the flight will not be given an infeasible TMAT assignment, while still allowing the flight to receive the earliest feasible TMAT that is available. Alternatively, failure to update a TOBT may result in an unachievable TMAT assignment which will then have to either be negotiated with the SMS Operator or the TMAT time will be missed and the flight flagged as non-compliant. Either way, invalid or out of date TOBTs may result in some form of penalty to the carrier.

In Phase B, Sensis will replace the bucket based Departure Metering Tool in Aerobahn with a new TMAT Timeline Tool. The TMAT Timeline presents an ordered list of flights with their assigned TMAT times. Flights under a user's control are highlighted while other flights are colored grey or hidden. Figure 30 illustrates two versions of the TMAT timeline, one as would be seen by the SMS Operator with all flights highlighted, and one for a theoretical JetBlue user with only JBU flights highlighted.

Figure 30 TMAT Timeline - SMS Operator (Left) and Airline Operator (Right)



The TMAT timeline will work in conjunction with all other real-time tools, such as the tabular departure list depicted in Figure 31. One of Aerobahn's most powerful features is its real-time tool integration that allows different aspects of flight data to be depicted and manipulated in a variety of complementing ways.

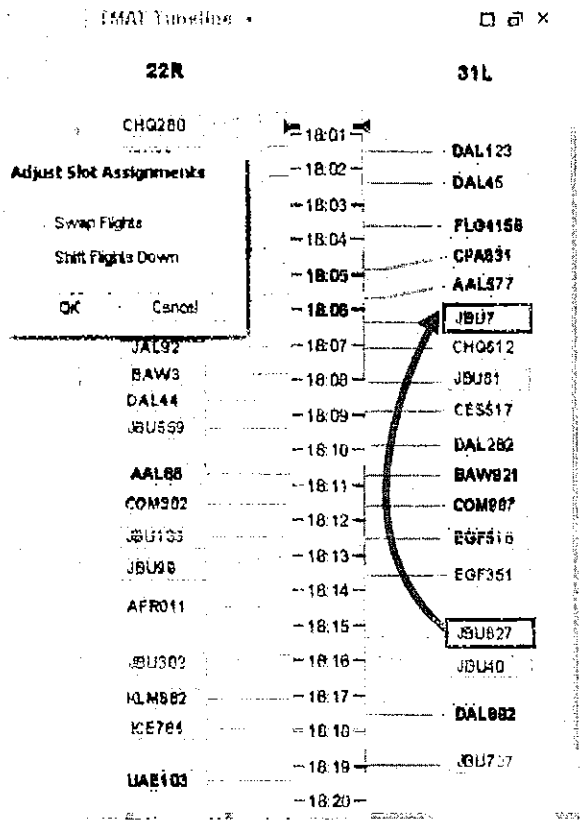
Figure 31 Tabular List of Departures

Departure List

Flight ID	Runway	Fix	Gate	MP	SOBT	TOBT	ROBT	TMAT	Est Taxi	TTOT
JBU22	22R	SHIPP	T5-19		[illegible]	[illegible]	[illegible]	[illegible]	00:16	[illegible]
JBU83	22R	GAYEL	T5-05		17:51	17:51	17:57	[illegible]	00:16	[illegible]
JBU919	22R	SHIPP	T5-04	MP 1	[illegible]	[illegible]	17:00	[illegible]	[illegible]	[illegible]
JBU7	31L	RBV	T5-17		17:57	17:57	18:01	[illegible]	00:18	[illegible]
JBU81	31L	RBV	T5-12		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
JBU559	22R	COATE	T5-11		18:00	18:00	18:07	[illegible]	00:13	[illegible]
JBU133	22R	SHIPP	T5-09	MP 4	[illegible]	[illegible]	[illegible]	[illegible]	00:21	[illegible]
JBU99	22R	GAYEL	T5-07		18:12	18:12	18:11	[illegible]	00:19	[illegible]
JBU827	31L	RBV	T5-03		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
JBU302	31L	RBV	T5-14		18:13	18:13	18:12	[illegible]	00:15	[illegible]

Within the Aerobahn Automated Departure Metering and Sequencing Tools, carriers may swap their own flights within the virtual departure queue to account for business priorities. Each carrier effectively "owns" its queue positions or TMAT slots, which are assigned based on its original schedule. The system automatically assigns individual flights to these positions but carriers or terminal operators may change these assignments as desired. If a carrier must cancel a flight, it still retains ownership of the original position, and its other flights are automatically moved forward to use the vacated queue position while still respecting the "freeze" horizon and related manual changes. To reorder or reassign flight TMAT times, flights can be dragged and dropped within the TMAT timeline or tabular tools as indicated in Figure 32 Swapping or Shifting Flights.

Figure 32 Swapping or Shifting Flights



Non-scheduled flights are entered into the Aerobahn system through coordination between the FBO, or equivalent Ramp controller, and the SMS Operator. Once entered, these flights are handled by the metering system just like any other flight, with an assigned TMAT for the pop-up flight.

As a result of this process, each scheduled and non-scheduled flight is assigned a TMAT time that accounts for the latest information and user priorities, and that time is shown to the ramp controller via the Aerobahn SMS display. The ramp controller is responsible for controlling push-back and ramp taxi such that the flight reaches the spot by the prescribed time and calls ATC for service at that time.

As in the Phase A metering program, a flight which must leave the ramp before its TMAT may do so as long as it is assigned a metering point and then proceeds to that location to wait before taxiing to the runway. The process by which metering points are requested and assigned remains the same as Phase A (See Section 1.3.2.) When a flight is assigned to a metering point, its TMAT is replaced by a prescribed time when it should leave the metering point and taxi to the runway. Flights that must enter the movement area to get to a metering location are monitored to verify that they do in fact utilize a metering point; otherwise they are recorded as non-compliant.

During metering, the SMS Operator monitors the process, updates the runway configuration and departure rates, handles metering point requests, and communicates with air carrier personnel to handle unusual situations and facilitate compliance. In particular, he or she proactively monitors the airport to identify flights which may have difficulty complying with their prescribed times. The Aerobahn system aids in this monitoring by highlighting flights whose TMAT is in the near future but which are estimated to arrive at the spot late, as well as flights that have already missed their TMAT (Figure 33). The SMS Operator communicates by text chat or phone with the appropriate ramp personnel to ensure compliance or formulate an alternative plan. If a flight cannot meet its TMAT, the SMS Operator may substitute another flight that is "Ready" to enter the movement area. Because the SMS Operator is armed with the Aerobahn SMS Service's comprehensive altering and situational awareness tools, potential problems are identified early and alternatives can be selected and executed quickly, thereby ensuring that the airport continues to operate smoothly.

Figure 33 Potential Missed TMATs

Potential Missed TMATs

Flight ID	Runway	Fix	Gate	TOBT	TMAT	Est Taxi	TTOT
JBU133	22R	SHIPP	T5-09	18:20	18:13	00:21	18:24

Note that other stakeholders, such as the FAA, can also access the status of departing aircraft using these real-time tools. The departure list shown in Figure 31 provides an FAA controller the status of all aircraft in the virtual departure queue on the JFK surface. This tabular data listing can be used to coordinate airspace utilization with FAA controllers for the LGA surface, and the NY Tracon and NY Center.

At any time, authorized stakeholders may assess the performance of the metering program and the compliance of each participant through Aerobahn's real-time statistics and reporting features. In particular, the Departure Metering Scorecard (Figure 26 in 1.4.1.3) highlights the overall compliance across the airport and by each participant over a period of time. For non-compliant flights, it identifies the type of non-compliance (early movement area entry, late movement area entry, or skipping of a metering point) and compiles statistics across all flights.

1.4.1.5.2 Phase B Departure Management Rationing and Algorithm Details

The Aerobahn SMS departure metering and sequencing function determines ROBT, TMAT, and TTOT times using established rationing and allocation principles, and taking advantage of Sensis' experience with implementing allocation algorithms. The allocation follows the principle of Ration by Schedule (RBS), in which positions in the take-off sequence are assigned according to the original scheduled departure times without imposing a "double penalty" due to a reported delay or cancellation.

While the Ration by Schedule principle helps to define the allocation algorithms, overly

simple implementations of this principle may still fail to treat participants equitably. For example, one simple algorithm assigns positions in the departure sequence to carriers ordered by their flights' scheduled departure times (first-scheduled, first-served). However, this may lead to very different levels of average delay across different carriers. As an example, consider the flight schedule in Table 1, where Carrier A has a block of flights which are scheduled to depart before Carrier B's block of flights. In this example, Carrier A gets all of the earlier sequence positions, and Carrier B must take the later ones. As a result, Carrier B suffers much larger overall delay. At JFK, as delays accumulate towards the end of the day, this first-scheduled, first-served algorithm would penalize carriers whose flights are scheduled to depart later.

Table 1: A simple allocation algorithm, assigning sequence positions ordered by scheduled departure time, may not produce an equitable allocation.

Carrier	Sch. Dep.	TTOT	Delay (min)	
A	11:01	11:10	9	**Carrier A Average Delay: 17 minutes**
A	11:02	11:15	13	
A	11:03	11:20	17	
A	11:04	11:25	21	
A	11:05	11:30	25	
B	11:06	11:35	29	**Carrier B Average Delay: 37 minutes**
B	11:07	11:40	33	
B	11:08	11:45	37	
B	11:09	11:50	41	
B	11:10	11:55	45	

In an extreme example, if on a given day capacity was severely reduced such that only half of the scheduled flights could depart, under this allocation algorithm only the first 50% of the scheduled flights would be allowed to depart. A carrier with all of its flights scheduled in the second half of the day would have to cancel all of them.

To ensure equitable allocations, the Aerobahn SMS uses a more advanced allocation engine which explicitly considers each carrier's level of delay. It assigns sequence positions such that at any given time, average delay is similar between carriers. (In the example in Table 1, the sequence would instead mix the flights of Carrier A and Carrier B so that their average delays match.) This average delay measure applies regardless of

the number of flights each carrier has. For general aviation flights or carriers with a single flight, that flight will receive a delay that matches the average across all carriers at that time.

If capacity is severely reduced such that many cancellations will be necessary, the Aerobahn SMS assigns the available departure slots proportionally, so that the cancellation rate is similar across carriers.

The allocation algorithms can, if desired by the Port Authority, account for each carrier's past degree of compliance, applying a bonus or penalty to incentivize compliance. For example, a carrier which fails to meet its schedule and thereby causes added delay for others might be given lower priority for future assignments. Or, if a carrier is unable to use a slot and fails to provide advance notice, the carrier may lose that slot and suffer additional delay.

Recognizing that the allocation algorithms will evolve based on feedback from the Port Authority and air carriers, the Aerobahn SMS allocation engine is designed to be flexible and modular. This will allow for adaptation of the algorithms and adjustment of weighting parameters based on agreed upon principles and priorities.

The equitable allocation of departure sequence positions to particular carriers is an important component of the overall planning process, but not the only one. In particular, upon inserting individual flights according to each carrier's preferences, the final sequence is modified to a small degree, ensuring that all flights are assigned to feasible times satisfying all constraints and making small adjustments to improve runway throughput and reduce delay.

The assignment of individual flights must account for various constraints:

- Existing Queue: Aircraft already in the queue, or about to enter the queue, are placed at the head of the expected sequence, and their TTOTs are estimated given that sequence and the departure rate. Other flights are assigned TTOTs which come after these departures.

- Feasibility: No flight will be assigned a TTOT which it cannot achieve, given its SOBT/TOBT, predicted taxi-out time, and any already-frozen TMAT time (if applicable).

- Stability: The prescribed sequence should not change over time, except in response to significant changes or new constraints, where a change either is required or produces a significant improvement.

- External Constraints: The TTOTs adhere to the various external constraints which may be imposed on particular flights. For example, a flight with an EDCT assigned will be given a TTOT within the EDCT window. Or, if a flight is subject to a lengthy, indefinite restriction, such as a Ground Stop at the destination airport, it may not receive any TTOT assignment until the restriction

is about to be lifted. These external constraints are provided to the Aerobahn system from a number of data feeds and are automatically considered in the planning process. Manual restrictions may also be entered if necessary.

Finally, the system makes small adjustments to the departure sequence to improve runway throughput and reduce delay. These adjustments will, for example, separate aircraft bound for the same departure fix and group aircraft by weight class. In these adjustments, no flight can be moved by more than one or a few sequence positions, thereby ensuring that greater throughput is achieved without unfairly disadvantaging particular flights. The improved sequence must also satisfy all applicable constraints on individual flights.

For each flight, once its TTOT is determined, the TMAT and ROBT are calculated from the target queue length or wait time, the predicted movement area taxi-out time from the spot to the runway, and the predicted ramp taxi-out time from the gate to the spot. The TMAT is chosen so that the flight will arrive in the departure queue at the proper time before take-off, and the ROBT is calculated so that the flight will reach the spot just before the TMAT. If the flight has been assigned to a metering point, then in place of the TMAT the system calculates when the flight should leave the metering point, based on the target queue length or wait time and the predicted taxi time from metering point to runway.

This planning process is repeated constantly, each time making use of the most up-to-date schedule, surveillance, and user-entered data and producing an updated set of times for each flight. However, as discussed previously, these updates maintain stability in the sequence and freeze any TMAT times which are up coming within the defined freeze horizon.

1.4.1.6 Chat (D1d–covered in IV.A3 above)

d. Provide a 'chat' function or other approved means of facilitating instantaneous communication between Users.

The Aerobahn Integrated Chat System will be provided in Phase A and was detailed in Section 1.3.3 above.

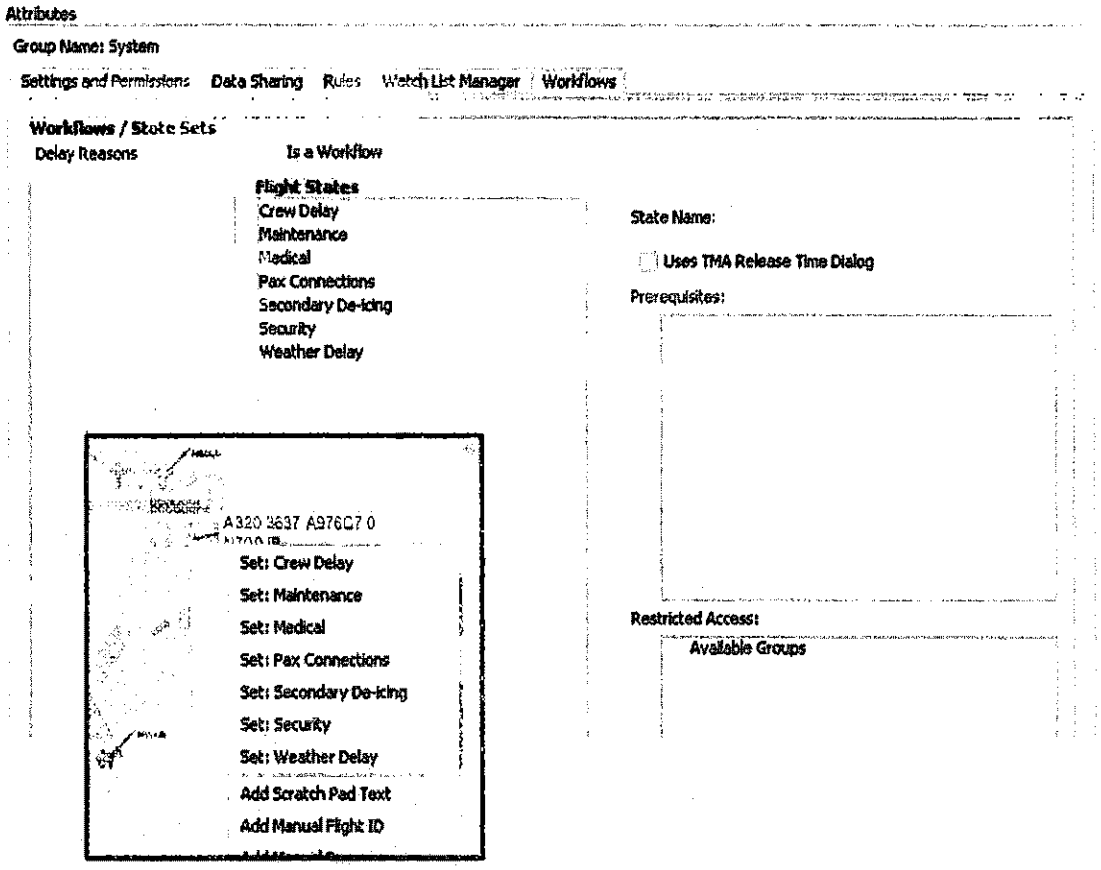
1.4.1.7 Manual Operational Event Tagging (D1m)

m. Provide the capability to allow a User to match a "delay type time-stamp" for an Aircraft to log an operational event such as a reason for a delay. There shall be a list of 20 delay type time-stamps available in a drop-down style menu. These data elements will be stored, accessible and available to appropriate Users for reporting purposes.

The Automated Workflow Processing feature in Aerobahn enables a user to define a list of textual tags that can be applied to any flight. These tags can refer to a workflow state, such as "Refueled" or "Boarded;" or an operational state such as "Medical Emergency On-Board" or "Priority Flight." Thus, these tags could also be used to indicate the delay type.

The application administrator simply configures the workflow in the System Administration Tool. Any permissioned user can set the delay reason by right clicking on the aircraft on the Map Display, selecting the correct workflow and choosing the reason from a drop down list.

Figure 34 Using Workflows to Tag a Flight with a Reason for Delay



With Aerobahn Automated Workflows, the Port Authority and airport stakeholders can track any number of processes or manual states in an automated and efficient manner. Much like Aerobahn's Dynamic Rule Engine and Watch List features, the provided benefits go well beyond the Port Authority's specific requirements as these tools were designed for extreme flexibility. For example, Workflows are today being employed by operators and the FAA in the ATL Center (ZTL) to coordinate expected push back times and proactively assign TMA slots, and are being used by US Airways to implement an ad-hoc form of departure metering in CLT.

1.4.1.8 Playback with Audio (D1e)

e. Have a feature to provide instant replay of specified historical time periods, synchronizing both

surface surveillance, chosen local radio frequencies, and the respective time frame of the taxi time allocation and chat functions. The System shall have the capability to save a copy of the recorded playback in a MPEG-2 format.

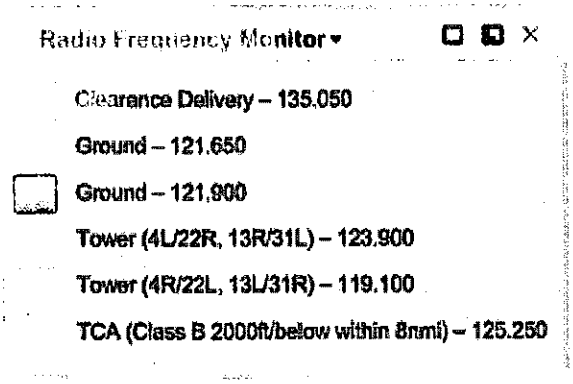
For the Phase A deployment Aerobahn will integrate surface surveillance and voice audio, from JFK aviation radio frequencies, for use in real time viewing, or for playback. The comprehensive Aerobahn playback capability is described in detail in section 1.3.4, Traffic Display (C15,16,18). The Aerobahn Playback Dialog allows the user to enter a time value to playback historical system activity. The Aerobahn system also supports playback of historical system data by selection of a time tag from Aerobahn reports, as described in section 1.5.1.5, Playback (E1e). The playback of the Traffic Display surveillance, and taxi time allocations, and voice audio is synchronized to support after action review of events and SMS processing. Aerobahn playback in general may be run at speeds between 1x to 10x real-time, the audio will only be available in 1x playback.

1.4.1.8.1 Voice Audio Selection (live and playback)

Aerobahn will provide a user interface to listen to audio traffic, either live or playback (

Figure 35). This capability is integrated into the system to provide access, either live or playback, to any of the available audio frequencies.

Figure 35 Audio Data Interface Dialog Box for Live and Playback (Concept)



The frequencies shown in the figure are for illustration only. The voice audio selection options will include the set of frequencies currently available on the public web site liveATC.net, with a capability monitor up to 8 additional frequencies. Sensis has entered into a commercial agreement with LiveATC.net to provide access to their data feeds for the Sensis SMS for JFK Airport. This agreement provides the audio monitoring service (live and playback) for the complete set of frequencies listed in the Airport/ Facility Directory for the JFK Airport. This base Audio monitoring capability is provided with a predicted service availability of 99%. While LiveATC.net is a public web site that make many of its aviation feeds available for free, those feeds (and their archives) are not free to use in third-party commercial applications. Third-party solutions providers must enter a commercial agreement with LiveATC.net to obtain commercial use rights.

While this predicted availability for audio monitoring is lower than the rest of the service, it should not affect the core mission of the JFK SMS system, since the SMS base services can still be provided. If The Port Authority desires a more comprehensive audio monitoring capability with higher system availability, Sensis is also pleased to offer a priced option to increase the quantity of available audio channels, and to provide higher predicted audio monitoring availability.

1.4.1.9 Operational Support (D1j)

j. Forecast the projected airport throughput rates based on historical performance and current and forecasted conditions, including weather, flight schedule demand, traffic management initiatives and other operational constraints.

The database behind the Aerobahn SMS maintains extremely detailed records of airport conditions, performance, and individual flight trajectories and taxi times. This wealth of data is mined and processed with dynamic machine learning algorithms in order to generate highly accurate forecasts of airport performance. Following the input of the planned operation details, as coordinated with the FAA and discussed in Section 1.3.9, Aerobahn is capable of monitoring the changing conditions at Kennedy to dynamically refine the planned rates. This dynamic adjustment based on real, surveillance observed, throughput rates and dynamic forecasts, ensures that departures are metered at the correct rate – neither over or under feeding the runways.

1.4.1.10 Surveillance (D1g,1h)

g. Surface surveillance may be dependent on Federal Aviation Administration (FAA) system, e.g., ASDE-X, TFMS, ADS-B, or it may rely on an approved alternative(s) that provide(s) information comparable to data available through ASDE-X.

h. If wholly independent of FAA systems, unless otherwise agreed to by the PANYNJ, the surveillance or alternatively approved infrastructure shall be refreshed and/or upgraded a minimum every two (2) years.

The surface surveillance data source for the Aerobahn SMS is the FAA JFK ASDE-X system, augmented by the FAA JFK Gate surveillance system, along with an interface to the ASDI data feed. The FAA ASDE-X system includes surveillance (from Multilateration sensors and Surface Movement Radar) and displays used by FAA ATC Tower personnel. The ASDE-X system fuses the surface surveillance with data from the JFK Terminal Radar and correlates aircraft call sign and flight plans from the FAA flight planning system. The ASDE-X system includes a fully redundant set of data processing servers along with multiple displays. The JFK FAA Gate surveillance system consists of a network of distributed remote surveillance units in and around the JFK ramp and gate areas and a set of non-redundant processing servers. This Gate system is integrated with the ASDE-X system to provide surveillance for the airport movement area and for terminal Ramp and Gate areas.

The FAA ASDE-X surface surveillance system and the FAA JFK Gate surveillance systems are maintained by the FAA. Sensis currently provides the CLS maintenance

support for the JFK FAA Gate surveillance system.

This proposal includes an option to both augment the gate area surveillance and to improve system availability by adding redundant processing servers and a redundant communications interface between the Aerobahn System and this surface surveillance.

1.4.1.11 Web-Based Access (D1i)

i. Provide a secure, web-based environment available to authorized, geographically dispersed Users.

The Aerobahn application is accessible via a web-browser using the Universal Resource Locator (URL) (web address) provided by Sensis.

The Aerobahn system architecture includes high speed portals for web services and data inputs at both the Port Authority's JFK facilities and at airline facilities (both on and off the JFK airport property). Access to Aerobahn is also available via a virtual private network (VPN) tunneling through the public internet in a secure manner. See Section V.1.1.3 System Architecture for more details.

1.4.2 Integration with External Systems (D2,D3)

The System shall integrate with external systems to receive and distribute key Data Elements in accordance with the Scope of Work. Flight Plan Data Elements, Additional Data Elements and potential sources are listed in Exhibit 2, Data Element Sheet. The Service shall, at a minimum, integrate with the external systems listed in Exhibit 6 or another Port Authority approved equivalent.

Sensis will work with the FAA, NAS Operators and data vendors to gain access for integration into the Aerobahn SMS Service the following data sources:

- Gate Augmented ASDE-X Surface Surveillance System
- ASDI (TFMS)
- CDMNet
- TMA
- METAR
- RVR
- TAF
- ITWS
- CIWS
- RAPT

- FIDS
- NAS Operator Data

Detailed descriptions of these data sources are provided in 1.4.3, below. Sensis, as with any contractor, is restricted by the vendor source of data as to whether the data source will be permitted to be accessed and integrated. If the data sources are permitted to be accessed, then Sensis commits to acquiring the necessary permissions and integrating the data feeds as described in the following sections.

1.4.3 Function to Receive and/or Distribute Data Elements (D3, Exhibit 2)

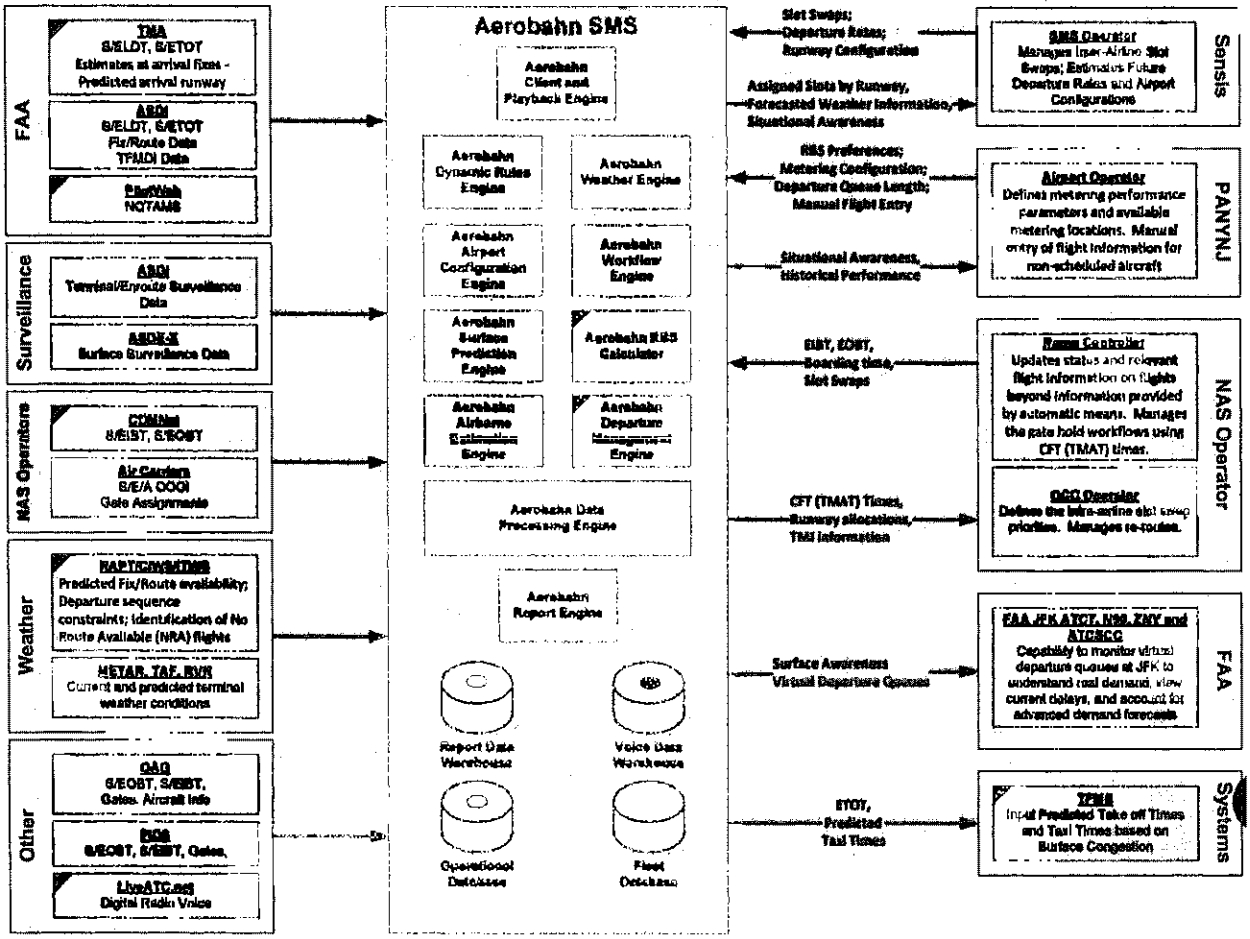
The Service shall receive and distribute the data elements listed in Exhibit 2, Data Element Sheet to perform functions in accordance with the Scope of Work. The data shall be derived from indicated general sources listed in the Data Element Sheet or approved equivalent:

Sensis has significant experience with integrating, correlating, and processing external data sources within the Aerobahn SMS, a task that is seemingly simple but very complex in practice. The diversity of IT systems at an airport, coupled with their inherent data overlaps, holes, unique peculiarities, and outright contradictions makes data integration much more difficult than the mere consumption of an agreed upon data format. Through years of experience, Sensis has developed sophisticated correlation algorithms that allow Aerobahn to consume data from multiple sources and select the best data to use for each particular situation. With JFK's size and large number of stakeholders, the IT landscape there is even more difficult. Sensis has substantial experience with the systems specifically required to support the Port Authority's needs, and has already struggled through discovering their real world limitations. As such, Sensis is again uniquely positioned to quickly deliver optimal functionality.

Aerobahn currently already has interfaces with six domestic carriers across its installed base. Sensis has been an early adopter of the Aviation Information Data Exchange (AIDX) interface that is used for several of these interfaces, in addition to the many different FIDS providers that Aerobahn interfaces with. Sensis has also recently added interfaces to key weather systems to integrate weather conditions into both the real-time as well as the reporting components of the Aerobahn Service. Because Sensis has the algorithms and processes already in place, adding in additional data feeds to augment the existing data already available in Aerobahn is a simple, low risk improvement to the existing system.

Sensis has already completed a thorough review and design to ensure it understands all of the systems being interfaced with, what data will be extracted, and how it will flow through the system and be leveraged by each stakeholder. The data feeds required to provide the data elements listed in Exhibit 2 of the RFP are shown in the integrated data flow figure below and then described in further detail in the subsequent sections.

Figure 36 Aerobahn SMS Integrated Data Flow



1.4.3.1 Adaptation Data

Adaptation Data — This data describes the layout of the airport. It shall include runways, taxiways, ramps, gates/stands among other items.

For discussion of the origin of the adaptation data see Section 1.4.4.3.1, Base Map.

1.4.3.2 Surface Surveillance Data

Surface Surveillance Data —Data received shall include real-time position information of aircraft and surface vehicles in both movement and non-movement areas. Sources include FAA and commercial systems.

The Aerobahn SMS platform is built using an open and flexible architecture allowing it to not only integrate a myriad of flight data sources, but also to be driven by different surveillance sources. For the requested JFK SMS, Sensis proposes to leverage the FAA-owned JFK Airport Surface Detection Equipment – X Band (ASDE-X) and the FAA-owned JFK ASDE-X Augmentation Gate System. This will lower the Port Authorities

operating costs and again allow Sensis to deliver the requested functionality expeditiously. Together these systems currently cover the airport surface, out to 10 nautical miles, and up to 5000 feet. Given appropriate coordination with the FAA, the coverage of this combined system could be extended beyond 10 nautical miles to provide this high quality surveillance for aircraft arriving at key locations, such as arrival or departure fixes. Sensis receives a direct feed from this combined ASDE-X systems into its data center delivering uninterrupted real-time surveillance. And, since Sensis is the provider of both the ASDE-X and the JFK ASDE-X Gate Augmentation system, Sensis has extensive operational experience in understanding the capabilities and limitations inherent at JFK. This is experience that has been honed over years of operation experience at JFK and has allowed Sensis to develop key algorithms within Aerobahn to accommodate these limitations, particularly in the high quality region occupancy and taxi time calculations which will be crucial to departure metering compliance tracking.

Sensis, under sub-contract to Volpe, also maintains the JFK ASDE-X Gate Augmentation system for the FAA and has done so since its inception. This allows Sensis to ensure that the JFK surface management services and its input JFK surface surveillance are able to meet the needs of the Port Authority stakeholders. If, in the future, the FAA chooses change the way they provide the JFK airport surface surveillance, Sensis is the only company with the background and experience to successfully transition the JFK ASDE-X Gate Augmentation system to the Port Authority.

1.4.3.3 Traffic Flow Management Data

Traffic Flow Management System (TFMS) Data — Data received from TFMS shall include flight plan information, takeoff time (DZ message), Traffic Management Initiative (TMI) data, etc. The data made available to TFMS shall include predicted taxi time, wheels off time, etc.

Sensis subscribes to the Airport Situation Display to Industry (ASDI) feed which delivers FAA Traffic Flow Management (TFM) data to commercial consumers. ASDI delivers information from the following message types: FZ (Flight Plan), AF (Flight Plan Amendments), DZ (Departures), UZ (Boundary Crossings), TZ (Track Updates), AZ (Arrivals), RZ (Cancellations), TO (Oceanic Track Updates), and RT (Route Messages for every FZ, AF and UZ).

Sensis will work with its airline partners to gain access to the CDMNet data feed. For the Port Authority, Sensis will create an interface in Aeobahn that can receive the feed from CDMNet, particularly the Aggregate Demand Level (ADL) data. In addition to the ADL data, the interface will be designed to handle additional data elements such as airport configuration data and RVR that may be available in the future. Sensis has extensive experience in processing similar data feeds. In addition to the Aircraft Situation Display to Industry (ASDI) data feeds, Sensis also receives the TFM Data to Industry (TFMDI) data feed and collects the FAA Operational Information System (OIS) data in real-time. Sensis will apply its expertise in handling and processing these data feeds to integrate the CDMNet feed in into Aerobahn.

Provided the FAA allows access to the awarded SMS contractor, Sensis will work with

the TFMS contractor to create an interface to deliver predicted wheels off times and predicted taxi times to the Traffic Flow Management System (TFMS).

1.4.3.4 Traffic Management Advisor (TMA) Data

Traffic Management Advisor (TMA) Data — Data received from TMA shall include arrival time estimates at arrival fixes and runway thresholds, and identification of arrival runway assigned to the arriving aircraft if available.

Sensis will develop an interface between Aerobahn and the FAA's Traffic Management Advisor (TMA) system, which is currently hosted at the N90 TRACON - the only place in the US where the hosting location is the TRACON versus the ARTCC. Given that JFK departures are routinely in the top 10 airports assigned departure delays through TMA, this integration will provide greater insight into the operational situation and the impact of ATC programs. Since Sensis is a current FAA Trajectory-Based Flow Management (TBFM) contractor, and its staff has been developing software to interface with TMA for over 10 years on many projects, Sensis is well-qualified to provide the desired TMA interface. The TMA interface will involve the integration of the following data into the Aerobahn SMS system:

- TMA-based arrival time estimates at arrival fixes and runway thresholds,
- TMA-based predicted arrival/departure runways, and
- TMA-based Traffic Management Initiative ground delay data,

In the future, Sensis could also potentially support integration of Aerobahn SMS actual and predicted wheels-off times to improve the TMA system predictions. In fact, to this similar end, Sensis is already collaborating with the FAA on integrating the operational Aerobahn system at ATL with Atlanta ARTCC (ZTL) to support improved TMA arrival scheduling.

1.4.3.5 Weather Data

Weather Data — Data received shall include Integrated Terminal Weather System (ITWS) data, and Aviation Routine Weather Report (METAR), Corridor Integrated Weather System (CIWS), wind direction and velocity reports, Runway Visual Range (RVR), and Terminal Aerodrome Forecast (TAF) data and Route Availability Planning Tool (RAPT) or any other Port Authority approved equivalent.

Aerobahn, for Phase A, will download, integrate and display Meteorological Terminal Aviation Routine Weather Report (METAR), which includes wind direction, velocity, current conditions and precipitation, Runway Visual Range (RVR), and Terminal Aerodrome Forecast (TAF) data for basic forecasts. As with all Aerobahn real-time data and metrics, this information will be available for presentation in Playback as well as in the Report functions.

Sensis will integrate data from the Integrated Terminal Weather System (ITWS) and

Corridor Integrated Weather System (CIWS) into the SMS Operator display for use by the SMS Operator in determining the effect of significant weather on the airport configuration and runway departure rate as part of Phase B.

Sensis will develop an interface between Aerobahn and FAA's Route Availability Planning Tool (RAPT) in Phase B. Managing departure traffic when hazardous weather impacts a terminal airspace such as the New York Metroplex – an airspace consisting of multiple major airports with a high degree of interaction between adjacent airport arrival and departure traffic flows – is a very difficult job. Owing to the high traffic demand in New York, it is necessary that the traffic managers make quick rerouting decisions when future weather impact is predicted, to avoid delays from escalating. However, decisions are to be made with uncertain or no information about the following:

- Predicted departure route usage timings per flight,
- Time-periods during which particular routes will be closed/impacted by convective weather and
- Physically implementable airport departure sequences (given that individual airports have already cleared aircraft on to the taxiways in a particular order independent of the departure routing decisions).

Things are further complicated by the fact that the point of rerouting decision (the En Route Air Traffic Control Center) is physically removed from the point of control (the Airport Air Traffic Control Tower), and decisions need time-consuming collaboration/coordination across multiple facilities.

Given this background, we propose to develop a Aerobahn RAPT interface for the Port Authority to enable efficient transfer of information and informed decision-making during periods of severe weather in the New York airspace to minimize departure delay escalation. We expect the Aerobahn RAPT interface to involve integration of:

- RAPT-predicted individual flight departure route and departure fix availability information, and
- RAPT-predicted departure route and departure fix weather-impact timeline along with echo tops information for weather-impacted routes.

Integrating active traffic information into the decision-making process (especially, airport surface surveillance providing information about realizable departure sequences), however, remains a challenge yet unaddressed. We further propose the option to incorporate any interface enhancements that might be needed for smooth interoperation of the Aerobahn with RAPT enhancements currently in progress to incorporate active traffic information into the tool's decision-making process (e.g., through MITRE Integrated Departure Route Planning (IDRP) decision support tool research.

1.4.3.6 National Airspace System (NAS) Operator Supplied Data

f National Airspace System (NAS) Operator Supplied Data — The data received shall include estimated gate/stand time, boarding time, target off block time, flight prioritization, other readiness of flight indicators, etc.

Other data — This could include data from airport authority, such as Flight Information Display System (FIDS), etc.

Sensis currently receives data from several NAS operators in support of Aerobahn Services at JFK and other airports. These include Delta Air Lines and JetBlue which are significant operators at JFK as well as FIDS providers at JFK. The data feeds typically include flight schedule data, estimated times, and gate information, but the actual content of the feed is ultimately dependent on what information the NAS Operator has available and is willing to release. Sensis supports the Aviation Information Data Exchange (AIDX) format specification which allows the NAS operators to provide data in a common format to Sensis for easy integration. Sensis has extensive experience in correlating disparate NAS Operator data sources at JFK and therefore Sensis fully understand the specific challenges required in correlating this data with the other FAA and Surveillance data sources.

1.4.4 Graphical User Displays

The Contractor shall provide, at a minimum, graphical displays to enable the User to perform the functionality described below:

1.4.4.1 Combine and Process Flight Data

This section lists below and describes the basic information that the System determines from the input data and then makes available to the User through information displays. Each individual component is not necessarily displayed directly to the User; rather the System combines this data into a set of informational displays presented on User terminals. The System shall process the data it collects, thereby generating both descriptive and predictive information about current and expected airport surface traffic situation and flows. This information shall include for each flight handled by the airport, the expected or predicted values for the quantities. These informational displays shall be updated frequently, in near real time, the frequency at which shall be approved by the Port Authority and will contain at a minimum the following information:

i. Flight number

ii. Aircraft type

iii. Heavy designator

iv. Mode S

v. Mode3A

vi. Destination city for departing flights

vii. Originating city for arriving flights

viii. Estimated time of arrival

ix. Estimated time of departure

x. Predicted time of arrival

xi. Predicted time of departure

xii. Identification of arrival runway assigned to the arriving aircraft

xiii. Predicted arrival runway assigned to the arriving aircraft

xiv. Predicted and actual arrival times of inbound flights at the runway inbound threshold

xv. Positions of arriving aircraft as it approaches the airport

xvi. Positions of aircraft as it travels on the surface of the airport from the arrival runway threshold to the boarding gate/stand

xvii. Identification of scheduled gate/stand assigned (as available)

xviii. Predicted gate conflict and length of conflict

xix. Predicted and actual taxi time from the runway inbound threshold to the assigned gate/stand

xx. Turn-around time

xxi. Identification of gate/stand predicted and assigned for departure

xxii. Predicted and actual time to travel from arrival gate/stand to departure gate/stand

xxiii. Latest estimated, predicted and actual gate/stand pushback time

xxiv. Predicted and actual identification of departure runway assigned to the aircraft

xxv. Identification of aircraft that have pushed back and since returned to a gate/stand without departing.

xxvi. Irregular operation times associated with departure events such as ground stops or de-icing

xxvii. Predicted and actual taxi-time to the runway outbound threshold

xxviii. Predicted and actual taxi time delays

xxix. Predicted and actual wheels-off time

xxx. Predicted and actual final runway-specific departure lineup order

1.4.4.1.1 Available Flight Data Elements

Aerobahn currently provides the specified data elements with exceptions noted below. A complete list of data elements available in Aerobahn is presented in Figure 37.

Data elements not currently provided (or not currently provided at JFK) will be addressed as follows:

1. *Identification of arrival runway assigned to the arriving aircraft* – Aerobahn does currently have access to this information. It will be available in the Phase B deployment.

2. *Predicted and actual time to travel from arrival gate/stand to departure gate/stand* – Aerobahn cannot provide this information unless the associated NAS

operator makes tow and/or gate change schedules available.

3. *Irregular operation times associated with departure events such as ground stops or de-icing* – Assuming this means metering delay, Aerobahn will incorporate these times into our tools for Phase B.

4. *Predicted gate conflict and length of conflict* – Aerobahn can predict and alert the user to a gate conflict if a Dynamic Rule is configured to do so. The duration can be determined by examining the estimated off-block time of the flight occupying the gate in conflict.

5. *Turnaround time* – User can determine turn-around time by examining estimated (or scheduled) in-block and off-block times for a particular aircraft.

6. *Identification of aircraft that have pushed back and since returned to a gate/stand without departing* – Can be done using Dynamic Rules.

7. *All predicted times* – The Aerobahn prediction engine is not deployed with the existing JFK system. Once it is deployed as part of Phase A, predicted times will be available.

Figure 37 Aerobahn Data Elements

				Tools/Functionality																
	Long Name	Short Name	Source	Active Flights	Airline Operations	Chat	Daily Operations Graph	DQM	DQM Graph	Dynamic Rules Engine	Data Block (Inbound)	Data Block (Outbound)	Data Block (Unknown)	Data Block (Persisted)	Real-Time Taxi-Time Display	Rwy Ops by Hr / Airline Ops	Runway Status Last 15 min	Selection Details	Video Export	Watch List Viewer
AP	Heavy Designator	Heavy Des	FAA Reg							A	A	A	A	A				D		A
AI	Mode 3/A	Mode 3/A	Surv							A	A	A	A	A				D		A
AI	Mode S	Mode S	Surv							A	A	A	A	A				D		A
AI	Registration	Reg	Aero					D		A	A	A	A	A				D		D
AI	Ship Number (Carrier)	Ship #	Carrier					D		A	A	A	A	A				D		A
AI	Special Aircraft Qualifier	Sp AC Qual	ASDI							A	A	A	A	A				D		A
AT	Aircraft/Vehicle Type (Auto)	AC Type (Auto)	Auto					D		A	A	A	A	A				D		D
AT	Aircraft Type (FAA Registry)	AC Type (FAA Reg)	FAA Reg							A	A	A	A	A				D		A
AT	Aircraft Type (FAA)	AC Type (FAA)	ASDI							A	A	A	A	A				D		A
AT	Aircraft/Vehicle Type (Surveillance)	AC Type (Surv)	Surv							A	A	A	A	A				D		A
E	Flight Info ID	Flt Info ID	Aero							A	A	A	A	A				D		A
E	Flight Info Rev	Flight Info Rev	Aero							A	A	A	A	A				D		A
E	Physical Object ID	Phys ID	Aero							A	A	A	A	A				D		A
E	Target ID	Target ID	Aero							A	A	A	A	A				D		A
E	Target Rev	Target Rev	Aero							A	A	A	A	A				D		A
FI	Call Sign Inbound	Call Sign Inb	Carrier							A		A	A	A				A		A

				Tools/Functionality																
FI	Call Sign Operating Carrier	Call Sign Opr	Carrier					D		A	A	A	A	A				D		A
FI	Carrier Code Marketing	Carrier Mktg	Carrier							A	A	A	A	A				D		A
FI	Carrier Code Operating	Carrier Opr	Carrier							A	A	A	A	A				D		A
FI	Flight ID (Auto)	Flt ID (Auto)	Auto	D						A	D	D	D	D				A		D
FI	Flight ID (Manual)	Flt ID (Manual)	User							A	A	A	A	A				D		A
FI	Flight Number (Downline Connection)	Flt Num (Dnline)	Carrier								A	A	A	A				A		A
FI	Flight Number (Downline Crew Connection)	Flt Num (Dnline Crew)	Carrier								A	A	A	A				A		A
FI	Flight Number (Downline Crew Deadhead Connection)	Flt Num (Dnline Crew DH)	Carrier								A	A	A	A				A		A
FI	Flight Number (Next Flight Leg)	Flt Num (Next Leg)	Carrier							A	A	A	A	A				D		A
FI	Flight Number (Prior Flight Leg)	Flt Num (Prior Leg)	Carrier							A	A	A	A	A				D		A
FI	Flight Number (Upline Connection)	Flt Num (Upline)	Carrier								A	A	A	A				A		A
FI	Flight Number (Upline Crew Connection)	Flt Num (Upline Crew)	Carrier								A	A	A	A				A		A
FI	Flight Number (Upline Crew Deadhead Connection)	Flt Num (Upline Crew DH)	Carrier								A	A	A	A				A		A
FM	Is an Aborted Takeoff	Is an Aborted TO	Aero							A								A		A
FM	Airport Curfew	Airport Curf	Carrier									A		A				A		A
FM	Arrival Status	Arr Status	Carrier							A	A	A	A	A				A		A
FM	Assigned Equipment	Asgn Equip	Carrier							A	A	A	A	A				A		A
FM	Boarding Time	Board Time	Carrier							A	A	A	A	A				A		A
FM	Boarding Time Average	Board Time Avg	Aero							A	A	A	A	A				A		A
FM	Cargo Finalization Indicator	Cargo Final Ind	Carrier							A	A	A	A	A				A		A
FM	Crew Rest Due Time	Crew Rest Due	Carrier							A	A	A	A	A				A		A
FM	De-icing Data	De-icing Data	Carrier							A	A	A	A	A				A		A
FM	De-ice State	De-ice State	Aero							A	A	A	A	A				A		A
FM	De-ice Predicted	De-ice Pred	Aero/User																	
FM	De-ice Predicted Pad	De-ice Pred Pad	Aero/User																	
FM	Departure Status	Dep Status	Carrier							A	A	A	A	A				A		A

				Tools/Functionality																
FM	Direction	Direction	Aero					D		A								D		D
FM	Dispatch Desk Assignment	Dispatch Desk Asgn	Carrier							A	A	A	A	A				A		A
FM	Estimated Boarding Complete Time	Est Board Complete	Carrier							A	A	A	A	A				A		A
FM	Estimated Departure Clearance Time	EDCT	Carrier							A		A		A				A		A
FM	Estimated Departure Clearance Time (Manual)	EDCT (Man)	User							A		D	A	A				D		A
FM	Filed True Airspeed (knots)	Airspeed (kts)	ASDI																	
FM	Flight Leg Status	Flt Leg Status	Carrier							A	A	A	A	A				A		A
FM	Flight Origination Date	Flt Orig Date	ASDI							A	A	A	A	A				D		A
FM	Flight Origination Date (Downline Connection)	Flt Orig Date (Dnline)	Carrier							A	A	A	A	A				A		A
FM	Flight Origination Date (Downline Crew Connection)	Flt Orig Date (Dnline Crew)	Carrier							A	A	A	A	A				A		A
FM	Flight Origination Date (Downline Crew Deadhead Connection)	Flt Orig Date (Dnline Crew DH)	Carrier							A	A	A	A	A				A		A
FM	Flight Origination Date (Next Flight Leg)	Flt Orig Date (Next Leg)	Carrier							A	A	A	A	A				D		A
FM	Flight Origination Date (Prior Flight Leg)	Flt Orig Date (Prior Leg)	Carrier							A	A	A	A	A				D		A
FM	Flight Origination Date (Upline Connection)	Flt Orig Date (Upline)	Carrier							A	A	A	A	A				A		A
FM	Flight Origination Date (Upline Crew Connection)	Flt Orig Date (Upline Crew)	Carrier							A	A	A	A	A				A		A
FM	Flight Origination Date (Upline Crew Deadhead Connection)	Flt Orig Date (Upline Crew DH)	Carrier							A	A	A	A	A				A		A
FM	Flight Release Status	Flt Rel Status	Carrier							A	A	A	A	A				A		A
FM	Ground Time Objective	Gnd Time Obj	Carrier							A	A	A	A	A				A		A
FM	International or Domestic Indicator	Intl/Dom Ind	Carrier							A	A	A	A	A				D		A
FM	Irregular Ops Status	IROPS Status	Carrier							A	A	A	A	A				D		A
FM	Is a Persisted Aircraft	Is a Persisted AC	Aero							A								A		A
FM	Measured Flight Level (100's of feet)	Meas FL	Surv							A	A	A	A	A				D		A
FM	Is a Missed Approach	Is a Missed Aprch	Aero							A								A		A
FM	Operational State	Op State	Aero	D						A	A	A	A	A				D		A

				Tools/Functionality																
FM	Operational State Elapsed Time	Etime	Aero	D																
FM	Passenger Count (Downline Connection)	Pax Ct Conn (Dnline)	Carrier							A	A	A	A	A				A		A
FM	Passenger Count Status	Pax Ct Status	Carrier							A	A	A	A	A				A		A
FM	Passenger Count Thru	Pax Ct Thru	Carrier							A	A	A	A	A				A		A
FM	Passenger Count Total	Pax Ct Total	Carrier							A	A	A	A	A				A		A
FM	Persisted State	Persisted State	Carrier							A								D		A
FM	Scheduled Equipment	Sch Equip	Carrier							A	A	A	A	A				A		A
FM	Scratch Pad Text	Scratch Pad	User							A	D	D	D	D				D		A
FM	Speed (knots)	Speed (kts)	Surv							A	A	A	A					D		A
FM	Station Code (Downline Connection)	Station Cd (Dnline)	Carrier							A	A	A	A	A				A		A
FM	Station Code (Downline Crew Connection)	Station Cd (Dnline Crew)	Carrier							A	A	A	A	A				A		A
FM	Station Code (Downline Crew Deadhead Connection)	Station Cd (Dnline Crew DH)	Carrier							A	A	A	A	A				A		A
FM	Station Code (Upline Connection)	Station Cd (Upline)	Carrier							A	A	A	A	A				A		A
FM	Station Code (Upline Crew Connection)	Station Cd (Upline Crew)	Carrier							A	A	A	A	A				A		A
FM	Station Code (Upline Crew Deadhead Connection)	Station Cd (Upline Crew DH)	Carrier							A	A	A	A	A				A		A
FM	Taxi Time in Non-Movement Area	Taxi Time Non-Mvmt	Aero																	
FM	Taxi In Time Average Downline Airport	Taxi In Avg (Dnline)	Aero							A	A	A	A	A				A		A
FM	Taxi Out Time Average Upline Airport	Taxi Out Avg (Upline)	Aero							A	A	A	A	A				A		A
FM	Taxi Time (Aerobahn)	Taxi Time (Aero)	Aero							A	A	A	A	A				D		A
FM	Taxi Time (Auto)	Taxi Time (Auto)	Auto							A	A	A	A	A				D		A
FM	Taxi Time (Carrier)	Taxi Time (Carrier)	Carrier							A	A	A	A	A				D		A
FM	Taxi Time Estimated Remaining (Aerobahn)	Taxi Time Est Rem (Aero)	Aero							A	A	A						D		A
FM	Taxi Time After De-icing	Taxi Time After De-icing	Aero							A		A	A	A				D		A
FM	Taxi Time in Movement Area	Taxi Time Mvmt	Aero							A	A	A	A	A				D		A

				Tools/Functionality																
FM	TMA Release Time (Manual)	TMA Release	User							A	A	A	A	A				A		A
FM	TMA Void Time (Manual)	TMA Void	User							A	A	A	A	A				A		A
FM	Under Surveillance	Under Surv	Aero	D				D		A								A		A
FO	Actual In Block Time (Aerobahn)	AIBT (Aero) Actual In Block Time	Aero							A	A			A				D		A
FO	Actual In Block Time (Carrier)	AIBT (Carrier) Actual In Block Time	Carrier							A	A			A				D		A
FO	Actual In Block Time (FIDS)	AIBT (FIDS) Actual In Block Time	FIDS							A	A			A				D		A
FO	Actual Landing Time (Aerobahn)	ALDT (Aero) Actual Landing Time	Aero							A	A			A				D		A
FO	Actual Landing Time (Carrier)	ALDT (Carrier) Actual Landing Time	Carrier							A	A			A				D		A
FO	Actual Landing Time (FAA)	ALDT (FAA) Actual Landing Time	ASDI							A	A			A				D		A
FO	Actual Off Block Time (Aerobahn)	AOBT (Aero) Actual Off Block Time	Aero							A		A		A				D		A
FO	Actual Off Block Time (Carrier)	AOBT (Carrier) Actual Off Block Time	Carrier							A		A		A				D		A
FO	Actual Off Block Time (FIDS)	AOBT (FIDS) Actual Off Block Time	FIDS							A		A		A				D		A
FO	Actual Take Off Time (Aerobahn)	ATOT (Aero) Actual Take Off Time	Aero							A		A		A				D		A
FO	Actual Take Off Time (Carrier)	ATOT (Carrier) Actual Take Off Time	Carrier							A		A		A				D		A
FO	Actual Take Off Time (FAA)	ATOT (FAA) Actual Take Off Time	ASDI							A		A		A				D		A
FO	Estimated In Block Time (Aerobahn)	EIBT (Aero) Estimated In Block Time	Aero							A	A			A				D		A
FO	Estimated In Block Time (Carrier)	EIBT (Carrier) Estimated In Block Time	Carrier							A	A			A				D		A
FO	Estimated In Block Time (FIDS)	EIBT (FIDS) Estimated In	FIDS							A	A			A				D		A

				Tools/Functionality																
		Block Time																		
FO	Estimated Landing Time (Aerobahn)	ELDT (Aero) Estimated Landing Time	Aero	D						A	A			A				D		A
FO	Estimated Landing Time (Carrier)	ELDT (Carrier) Estimated Landing Time	Carrier							A	A			A				D		A
FO	Estimated Landing Time (FAA)	ELDT (FAA) Estimated Landing Time	ASDI							A	A			A				D		A
FO	Estimated Off Block Time (Aerobahn)	EOBT (Aero) Estimated Off Block Time	Aero							A		A		A				D		A
FO	Estimated Off Block Time (Carrier)	EOBT (Carrier) Estimated Off Block Time	Carrier							A		A		A				D		A
FO	Estimated Off Block Time (FIDS)	EOBT (FIDS) Estimated Off Block Time	FIDS							A		A		A				D		A
FO	Estimated Off Block Time (Manual)	EOBT (Man) Estimated Off Block Time	User																	
FO	Estimated Take Off Time (Aerobahn)	ETOT (Aero) Estimated Take Off Time	Aero							A		A		A				D		A
FO	Estimated Take Off Time (Carrier)	ETOT (Carrier) Estimated Take Off Time	Carrier							A		A		A				D		A
FO	Estimated Take Off Time (FAA)	ETOT (FAA) Estimated Take Off Time	ASDI							A		A		A				D		A
FO	Scheduled In Block Time (Carrier)	SIBT (Carrier) Scheduled In Block Time	Carrier							A	A			A				D		A
FO	Scheduled In Block Time (FIDS)	SIBT (FIDS) Scheduled In Block Time	FIDS							A	A			A				D		A
FO	Scheduled Landing Time (Carrier)	SLDT (Carrier) Scheduled Landing Time	Carrier							A	A			A				D		A
FO	Scheduled Landing Time (FAA)	SLDT (FAA) Scheduled Landing Time	ASDI							A	A			A				D		A
FO	Scheduled Off Block Time (Carrier)	SOBT (Carrier) Scheduled Off Block Time	Carrier							A		A		A				D		A
FO	Scheduled Off Block Time (FIDS)	SOBT (FIDS) Scheduled Off Block Time	FIDS							A		A		A				D		A

				Tools/Functionality																
FO	Scheduled Take Off Time (Carrier)	STOT (Carrier) Scheduled Take Off Time	Carrier							A		A		A				D		A
FO	Scheduled Take Off Time (FAA)	STOT (FAA) Scheduled Take Off Time	ASDI							A		A		A				D		A
FR	Arrival Procedure Name	Arr Proc	ASDI							A	A		A	A				D		A
FR	Arrival Station GMT Adjustment	Arr Station GMT Adj	Carrier							A	A	A	A	A				A		A
FR	Assigned Altitude (100's of feet)	Asgn Alt	ASDI							A	A	A	A	A				D		A
FR	Departure Procedure Name	Dep Proc	ASDI							A		A	A	A				D		D
FR	Departure Station GMT Adjustment	Dep Station GMT Adj	Carrier							A	A	A	A	A				A		A
FR	Destination Airport	Dest	Auto					D		A		A	A	A				D		D
FR	First Departure Fix	First Fix	ASDI					D		A		A		A				D		A
FR	Flight Route	Flt Route	ASDI							A	A	A	A	A				D		A
FR	Gate Actual	Gate Act	Aero							A	A	A	A	A				D		A
FR	Gate Assigned (Auto)	Gate Asgn (Auto)	Auto																	
FR	Gate Assigned (Carrier)	Gate Asgn (Carrier)	Carrier					D		A	A	A	A	A				D		A
FR	Gate Assigned (Carrier) Status	Gate Asgn (Carrier) Status	Carrier							A	A	A	A	A				A		A
FR	Gate Assigned (FIDS)	Gate Asgn (FIDS)	FIDS							A	A	A	A	A				D		A
FR	Gate Assigned (FIDS) Status	Gate Asgn (FIDS) Status	FIDS							A	A	A	A	A				A		A
FR	Gate Assigned (Manual)	Gate Asgn (Man)	User							A	D	D	D	D				D		A
FR	Gate Assigned Estimated Availability	Gate Asgn Est Avail	Aero							A	A	A	A	A				A		A
FR	Gate Currently Occupied	Gate Curr Occ	Aero							A	A	A	A	A				D		A
FR	Gate Predicted	Gate Pred	Aero							A	A		A	A				D		A
FR	Last Arrival Fix	Last Arr Fix	ASDI							A	A			A				D		A
FR	Last Fix Coordination Time - Actual	Last Fix Coord Time - Act	ASDI							A	A		A	A				A		A
FR	Last Fix Coordination Time – Estimated	Last Fix Coord Time – Est	ASDI							A	A		A	A				A		A
FR	Last Fix Coordination Time – Proposed	Last Fix Coord Time – Prop	ASDI							A	A		A	A				A		A
FR	Origination Airport	Orig	Auto	D				D		A	A			A				D		A

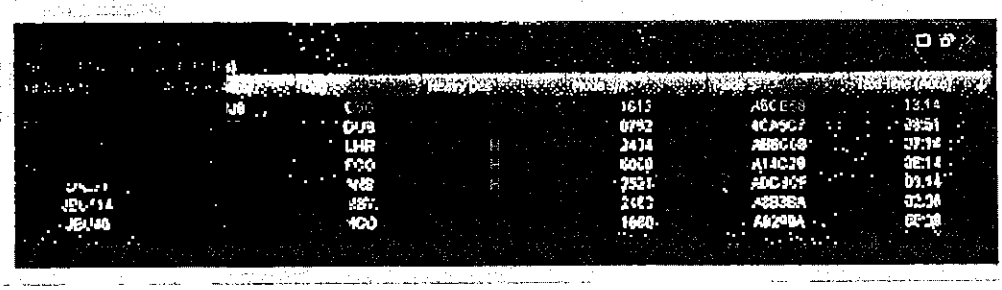
				Tools/Functionality																
FR	Runway Actual	Runway Act	Aero							A	A	A	A	A				A		A
FR	Runway Assigned (Manual)	Runway Asgn (Man)	User							A	D	D	D	D				D		A
FR	Runway Predicted	Runway Pred	Aero							A	A	A	A	A				A		A
RO	Gate Occupancy Time	Gate Occ Time	Aero							A	A	A	A	A				D		A
RO	De-ice Pad Occupancy Time	De-ice Occ Time	Aero							A		A	A	A				D		A
RO	Region Current	Region Current	Aero							A										
RO	Region Entry Times	n/a - List	Aero					D		A								D		
RO	Region Names	n/a - List	Aero							A								D		
RO	Region Occupancy Times	n/a - List	Aero					D		A								D		
RO	Region Types	n/a - List	Aero							A										
TT	Target Type	Target Type	Aero							A	A	A	A	A				D		A
V	Is a Vehicle?	IsVeh?	Aero							A										
V	Tracking Device ID	Trk Dev ID	User																	
V	Mode S (same field as Aircraft Identification field Mode S)	Mode S	Aero																	
V	Vehicle Callsign (same field as Callsign Operating Carrier field)	Callsign	User																	
V	Vehicle Name	Veh Name	User																	
V	Vehicle Type (same field as Aircraft/Vehicle Type)	Veh Type	User																	
V	Vehicle Model	Veh Model	User																	
V	Vehicle Owner	Veh Ownr	User																	
V	Vehicle Owner Phone	Veh Ownr Phn	User																	
WL	Watch List Entry Time	Watch Entry	Aero																	A
WL	Watch List Duration Time	Watch Dur	Aero																	A

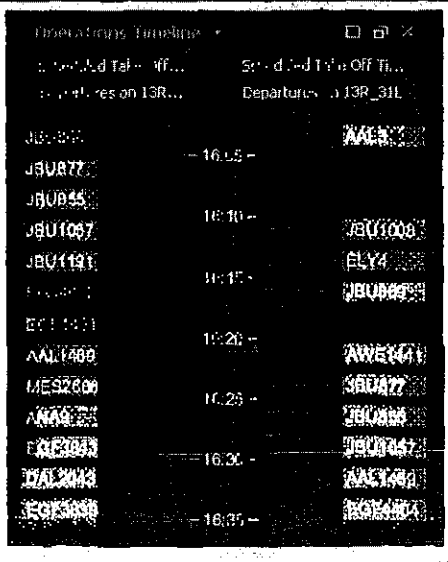
1.4.4.1.2 Display of Flight Data Elements

Sensis has over a decade of integrating and processing flight data within Aerobahn. Many of these capabilities are already deployed at JFK. Many other of the required capabilities are deployed at other Aerobahn locations such as Atlanta, and finally there are other capabilities that are not yet deployed, but are already on our product road-map that will be available by Phase A commencement.

Figure 38 is an example of different data elements are displayed in Aerobahn.

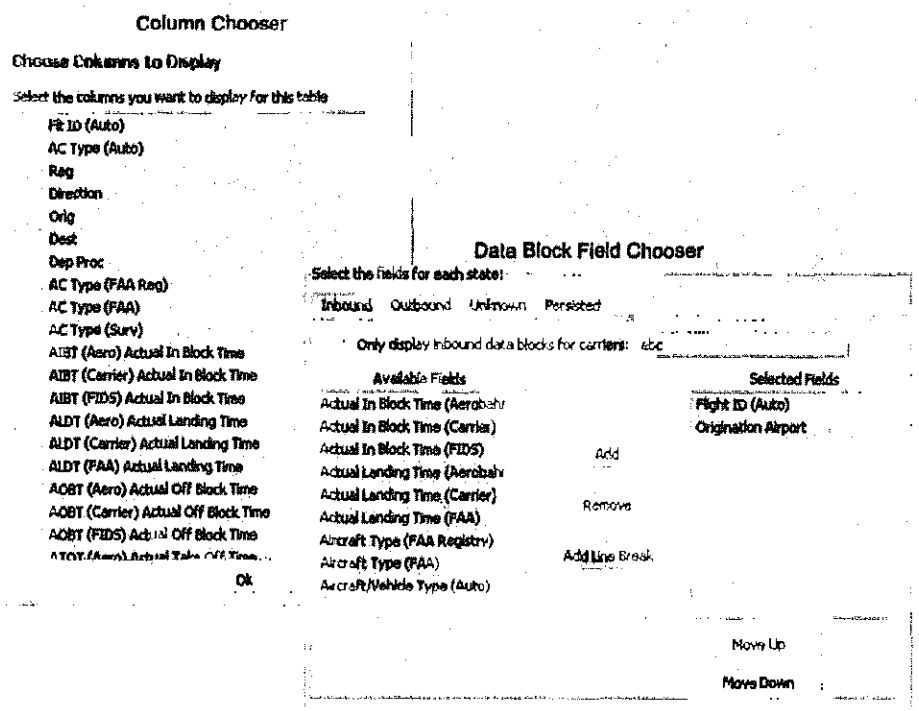
Figure 38 Data Element Manifestation in Aerobahn

Feature	Example
Data Tag	
Watchlist	

Feature	Example
Tool	

Aerobahn has very power and flexible methods to modify data tags, watch list elements, and tools. Included below are examples of the dialog boxes users have available to select items in data blocks (Figure 39) and Watch Lists.

Figure 39 Aerobahn Field Selection



1.4.4.2 Workspace (D4i.i,i.ix)

i. Additional Characteristics of the Base Map

The Base Map shall provide the following characteristics and capabilities:

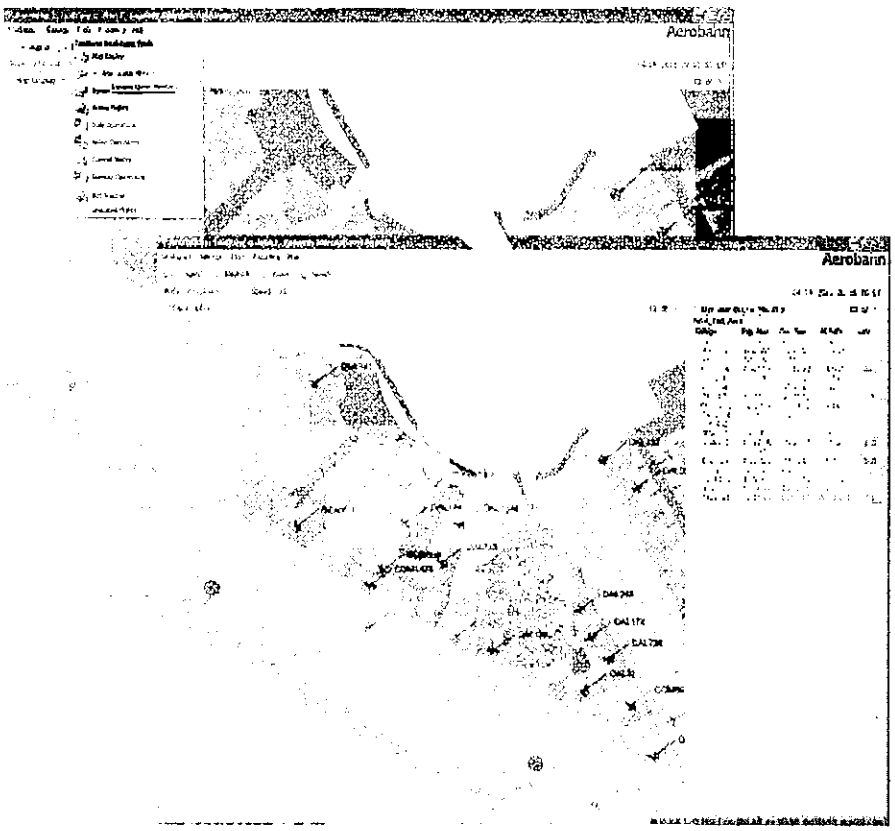
i. The display of all of the items should be configurable to be displayed on one screen or if multiple screens should be used to hold the full set of items. These preferable setting should be savable as a default for each User.

ix. Through the Base Map, the user shall have the capability to open additional windows on screen(s) that displays additional content without obscuring the Base Map view. These windows shall contain performance indicators, predictive/forecasted data, etc., all being displayed concurrently.

The Aerobahn display can be expanded to fill two screens. This configuration is easily recalled since the latest workspace configuration is automatically saved on exit. In addition, the user may save a particular workspace, giving it a name, for future use.

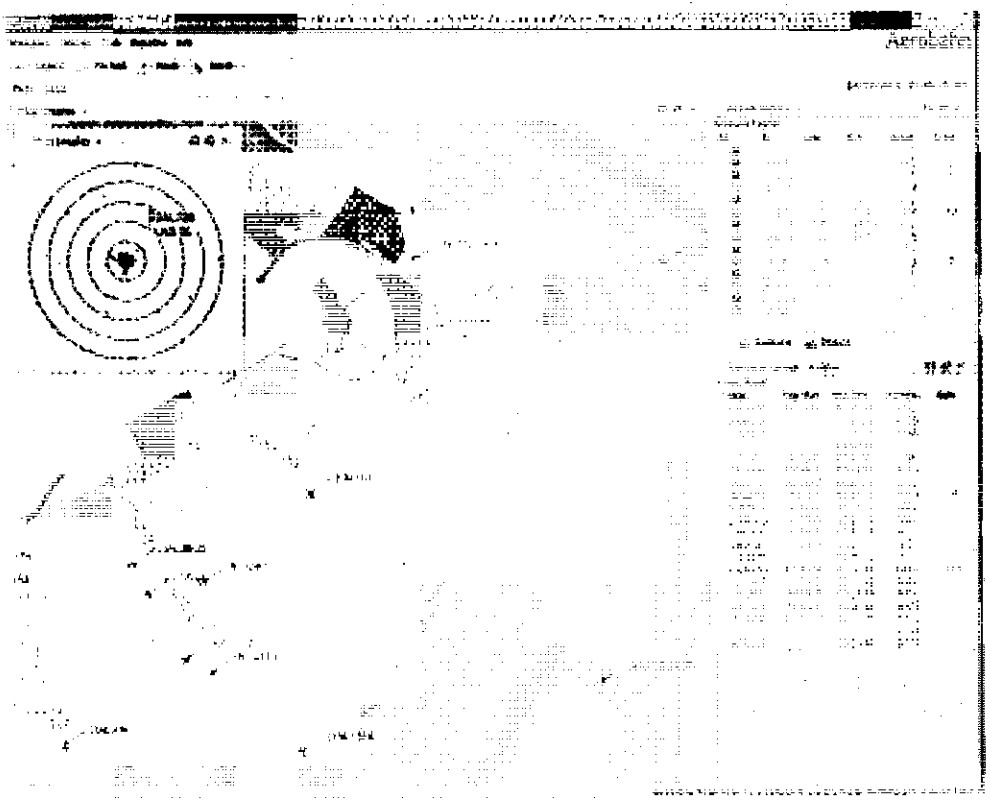
Included in Aerobahn is the ability to add tools in a flexible workspace. These tools are enabled by a pull down menu on the top of the workspace window. These tools can then be configured and placed in desired locations in the workspace as shown in Figure 40.

Figure 40 Launching Tools in the Flexible Workspace



Tools can also be "floated" in the Flexible Workspace to achieve a picture-in-picture effect (Figure 41).

Figure 41 Floating Tools in the Flexible Workspace



1.4.4.3 Map Background (D4b,c,d,e,f.i,f.iv,i.ii,i.vii,i.viii,k)

1.4.4.3.1 Base Map

b. Base Map (Visual Overview Display) of the Airport

The Contractor shall provide a Base Map, visual display, of the Airport that will show a top down view of, at a minimum, the following airport elements: runways, taxiways, ramps, gates/stands, possibly structures, and other physical structures as required to provide the Services described herein. The base map will provide a context for displaying situational information about surface traffic at the airport. A PDF of the current airport layout is provided as Exhibit 7.

c. Organize Airport Adaptation Data to Support the Base Map

One of the groups of data collected is data that describes the layout of the airport. This data shall be organized to support the drawing of a detailed visual overview of the airport. It is expected that this function of mapping the adaptation data to a visual overview will need be executed infrequently. Airport adaptation data shall be used to support a detailed visual overview of the airport layout.

The Port Authority shall provide information, adaptation data, which describes the physical details of the airport layout. The contractor shall update adaptation data to accurately reflect the physical details of the airport layout as provided by the Port Authority.

d. Characteristics of the Base Map At a minimum, the visual overview shall:

i. Display the name and location of the airport.

ii. Show all of the runways, hold bars, taxiways, ramps, gates/stands, and other fixed elements at the airport.

iii. Display the runway configuration and the names of the active runways.

iv. The Service shall mark unavailable runways, taxiways, etc. in a distinctive, color-coded or other approved manner. Such availability and closure information shall reflect real-time Notices to Airmen (NOTAM) and shall be obtained through the following website or another Port Authority approved source: https ://pilotweb.nas.faa.gov/PilotWeb/

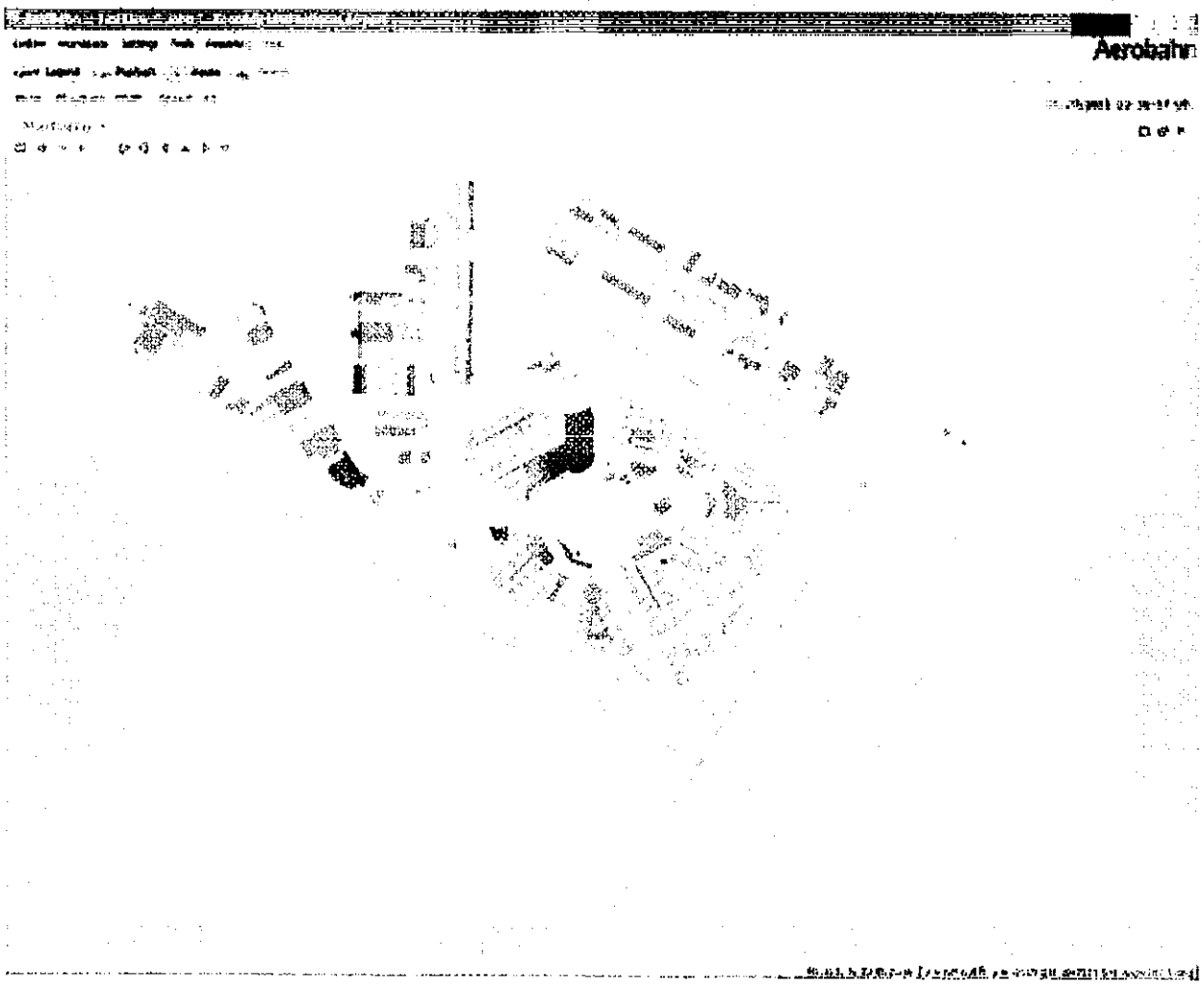
v. Be updated when the physical details of the airport are changed.

vi. Be drawn to scale.

The Aerobahn base map is a scale detailed representation of the airport surface depicting buildings, parking areas, individual gates, taxiways, runways, major pavement markings, service roads, and construction areas. It is based on the latest Requirements and Technical Concepts for Aviation (RTCA) DO-272 compliant, industry-standard aerodrome maps and can be changed or augmented based on customer feedback as needed.

The latest John F. Kennedy International Airport map is depicted in Figure 42.

Figure 42 Aerobahn Map of John F. Kennedy International Airport



Aerobahn application administrators, in coordination with the customer, regularly modify the map as updates to the adaptation are provided. These updates may come from Sensis' third party map provider or directly from the customer. The JFK airspace information, such as departure and arrival fix locations, can also be viewed in relation to the airport surface when the current JFK airport map is adapted to include them.

The SMS Operators at JFK will be responsible for monitoring Notices to Airmen (NOTAM) and updating region closures accordingly. Using the Region Closure Tool the SMS Operator will notify Aerobahn of region (taxiway, runway, etc.) closures so that the predictive tools can take the closures into account. At the same, time the SMS Operator will mark the closed region(s) using Annotations, giving all users a visual indication of the unavailability.

1.4.4.3.2 Map Manipulation

e. User Interface to the Base Map

The interface is to the overview itself, not to the situational displays, superimposed on or around the overview. The User shall be given the capability to:

i. Move the focus to any point on the overview

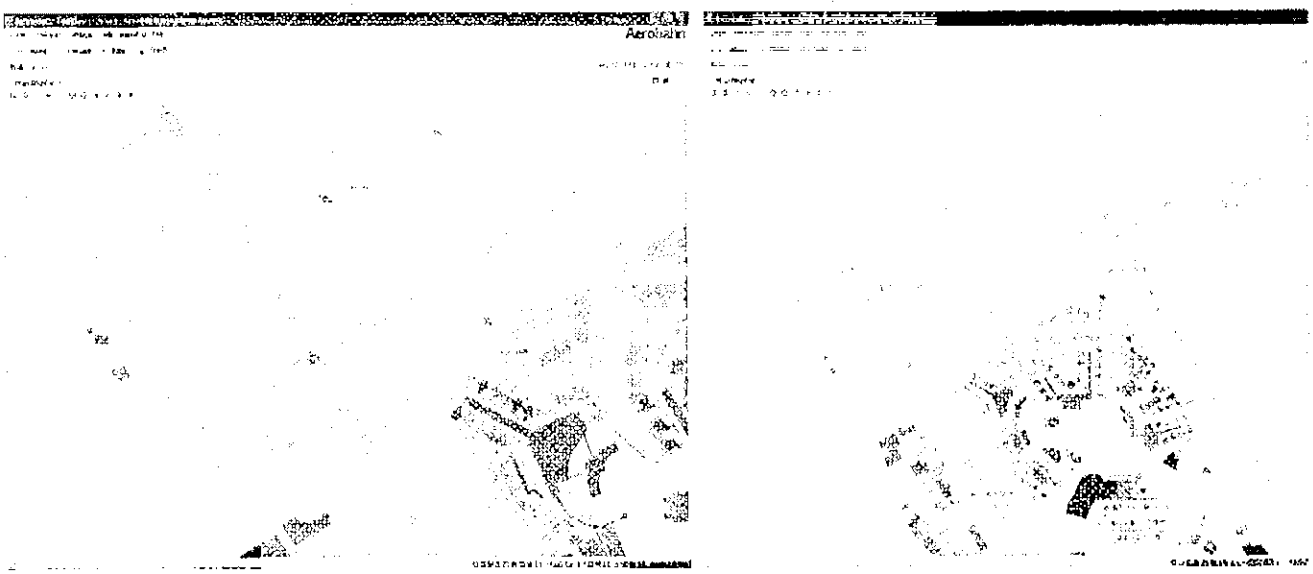
ii. Scalable graphics enabling the user to seamlessly zoom in or out on whatever region is under focus, to the area the size of a gate.

iii. Rotate the display, by any angle, to the user's preferred perspective

iv. Create multiple instances of the Base Map in separate windows

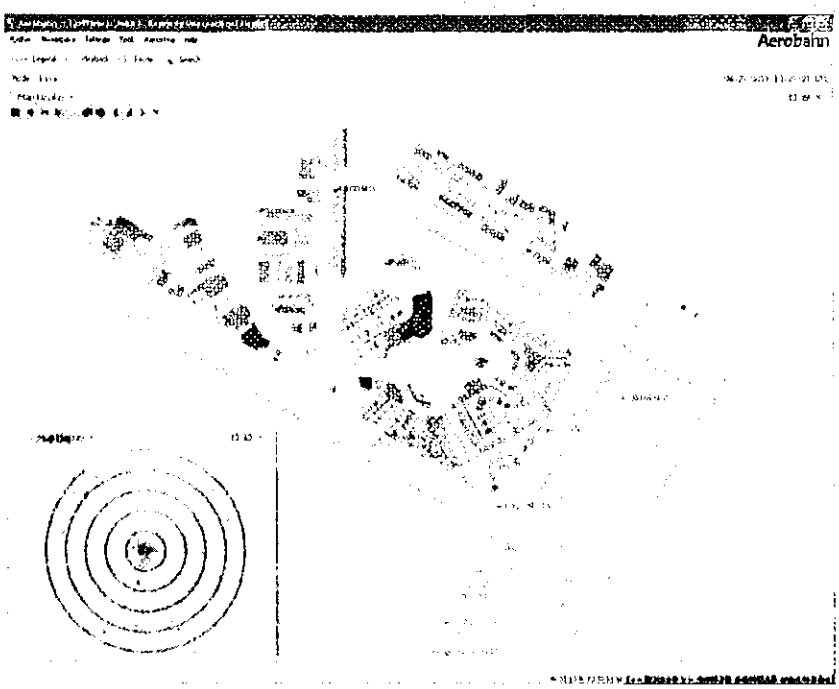
The user has the ability, using the mouse or keyboard, to pan, zoom, and rotate the map to configure the precise view he or she needs. The granularity of these controls is adjustable to allow for a quick coarse adjustment, or slow fine-tuning.

Figure 43 Aerobahn Maps - Pan, Zoom, and Rotate



Multiple traffic displays may be instantiated, each with different settings, so the user can have all the views he or she needs at the fingertips.

Figure 44 Map Background - Multiple Instances (Light Color Settings)



1.4.4.3.3 Runway Configuration and Gate Occupancy

f. Situational Displays and Associated User Interfaces

Situational displays provide information that is layered on top of the Base Map and provide information about surface data to the User. The System shall allow the user to control the format and the information to be presented.

The following items shall be displayed to the user by default; but the System shall allow the user to choose to either show or hide the display of each of these items.

i. An indication of the runway configuration and the names of the active runways shall be superimposed on the base map of the airport

iv. An indication for each gate/stand as to whether it is occupied or vacant

Gate occupancy is indicated by the presence of an aircraft icon in the gate. Gates scheduled to be occupied can be found by bringing up a list of scheduled flights in the Watch List Viewer tool and sorting by terminal or gate.

The runway configuration is indicated using arrows pointing in the direction the runway is being used and colored according to the type of operation: arrival/departure. Further, the average operations rate over the last ten minutes is displayed on the arrow in arrivals or departures per hour.

Figure 45 Runway Configuration and Gate Occupancy

1.4.4.3.4 Additional Characteristics of the Base Map

i. Additional Characteristics of the Base Map

The Base Map shall provide the following characteristics and capabilities:

ii. Mark the name of the runway configuration, and the names of the active runways, on the Base Map of the Airport

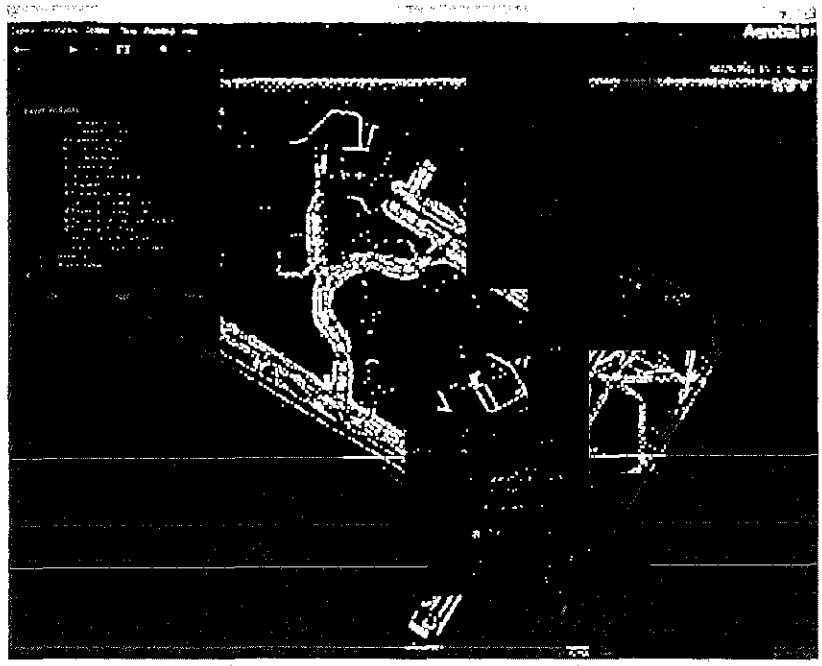
vii. Allows customization through editing of all visual layers. Editing capabilities include the creation of new layers and textual and graphical objects within each layer. The User shall be provided the ability to configure the color of all layers and override the color for specific objects within a layer.

viii. Selectable visual layers can be displayed including ramps, taxiways, runways and buildings

The map layers are widely configurable. Any map object can by toggled on or off. Further, the user can turn on labels for all airfield components on the base map. Additionally, every type of object, e.g., runways, taxiways, buildings, may be configured a different color.

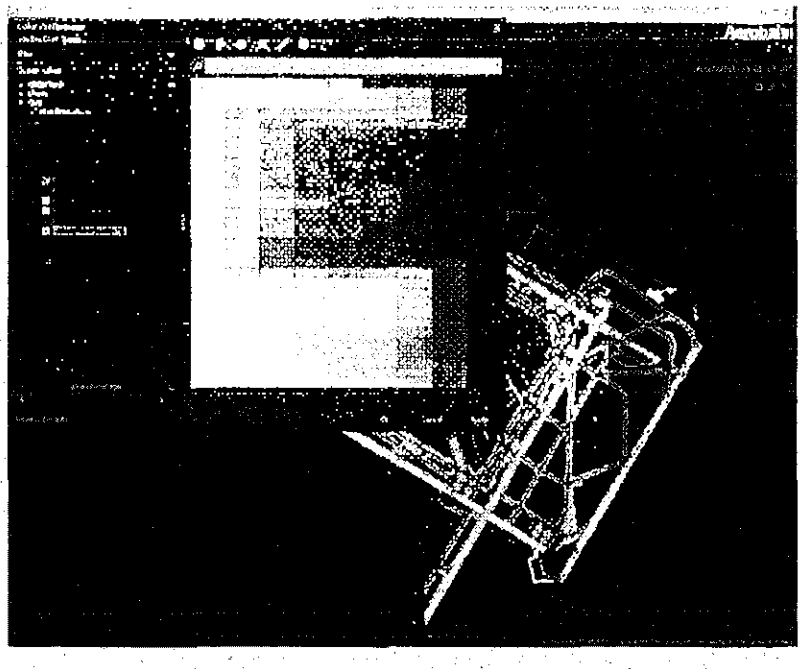
The Layer Visibility Dialog lets users can toggle the visibility of virtually anything on the background map, whether it be one or more buildings, runway markings or the entire map (Figure 46).

Figure 46 Map Background Layer Visibility (Dark Color Settings)



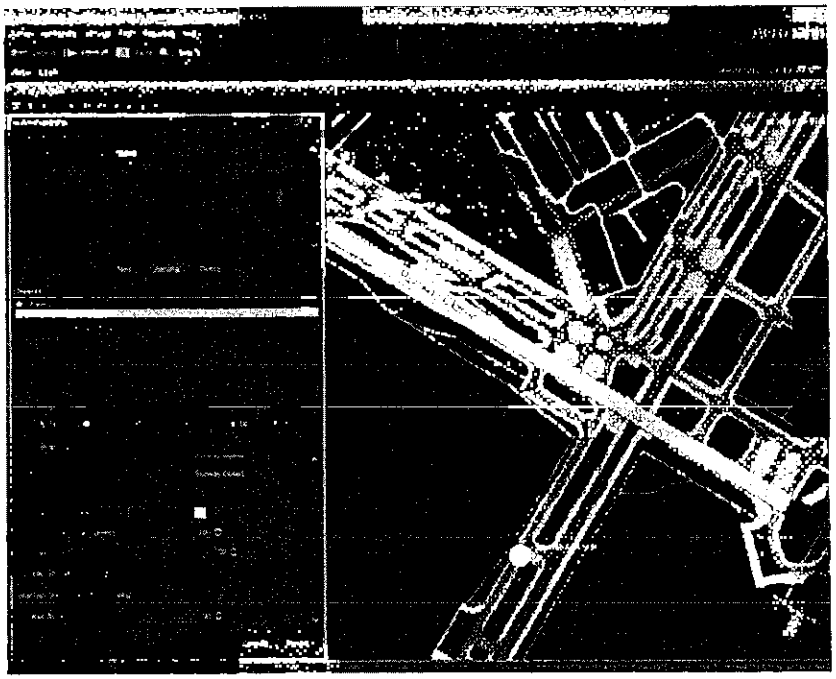
The Color Preferences dialog lets users change the color of any item on the map background, e.g., runway as seen in Figure 47.

Figure 47 Map Background Color Selection (Dark Color Settings)



The Annotation Editor enables users to add custom text and graphics to the background map.

Figure 48 Map Background - Annotation Editor (Dark Color Settings)



1.4.4.3.5 Gates and Stands

k. Gates and Stands

The System shall display every gate and stand position at the airport on the Base Map, and provide the following information:

a) Indicate if Vacant or Occupied

b) Active aircraft icons positioned on the surface graphical display will indicate scheduled gate/stand occupation for aircraft in the aircraft data tag.

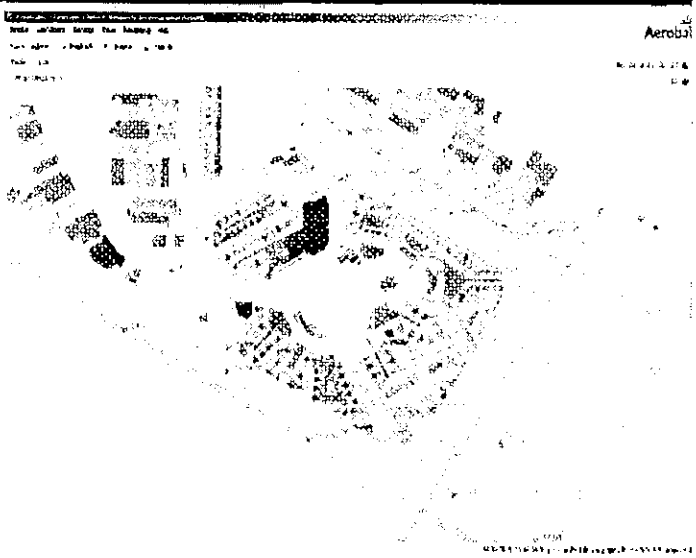
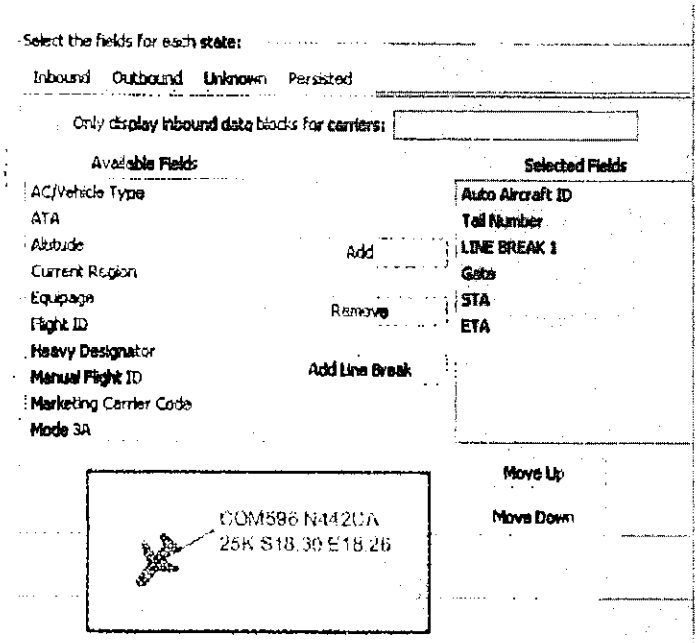
c) Indicate if an aircraft is scheduled to be serviced at the gate/stand. The method of illustrating that the gate/stand is scheduled for an aircraft is subject to Authority approval.

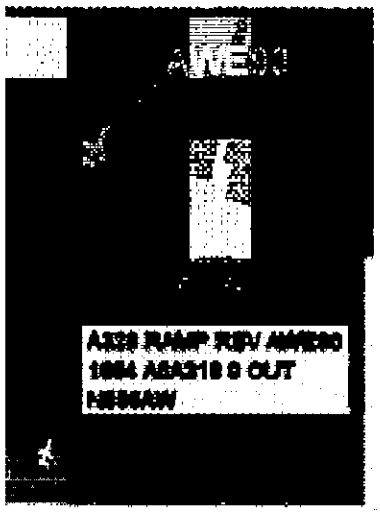
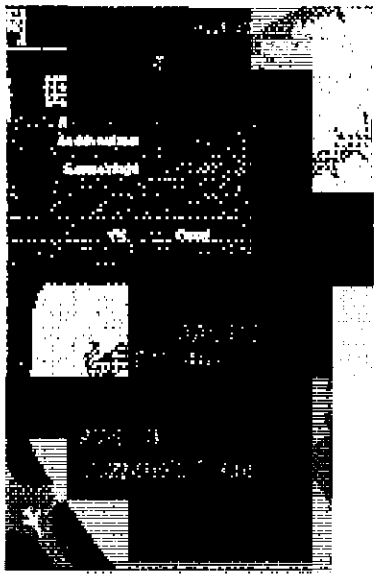
See 1.4.4.3.3 above.

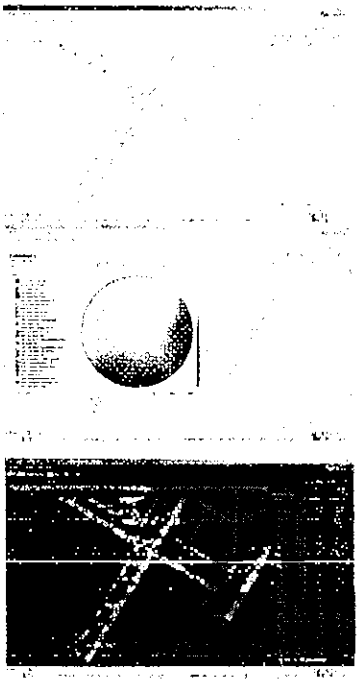
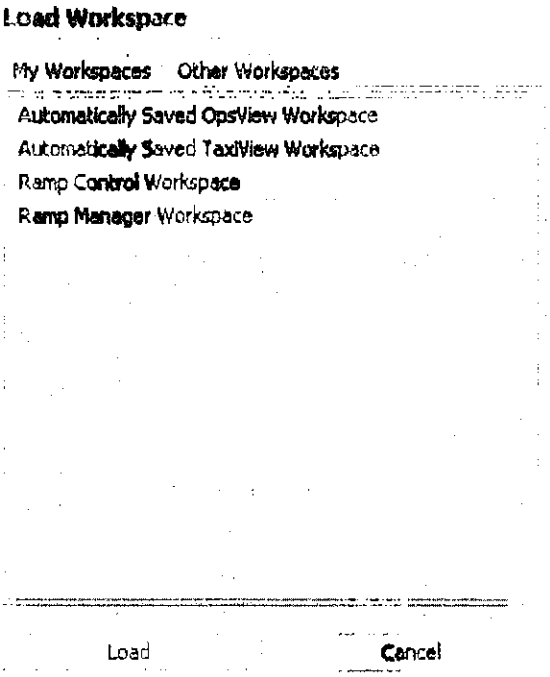
1.4.4.3.6 TaxiView Detailed Functionality

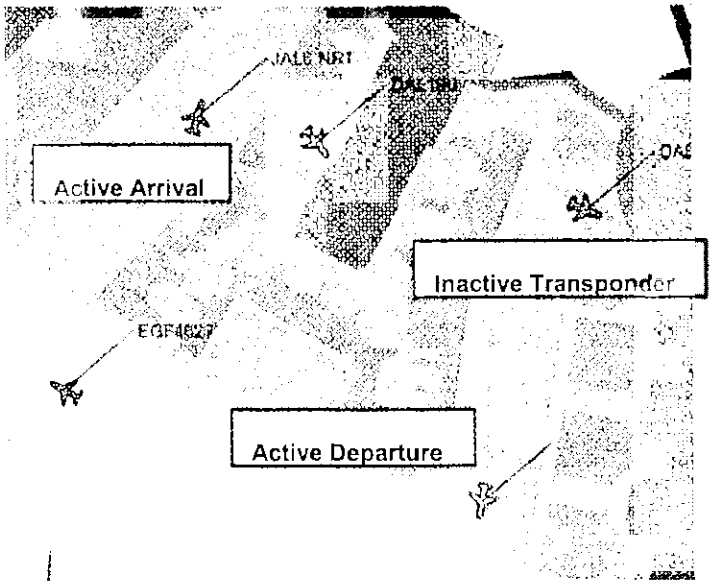
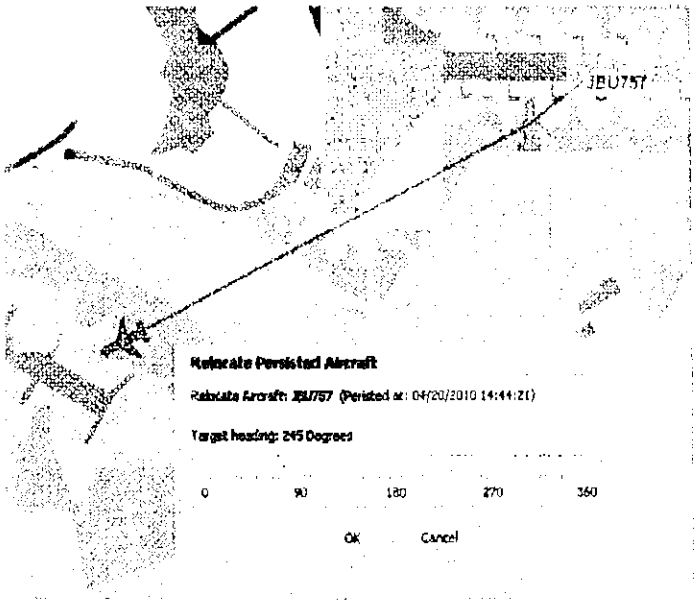
Additional features of TaxiView are detailed in Figure 49, below.

Figure 49 Additional Taxiview Features

Feature	Description/Use	Example
Real-time display of aircraft position and status	Departing and Arriving aircraft are displayed on a map of the airport. Real-time situational awareness of the airside operation, eliminating the need to perform "roll calls" on the already congested RF to determine which flight is which on the airfield, particularly during an irregular operation such as a thunderstorm, or unplanned events such as a maintenance emergency.	
Configurable Data block	A configurable textual data block is associated with all aircraft displayed to users. The content of the data block is customized by each user, and the available content is influenced by the data obtained via the data interfaces to stakeholder flight information systems and the surveillance source. This capability provides users with the information needed for tactical management of the aircraft traffic flows, reducing the number of holdouts, and improving the sequence in which aircraft are pushed off of a gate. This will reduce the workload and delays associated with radio communications between ramp control and aircraft to determine which direction and airplane is to go in order to taxi to its runway.	 Depiction of the dialog screen to select data block elements and how is displayed.

Feature	Description/Use	Example
Data Block Mouseover	The mouseover function highlights the target and displays additional target information when the pointer hovers over a target icon. The user may set the normal data block to a minimum of information to reduce clutter and reduce the visual workload while using the Map Display, then use the mouseover function to show a more detailed data block for a selected target of interest as needed.	 This is an example of a before and after of a mouse over on target AWE90. The content of the mouse data block is selected the same way as the non mouse over dialog.
Data Block Scratch Pad	Authorized users may add textual information directly on selected data blocks within the Map Display by right-clicking on a target. This textual information is stored in the database for use in playback and is also shared to all users currently using the Map Display. This allows collaboration between users regarding priority and the nature of key flights.	 This is an example of how flight AWE90 has a custom message appended to the target.

Feature	Description/Use	Example
Color **Customizatio n**	**Users can configure the color of most elements in the Map Display and the workspace in general.** Among **other things, this** allows users **to optimize** the display for **day or night use.**	 Sample **screens of** different **color selection dialogs and** outcomes.
User Preferences	Aerobahn stores **all user preferences at the central server located in the Sensis Data Service Facility. This means that users may login to the Aerobahn Service from any computer and have access and configuration commensurate with established preferences.** Users **save time by sharing** and **storing configurations.**	 Example of the user Preference selection dialog.

Feature	Description/Use	Example
Target Persistence	Since Aerobahn relies on transponder based Multilateration as the source for aircraft positional information, aircraft position reports are not possible when a pilot turns off a transponder. Target persistence is logic within Aerobahn that notifies a user that an aircraft turned its transponder off in a region where it is expected to be turned off. Examples would be a gate or a remote parking area. Aerobahn will continue to display the target until the transponder is re-energized. If the aircraft is moved without its transponder, users can manipulate the target and move it to the correct location.	 Depiction of how **transponder off aircraft** is depicted.
Moving Persisted Targets	Users can drag a persisted target to any other location on the airport configured for persistence. This enables the user to manually account for aircraft moves while the transponder is inoperative, e.g. tow operations.	

1.4.4.4 Display of Aircraft & Vehicles (D4f.ii,f.iii,g,h,i.iii,i.iv,j)

1.4.4.4.1 Icons and Data Blocks

f. Situational Displays and Associated User Interfaces

Situational displays provide information that is layered on top of the Base Map and provide information about surface data to the User. The System shall allow the user to control the format and the information to be presented.

The following items shall be displayed to the user by default; but the System shall allow the user to choose to either show or hide the display of each of these items.

ii. An icon to represent each aircraft on the base map of the airport

iii. An icon to represent each non-aircraft vehicle on the base map of the airport

g. Data Tag Associated With Each Aircraft Icon

Each aircraft icon displayed on the Base Map of the airport shall have a small block of text drawn with it that provides key data about the aircraft. This document refers to the attached textual data block to an aircraft as a "data tag."

i. The data tag shall include the aircraft's ACID (Aircraft Identification) and aircraft type.

ii. For aircraft on the surface, and not at a gate/stand, the data tag shall include the number of minutes the aircraft has been on the surface.

- *For departing aircraft this number of minutes shall be counted from leaving the gate/stand*
- *For arriving aircraft this number of minutes shall be counted from wheels-on*

iii. Additionally, a departing aircraft shall have in its data tag: the departure fix, the destination airport, and the flight plan Field 10.

iv. An arriving aircraft shall have in its data tag the arrival fix and the origin airport

v. While arriving aircraft remain airborne, their data tag shall have the aircraft altitude.

vi. The user interface shall allow the user to turn on or off the display of tags for all flights.

vii. The user interface shall allow the user to perform an on or off toggle via mouse or touch-screen action.

viii. The user interface shall allow the user to elect to hide the display of data tags for any specified aircraft. It shall also allow the user to show the tags only for aircraft that the user specifies.

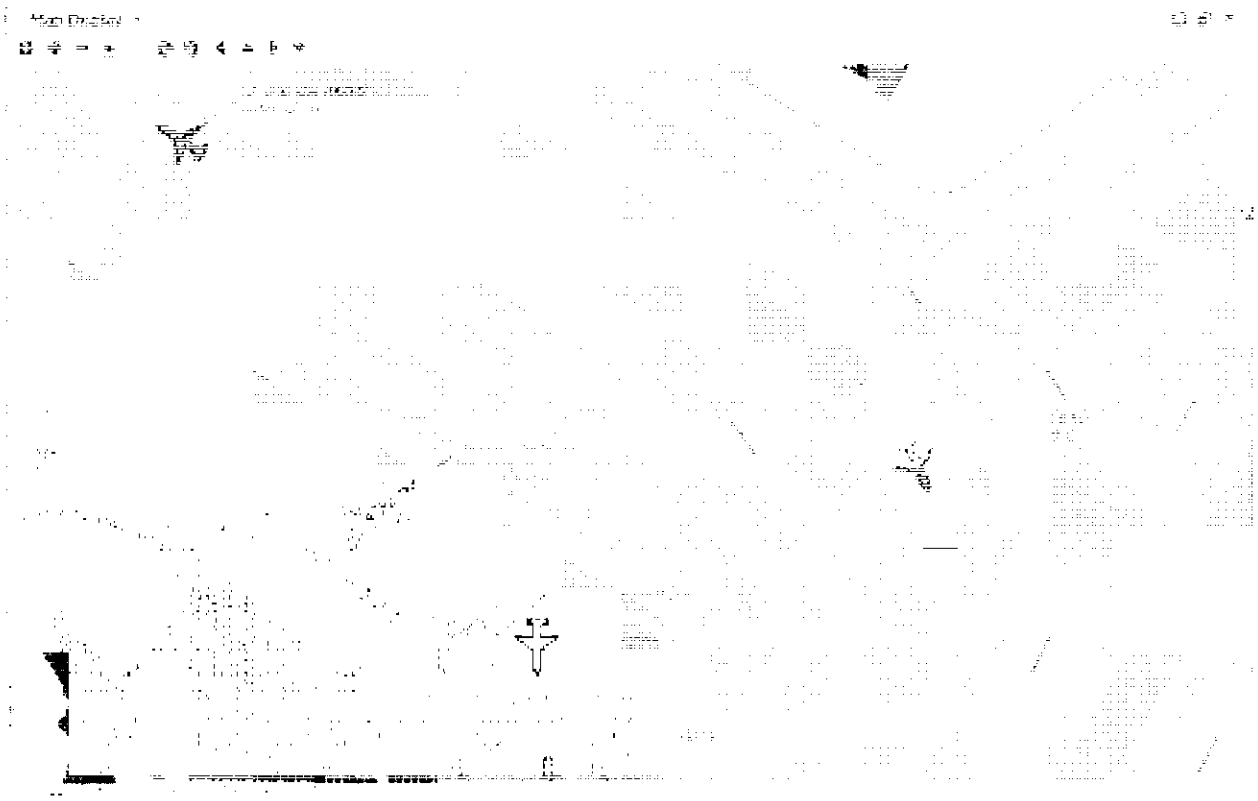
ix. The user interface shall allow the user to hide the display of specific fields (such as the flight plan Field 10) of the data tags from all aircraft, from a selected list of aircraft, or for all but a selected list of aircraft.

x. The user interface shall allow any data tag to be dragged to a new position and connected to its icon by a line. (This is intended to allow the user to separate overlapping data tags, or move tags that obscure icons or other features the user wants to view.)

Aerobahn displays aircraft and vehicles on the base map as illustrated in Figure 50. Display of vehicle is subject, of course, to the availability of vehicle surveillance. Note icons in the diagram have all the specified data block contents. Additional data fields may

be added. See Figure 37 for a complete list of fields available in the data block.

Figure 50 Aerobahn Icons and Data Blocks



Aerobahn users may drag the data block to reposition it (Figure 51).

Figure 51 Dragging the Data Block

Airborne icons may display the measured flight level (Figure 52).

Figure 52 Arrival Data Blocks with Measured Flight Level

1.4.4.4.2 Icons and Data Blocks

h. Data Tags and Expanded Detail Window

Each aircraft shall be rendered with an associated set of operational details contained in a data tag shown on the Base Map. The data tag shall serve as a concise reference to important aircraft and flight information so that Users have access critical operational data without losing focus of the airfield. The System shall provide the capability to the User to configure the data that is shown in both data tag views and the capability to quickly view or hide information. Each aircraft data tag can be individually toggled on or off through the aircraft's icon.

Furthermore, the Base Map view also shall allow Users to configure a completely separate list of data tag fields that will be shown when the User hovers the mouse over an aircraft icon. This "mouse over" feature shall allow Users to access an expanded set of data on a per aircraft icon basis without unduly cluttering the default display.

The visibility of the data tag will allow the user to see the information under a minimum of the following ways:

i. Air carrier

ii. Flight number

iii. Aircraft type

iv. Destination city for departing flights

v. Originating city for arriving flights

vi. Time elapsed during taxi

vii. Scheduled departure runway for departing aircraft (based on departure fix or other reliable data)

viii. Estimated time of arrival

ix. Estimated time of departure

x. Scheduled arrival gate

xi. Configurable alert of predicted gate conflict when applicable

xii. All data tags shall be visible at once

In addition to the flight information contained in the data tag, Users shall also have the ability to quickly access detailed flight information for any aircraft in the Base Map by simply clicking on it or mousing-over the aircraft icon.

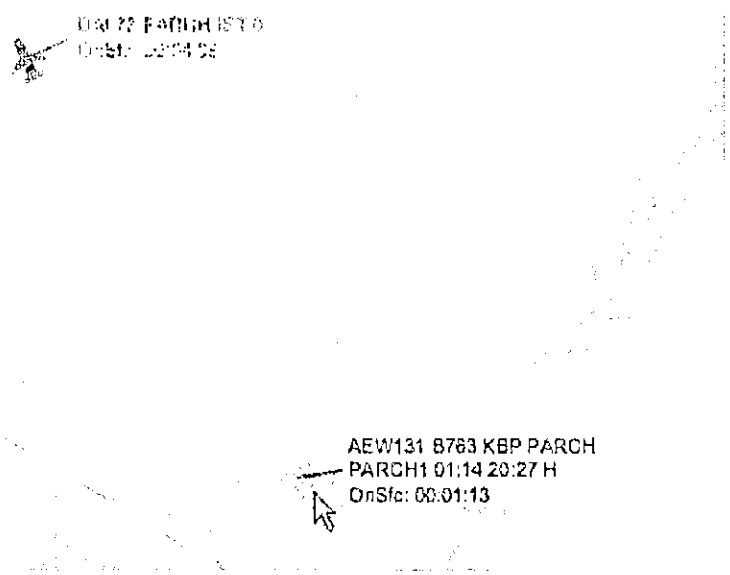
When an aircraft or vehicle icon is selected from the situational display, detailed information such as the values of all optional data block fields, as well as the predictive assumptions, shall be viewable in a separate, Expanded Detail Window that can be added and arranged within data tag.

If the System is predicting a specific airport surface destination for an aircraft, such as a gate, and the destination changes, a User shall have the ability to manually change the destination and the System shall automatically recalculate the estimated taxi time to the new location.

Aerobahn users can configure an alternate set of data tag information to appear when they mouse over a target on the Map Display (Figure 53). Again, any of the elements in Figure 37 that are marked as being available for data blocks can be added to the mouseover data block.

Note, configurable alerts, e.g., Gate Conflict, can manifest themselves visually via changes to the icon (color, transparency, shape, decorations) or changes to the data block (text color, background color, added text).

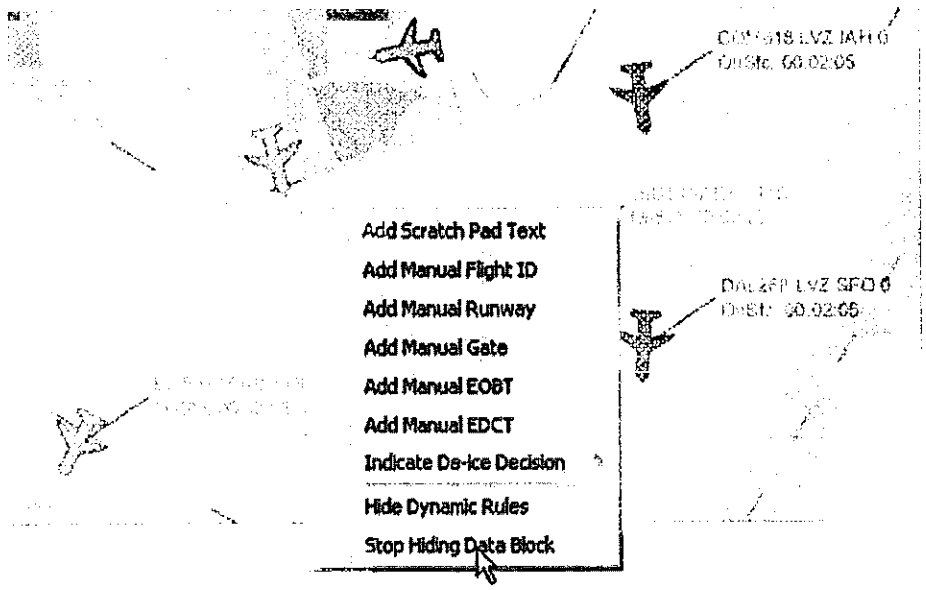
Figure 53 Mouseover Data Tag



Unless the user toggles one or more data blocks off, they will all be visible to the user. However, the user can choose to toggle all data blocks off, or only selected ones (Figure

54).

Figure 54 Toggle Data Block



Predicted times and manual flight information may also be added to the data block. If a user manually changes the destination of a particular flight (gate, runway), the Aerobahn Prediction Engine will re-calculate the predicted route and waypoint times. These will be updated in the data block automatically.

1.4.4.4.3 Icon Types and Characteristics

i. Additional Characteristics of the Base Map

The Base Map shall provide the following characteristics and capabilities:

iii. Draw an Icon, on the Base Map, to represent each aircraft near or on the airport surface.

iv. For each flight (airborne and shortly to arrive on the surface, or airborne shortly after departure), the Service shall draw an icon and properly position it on the Base Map.

j. Icons

i) Icon Types

The System shall support, at a minimum, at least the distinct icon types to represent different aircraft and vehicle types as listed below, and the icons selected for each aircraft type shall be configurable by the User:

a) Small Aircraft

b) Large Aircraft

c) Heavy Aircraft

d) Super-Heavy Aircraft

e) Helicopter

f) Vehicles/Non-Aircraft

a. Port Authority Snow Removal Equipment

b. Contractor Snow Removal Equipment

c. Super Tugs

d. Other

ii) Aircraft Icon Characteristics

The System shall support the following characteristics for each aircraft icon:

a) The aircraft shall indicate the plane orientation by having a recognizable nose and tall.

b) Each icon's nose shall point in the direction of most recent motion of the aircraft.

c) Each flight's icon shall be repositioned when the aircraft moves and changes its position.

d) Each icon shall be configurable by the User to be color coded to indicate the flight's status:

i) An aircraft currently airborne but about to land shall have its icon colored-coded to a configurable setting.

ii) An aircraft landed but did not yet arrived at a gate/stand shall have its icon colored-coded to a configurable setting.

iii) An aircraft parked shall have its icon colored-coded to a configurable setting.

iv) An aircraft that is moving from an arrival gate/stand to a departure gate/stand shall have its icon colored-coded to a configurable setting.

v) An aircraft that has left its gate/stand but has not yet departed shall have its icon colored-coded to a configurable setting.

vi) An aircraft that has achieved wheels-off shall have its icon colored-coded to a configurable setting.

vii) The information represented by the icon coloring shall also be displayed as a part of the aircraft's data tag.

iii) Vehicles/Non-Aircraft Icons

The System shall display an icon on the Base Map to indicate each non-aircraft vehicle at its current location on the Airport Operations Area. The System shall provide the following:

a) The user shall be able to configure the non-aircraft icons.

b) Reposition each vehicle's icon when the vehicle moves and changes its position on the movement and non-movement areas covered by surface surveillance.

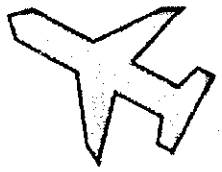
c) The user shall be able to select to show or hide the icons representing non-aircraft vehicles.

Currently, Aerobahn provides unique icon types for aircraft and vehicles. Further the icon characteristics (shape, outline color, fill color) can be modified by writing Dynamic Rules that switch on various flight characteristics.

For the Phase B deployment, Sensis will change the size of the icon based on the class of the aircraft.

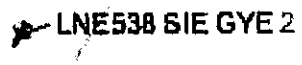
The standard Aerobahn aircraft icon is easily recognizable as an airplane (Figure 55). It indicates direction of movement and is located on the Map Display according to the latest position update (approximately once per second).

Figure 55 Aerobahn Airplane Icon



Users can use Dynamic Rules to change the color or other characteristic of the icon to reflect the aircraft status. All the specified can be implemented using Dynamic Rules. Figure 56 illustrates one example, where an arriving aircraft is in the approach corridor, and not yet landed.

Figure 56 Aircraft in Approach Corridor and Not Yet Landed Colored Purple using Dynamic Rules



Vehicles bearing an active Mode S transponder can be displayed in Aerobahn. The application administrator simply configures the Sys Admin Vehicle Tracking menu with the vehicle Mode S code, vehicle type, vehicle name and other vehicle attributes. Then, when Aerobahn receives a position associated with a known vehicle Mode S code, it

displays the vehicle icon on the Map Display in the proper location. The user can select whether to display vehicles or not.

The vehicle icon (Figure 57) has direction like the aircraft icon and its attributes can be changed using Dynamic Rules. Thus, different type vehicles can be indicated using different outline and/or fill colors.

Figure 57 Aerobahn Vehicle Icon

1.4.4.5 Search (D4i.v,i.vi)

i. Additional Characteristics of the Base Map

The Base Map shall provide the following characteristics and capabilities:

v. The user interface shall provide a method for searching and identifying an icon that represents a specified Aircraft Identification (ACID).

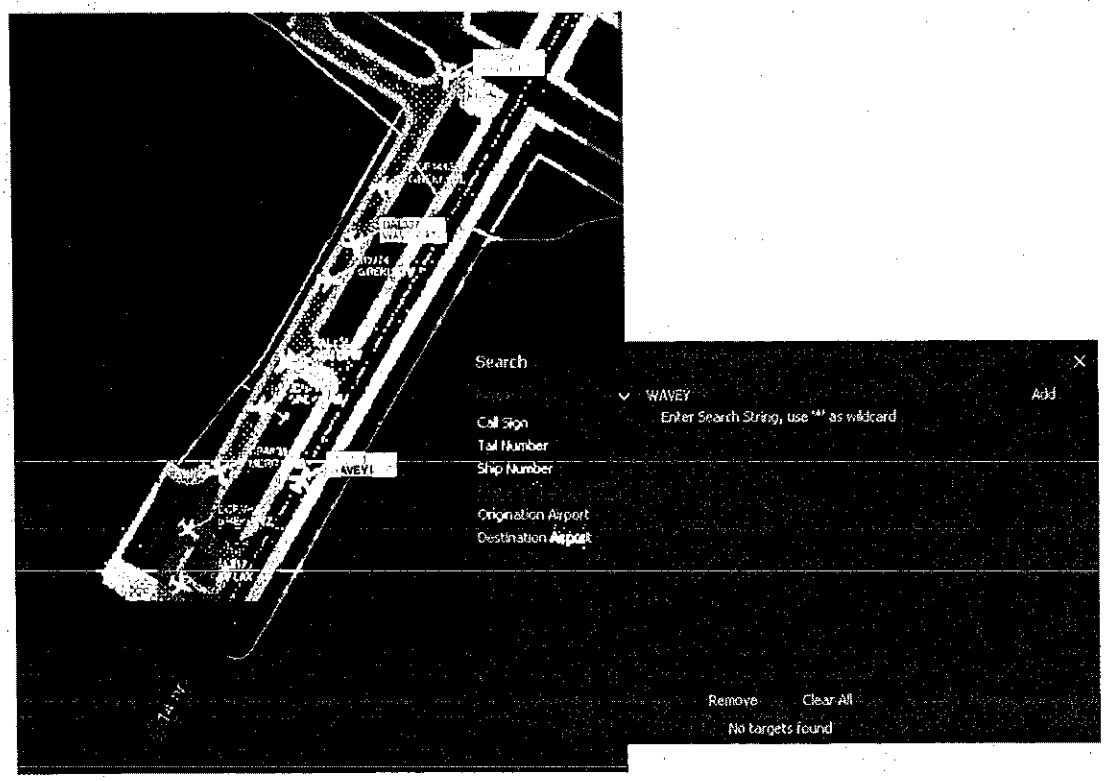
vi. The user interface shall provide a method for searching and identifying all the icons that fit into a specified class; the class shall be defined as an aircraft type, air carrier, first fix information or destination airport.

A standard feature of Aerobahn is a simple, yet powerful search tool (Figure 58). Currently it allows for a search of the following elements:

- Call Sign
- Carrier (Call signs with wildcards)
- First Fix
- Tail Number
- Ship Number
- Origination Airport
- Destination Airport

In addition, the ability to search on Aircraft Type will be available in the Phase A deployment.

Figure 58 Example of Aerobahn Search Feature



1.4.4.6 Timeline Display (D4l)

1. Timelines that Illustrate Pending Flight Arrivals and Departures

Timelines of arriving and departing aircraft shall be drawn as part of the user interface and are intended to be distinct from the airport Base Map. The System shall allow the User to hide any or all of the timelines and provide the following:

a) A timeline for each active arrival runway and departure runway.

b) A timeline for each active arrival fix and departure fix.

c) Minute marks for each timeline.

d) Display Aircraft ACIDs (Aircraft Identification) at their runway ETA (Estimated Time of Arrival) (or ETD (Estimated Time of Departure)) minute mark on the timeline associated with its arrival (or departure) runway.

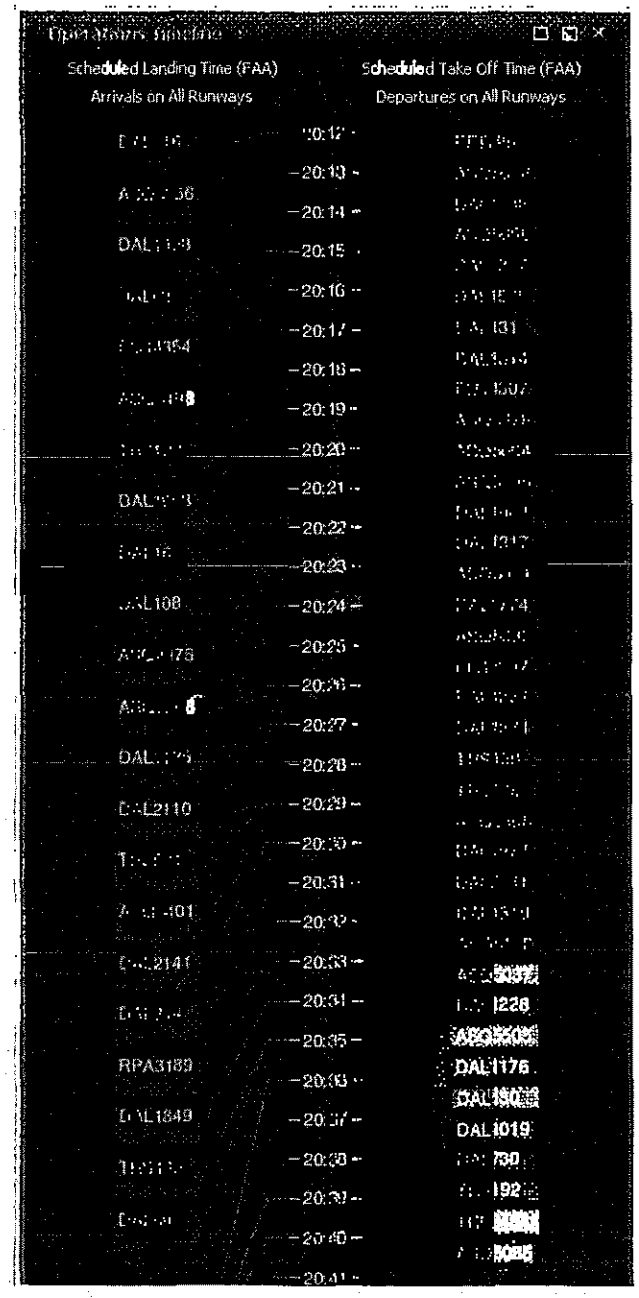
e) Display Aircraft ACIDs at their arrival fix ETA (or ETD) minute mark on the timelinc associated with its arrival (or departure) fix.

The Aerobahn Operations Timeline Tool can represent any available date/time data element via a selection menu. Two datasets can be represented on each instance of the tool and multiple tools can be displayed simultaneously. The user can configure each side of the timeline to plot either arrivals or departures, positioned on the timeline using a

selected time element, showing all operations at the airport, or just those on single runway. For Phase B, the Operations Timeline will also be able to display flights according to arrival/departure fix.

The flight representations are essentially data blocks like those in the Map Display and can be configured with all the same information.

Figure 59 Aerobahn Operations Timeline Tool



1.4.4.7 Weather Display (D4m)

m. Weather Display

The Service shall be capable of receiving, processing, warehousing and displaying data from, at a minimum, the following systems or other Port Authority approved equivalents:

a) RAPT-Route Availability Planning Tool

b) METAR - International standard code format for hourly surface weather observations

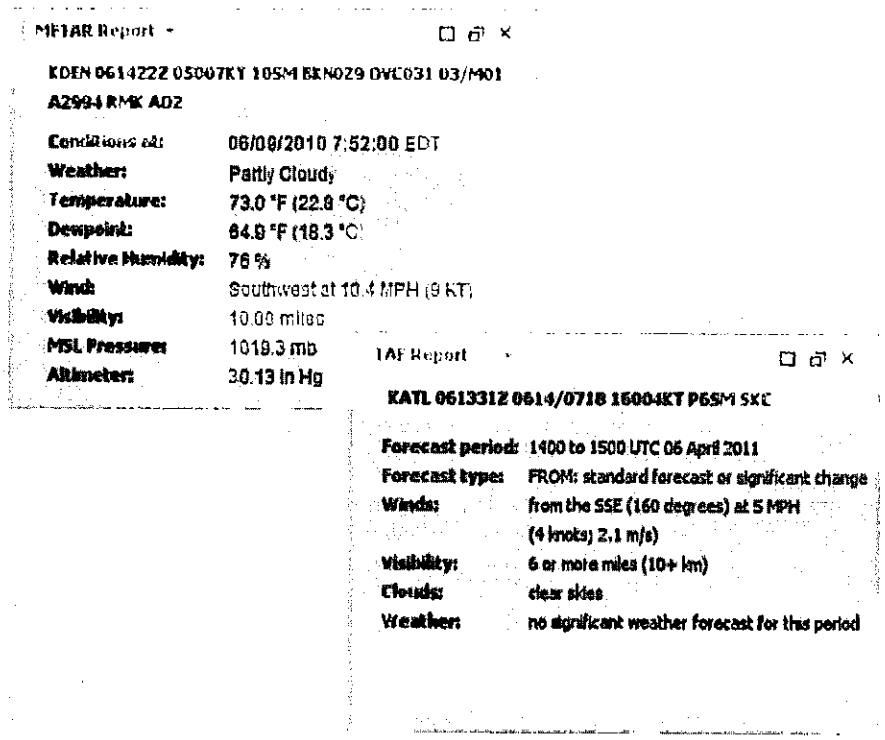
c) TAF — Terminal Aerodrome Forecast

d) RVR — Runway Visual Range

Users shall have the capability to incorporate stored weather data from the above list or other Port Authority approved equivalents into reports and playback capability.

Aviation Routine Weather Reports (METAR) and Terminal Aerodrome Forecast (TAF) weather reports will be retrieved from the Aviation Digital Data Service (ADDS), a free public service produced by the National Center for Atmospheric Research (NCAR). The real-time METAR Report and TAF Report tools will be available in both live and playback mode.

Figure 60 Aerobahn Weather Display



1.4.4.8 Tabular Data Display (D4n)

n. Tabular Data Display

The tabular display shall provide, at a minimum, the following information:

i. Name of the runway configuration

ii. Number of flights that have left gate/stand but not yet departed, and have been in this intermediate state for more than a configurable number of minutes

iii. Number of flights with reportable/configurable delay

iv. Average taxi time

v. Number of flights currently taxiing inbound

vi. Number of flights currently taxiing outbound

vii. Number of flights parked at gates/stands

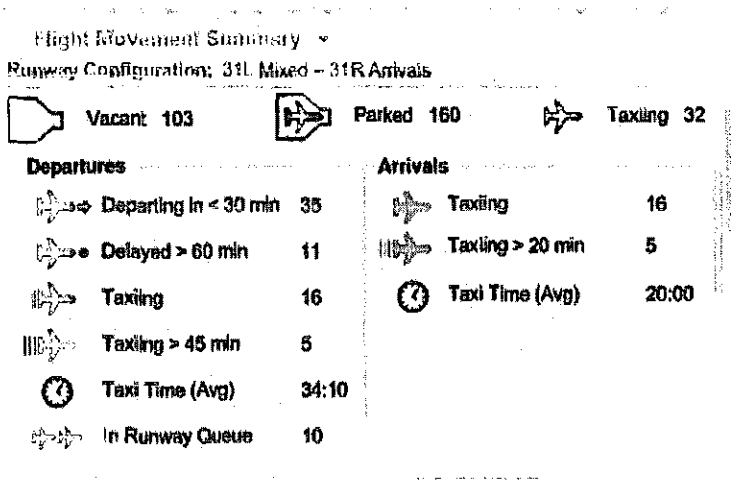
viii. Numbers of gates/stands occupied and vacant

ix. Number and order of flights in final lineup order for runway departure

x. To accurately indicate departure demand, indicate actual number of aircraft planning to depart within a configurable amount of time

The Airport Summary Tool (Figure 61), to be delivered for the Phase B deployment, provides an overview of the airport operations in terms of the state the all the aircraft on the surface.

Figure 61 Flight Movement Summary Tool (Concept)



At the top, the runway configuration and the gate occupancy loading are depicted. Below, the arrival and departure statistics are displayed. The thresholds for time to departure, delay, and taxi time are all configurable in the tool's drop down menu.

1.4.4.9 Alerts to User (D4o,p)

o. Alerts to User

The System shall provide notification to the User of off-nominal events via an alerting mechanism, which shall include, but not be limited to the following alert mechanisms;

- *An audible alarm which can be disabled by the user,*
- *A visual alarm that flashes on the screen and is color-coded based on the severity of the alarm. The color of the alarms shall be configurable by the User.*
- *Issuance of an email to designated individuals and distribution lists. The System shall provide the capability allow the user to assign a different email address to receive each type of alarm.*

The types of off-nominal events and the alarm features are described below:

i. The user shall have the capability to select which alerts are displayed.

ii. The user shall set thresholds based on stated criteria for those alerts based on exceeding or falling below set criteria. The System shall provide the User the ability to monitor any data point in real time or in the system database and create an alarm that will notify the User when the data point either exceeds or falls below a threshold value set by the user.

iii. The alert shall be of a form that is a significant change from what is shown when there is no alert, so that the alerted data attracts attention to itself

iv. The alerted items shall include, at a minimum the following:

- *An aircraft enters a runway or taxiway that it is not planned to enter*
- *An aircraft enters a runway that it is not allowed to enter at this time*
- *An aircraft deviates from its predicted path on the airport surface by more than a certain distance. This distance shall be approved by the Port Authority*
- *The ACIDs of any flights that have spent a set amount of time on the surface and have not arrived at a gate/stand.*
- *An aircraft that has pushed back and has since returned to the gate/stand without departing.*
- *An aircraft has been assigned a metering location in the movement area, but is not taxiing to the assigned location.*

p. Configuration of Alerts to Users

The Users shall be able to save specified configuration alerts under their respective User Preferences. The System shall provide the User the capability to configure the icons, data tags and other information presented on the Base Map to advise the User as to the status of a flight, including at a minimum the following:

- *Manual color-coding of aircraft icons to indicate various statuses of the flights.*
- *To accurately indicate a snapshot of departure demand, provide graphical display of the number of aircraft planning to depart within a configurable amount of time*

The Contractor shall propose alternative mechanisms to alert the operator. Implementation of the proposed alerts is subject to Port Authority approval.

Aerobahn's alerting system, Dynamic Rules, is covered in Section 1.3.5. Dynamic rules will enable users to provide alerts on the specified conditions with the following exceptions:

1. *Aircraft enters a taxiway it is not planned to enter* AND *Aircraft deviates from its predicted path on the airport surface by more than a certain distance* – While Aerobahn predicts a probable taxi route, it continuously updates based on the actual route the aircraft takes (similar to the way an automotive GPS device works). So this alert would not be feasible. Dynamic Rules in the Phase B deployment will, however allow users to alert if the aircraft enters a runway other than the predicted or assigned runway.
2. *Aircraft enters a runway it is not allowed to enter* – Dynamic Rules in the Phase

B deployment will enable users to alert when a flight enters a runway (or any other region) configured in the Region Closures Tool to be closed.

3. *An aircraft has been assigned a metering location in the movement area, but is not taxiing to the assigned location* – With some changes implemented for Phase B, Dynamic Rules will allow for a similar alert using the following criteria: The aircraft joins the departure queue for its assigned/predicted runway without having first entered the metering point region. In any case, the Phase B deployment of Aerobahn will monitor compliance with use of metering locations.

1.4.5 Transmit Modeled OFF Times

The System shall be capable of transmitting the OFF time estimates to the Traffic Flow Management System (TFMS) for each departing aircraft. The TFMS makes OFF time estimates on the basis of historical data, but has no mechanism to update those estimates to take account of recent and current surface traffic and flows and therefore the TFMS' estimates of OFF time are relatively static. By monitoring the surface traffic, the System calculates current, accurate estimates of OFF times and shall provide the OFF time estimates to the TFMS to supplement their data.

The Aerobahn SMS System will transmit the OFF time estimates to the Traffic Flow Management System (TFMS) for each departing aircraft if and when Sensis is granted write access, both administrative access and a physical connection, to the TFMS system and a description of the interface.

1.4.6 Fuel and Emissions Monitoring

Aerobahn provides the ability to monitor and report fuel burn and emissions estimates through the day-of-operations. These estimates are based on the data available in the Aerobahn database, including aircraft type (e.g., B737-800), detailed taxi time data, and functional relations between thrust and fuel burn rate and emissions (e.g., CO, NOx, HC). The estimates of fuel burn and emissions are provided for all phases of aircraft movement, including the partition into excess and minimum quantities. This ability to define the excess quantity for control depends on Sensis' proprietary algorithms to estimate the excess and unimpeded taxi durations from surveillance data.

1.5 Reporting

The Contractor shall provide standard, requested and custom reports with the System in accordance with the requirements described herein. All reports, with the exception of the Summary Windows view, shall be provided in both implementation Phases A and B. Summary Window reporting requirements shall be available in conjunction with Phase B.

The System shall provide advanced data querying and reporting capabilities enabling Users to create textual and graphical reports from a database. Upon initial implementation, the System shall begin saving and storing 24 months of data, which shall be used to generate the Reports. Five (5) years of stored data shall be available within two days of request. The System shall

provide the flexibility to create, save, execute, and download comprehensive reports about the surface operation and utilization of airport resources. Users shall have the capability to obtain comprehensive statistics, including gate occupancy; the number of holdouts by fleet type, time of day, and

concourse; average amount of time an inbound aircraft waits for a gate; taxiway occupancy; and runway occupancy. Similar information shall be obtainable about the Vehicles equipped with a tracking device.

Reports shall be sortable by Airline, flight number, aircraft type, terminal or parking area, destination airport and location where the delay occurred (ramp, taxiway, metering location, etc.), originating airport and location where the hold out occurred (ramp, taxiway, metering location, etc.). The reports shall measure taxi times against official ACARS and 0001 (Out, Off, On and In) times when available.

In addition to the ability to generate reports "on demand," the System shall have a scheduling capability that enables Users to schedule the automatic generation of daily, weekly, monthly, quarterly, and yearly operational reports. The User who scheduled an report shall have the ability to configure the system to automatically receive the report via email once it is generated.

Aerobahn currently has a rich reporting capability. Users may run one of the standard reports listing in Section 1.5.2 below, or create a customized report by selecting a data set and using the embedded pivot table and graphing functionality to create summaries of the data. A detailed description of Aerobahn reporting is given in Section 1.3.7.

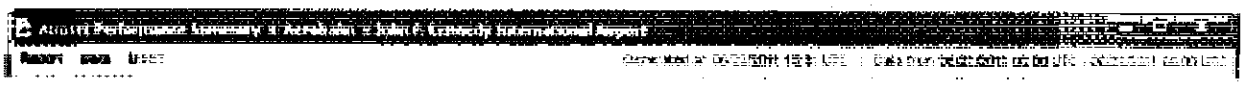
1.5.1 General Reporting Requirements

1.5.1.1 Header Format (E1a)

All reports shall be modified to reflect the configuration of the application furnished as part of this Contract. Headings should be standardized (Report Name, Airport, Date Report Run, Date Range of Report, Page Numbers, Column Headings on every page, Totals, etc.) and appear in a consistent manner throughout all presentation formats.

Reports, delivered in Phase B, will contain a header consisting of the report title, airport name, data the report was generated, and the date range of the report. Where there are multiple pages, they will be numbered. Further, every table has column headers.

Figure 62 Aerobahn Report Heading (concept)



1.5.1.2 Display and Output (E1b)

b. All reports shall be easily displayed and navigated on the User's access terminals, sent to a choice of any email address, network printer at the user's facility and saved to the User's desktop over the Authority's existing wide area network.

Currently, Aerobahn displays reports within the same framework as the real-time workspace. This way users can dock, float, or tab report elements in whatever way makes

them easiest to reference and best conveys the information for a given report. Aerobahn users can easily navigate their saved or newly created reports by selected different tabs or by using the scroll bar.

Further, a user may share any report with another user within the system simply by selecting the Share Report checkbox when saving.

For the Phase B delivery, Sensis will add the ability to print to a printer connected to the client PC, either directly or via a network. The ability to print will also enable users to print the report to a Portable Document Format (PDF) file using third party software. The PDF file can then be emailed like any other file.

1.5.1.3 Summary Window (E1c)

c. Users shall have the ability to access and display Summary Windows to actively monitor the current status items. Summary Windows are described below in further detail.

See Section 1.5.4 for a description of the various Aerobahn Summary Windows.

1.5.1.4 Access Rights (E1d)

d. Access to detailed operational statistics is limited to the "owner" of the aircraft and the Port Authority. For example, members of one organization are not permitted to view taxi times of other organizations.

The Aerobahn permissioning system (see Section V.1.6) allows for masking of airline proprietary data such as schedules and estimated times. However any data or statistics created by Aerobahn itself is deemed accessible by the entire user community.

The goal of Sensis by providing Aerobahn is to enhance collaborative decision-making at, and eventually between, airports to make the entire operation more efficient.

1.5.1.5 Playback (E1e)

e. When a user selects any time field listed in a Report, the System shall launch into a playback of the event in a separate window on the Base Map. The playback feature shall synchronize a selected local frequency to enable the user to hear radio transmissions. The frequencies shall include those listed in the current Airport/Facility Directory, under John F Kennedy Intl JFK Communications.

Any date field in an Aerobahn report acts as a link to playback. The user simply uses the mouse to click on the date field, e.g., Wheels Down Time, and Aerobahn displays the playback dialog configured with the selected date and time. Further, the flight of interest (from the report) is highlighted once the playback starts. Sensis is adding the capability to select a local aviation frequency and listen to the radio audio in synchronization with the visual playback. See Section 1.4.1.8 for details.

1.5.2 Standard Reports

The Contractor shall include the standard reports that are normally included in the System and Services that it provides. The standards reports shall be provided as part of this Contract and shall include the ability to query and sort through the event log.

a.) Region of Interest Report (i.e. departure or deicing queue)- Provides a list of all aircraft that are currently within a selected, configurable ROI along with the time of entry, time of exit, and total occupancy time.

b.) Arrival and Departure Summary- This summary shall provide a breakdown of the total number of departures and arrivals over a configurable time period for the airport in total, by runway and by individual Airline.

c.) Movement Area Taxi Time- This report shall target taxi details for individual flights upon entry into the movement area to wheels-up or from wheels-down to exit from the movement area. Breakdown of minimum information includes: flight call sign, aircraft registration number, runway, wheels down date and time, at gate date and time, total taxi time, gate and terminal assigned, gate and terminal used, time the aircraft transitioned from the movement area into the non-movement area, direction (inbound or outbound), Mode 3A and Mode S information, model of aircraft, movement area time, origin and destination airports, ramp/non-movement area time, runway occupancy time, taxiway used to enter/exit the ramp area, ship number, flight origination date, scheduled and actual out, off, on, in times, actual taxi in and out times and the marketing carrier.

d.) Total Taxi Time- This report shall target taxi details for individual flights from movement off the gate or stand to wheels-up or from wheels down to arrival at gate or stand. Breakdown of minimum information includes: flight call sign, aircraft registration number, runway, wheels down date and time, at gate date and time, total taxi time, gate and terminal assigned, gate and terminal used, time the aircraft moved off the gate or stand, transitioned from the movement area into the non-movement area, direction (inbound or outbound), Mode 3A and Mode S information, model of aircraft, movement area time, origin and destination airports, ramp/non-movement area time, runway occupancy time, taxiway used to enter/exit the ramp area, ship number, flight origination date, scheduled and actual out, off, on, in times, actual taxi in and out times and the marketing carrier.

e.) Wheels Up/ Wheels Down — This report shall highlight for wheels up and wheels down times for individual flights. Minimum information includes: flight call sign, aircraft registration number, runway, wheels down date and time, direction (inbound or outbound), Mode 3A and Mode S information, model of aircraft, ship number, flight origination date, scheduled and actual out, off, on, in times, actual taxi in and out times, scheduled and actual gate, and the marketing carrier.

f) Planned Taxi Time vs. Allocated Taxi Time — This report shall measure the difference in time between the when an aircraft can be ready to call for taxi versus the taxi time assigned to the aircraft due to departure constraints. This information shall be sortable on a flight-by-flight basis, by first fix, by airline, by terminal or by total airport average over configurable amounts of time selected by the User.

g.) Allocated Taxi Time vs. Wheels Up Time - This report shall indicate the difference in time between the Allocated Taxi Time assigned to an aircraft and the actual time that the aircraft's wheels leave the airport surface. This information shall be sortable on a flight-by-flight basis, by first fix, by airline, by terminal or by total airport average over configurable amounts of time

periods selected by the User.

h.) Gate Utilization

Amount of time between the vacating of departing aircraft from gate and the arrival time of the next AC at the same gate, including their associated time stamps, flight and gate information.

i.) Departure Delay

Amount of time between the vacating of departing aircraft from gate and wheels up VS. the scheduled time. This report should highlight the flights that had a wheels up indication more than 45 minutes past the scheduled departure time, including their associated time stamps, flight and gate information.

j.) Arrival Delay

Scheduled arrival time (block in) VS. actual arrival time (block in), highlighting flights that arrive (block in) more than 15 minutes past the scheduled arrival (block in) time, including their associated "wheels-on" indication, time stamps, flight and gate information.

k.) Runway Utilization

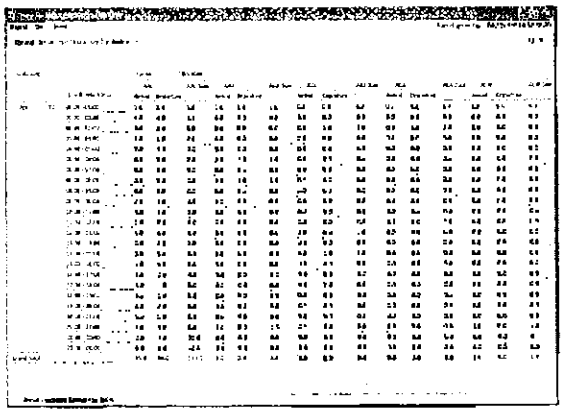
Runway utilization by hour, day, month and/or year.

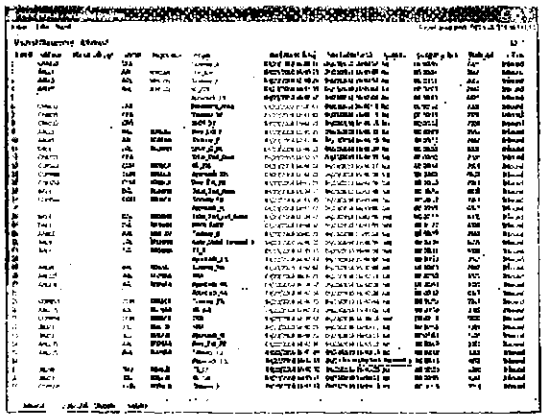
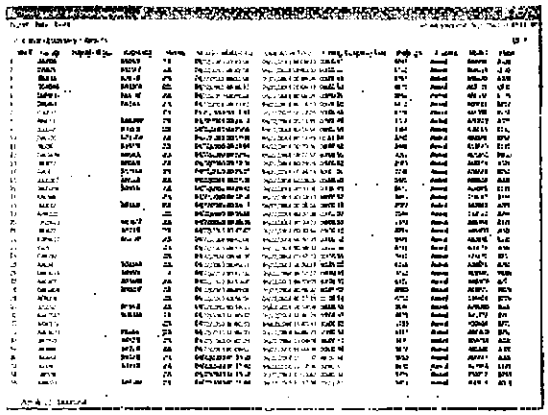
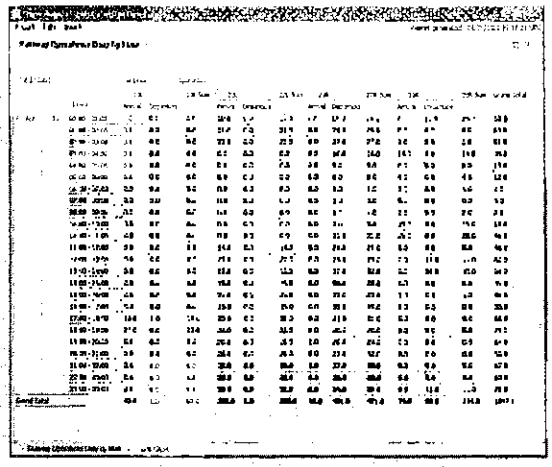
l.) Metering Area Usage

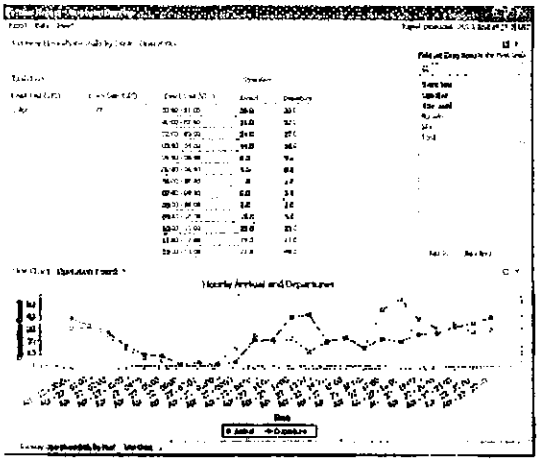
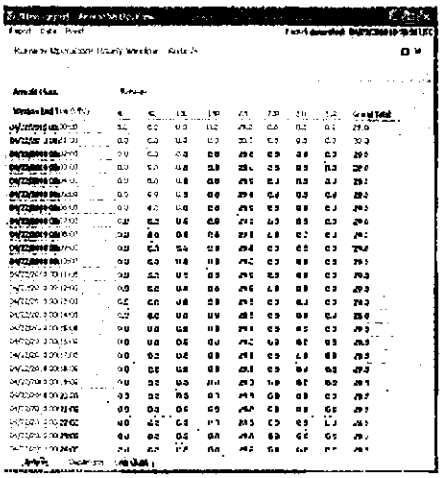
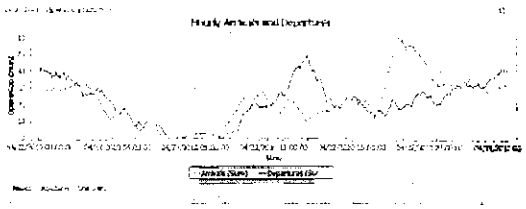
Metering location usage including flight information, time stamps in and out of region to highlight length of stay in region, and a count of how many aircraft metered in such locations, by hour and by total, for more than two minutes.

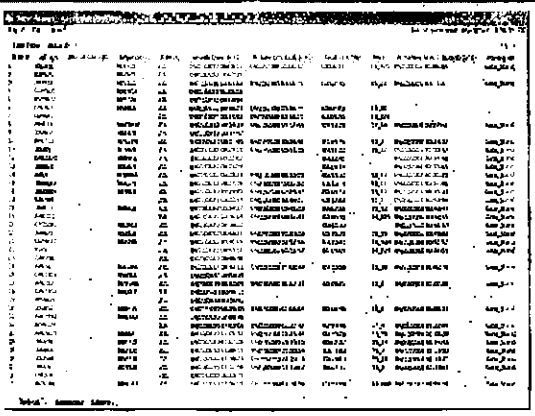
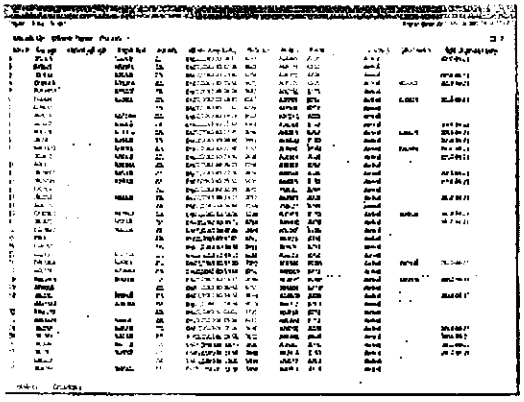
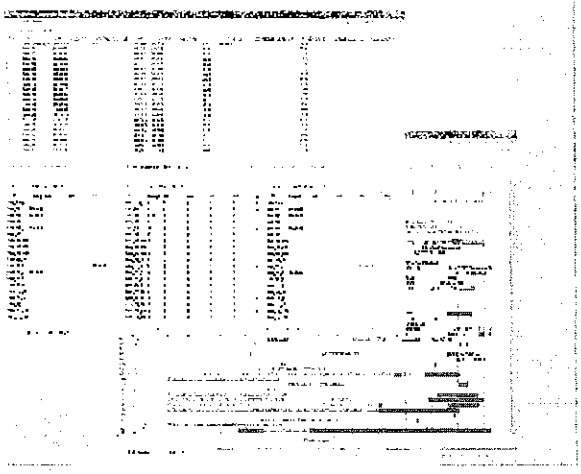
There are a number of preconfigured standard reports, as shown in Figure 63. These reports have evolved from nearly a decade of customer feedback. Additional standard reports can be added on customer request.

Figure 63 Standard Reports

Feature	Description	Example
Arrival Departure Summary	Provides a snapshot summary of operations per hour by air carrier. This provides a quick analysis of peak activity and banks.	

Feature	Description	Example
Region Occupancy	Provides a detailed listing of every aircraft that enters and exits every defined region on the airport. A defined region is every gate, taxiway, spot, and runway plus areas defined by the customer such as runway departure queues or deicing queues.	
Runway Occupancy	A subset of the Region Occupancy report where the occupancy times of aircraft in runways is reported. This provides an indication of airport efficiency.	
Runway Operations Per Hour	Provides a tabular view and graphical view of operations per runway per hour. This provides a snapshot of airport demands and capacity fluctuations during the day.	

Feature	Description	Example
		
Runway Operations Hourly Window	Like the Runway Operations per Hour report except each hour is on minute boundaries instead of hourly boundaries. The result is a clearer graph of airport inflow and outflows.	 

Feature	Description	Example
Taxi Time	Provides a snapshot of taxi times. This allows users to sort for excessive times and analyze the route taken in either a tabular form or by launching Playback and viewing the event again.	
Wheels Up/Wheels Down	Provides users with detailed records of landings and take-offs. This report can be merged with detailed databases of airframe weight and size to determine appropriate billing.	
Gate Occupancy	Provides a list, both textual and graphical, of all gate occupancy events, and summaries of gate occupancy times (total and average) by gate and airline and number of gate occupancies by gate and airline.	

Additional reports delivered as part of Phase B include the following as specified in the RFP:

1. Planned Taxi Time vs. Allocated Taxi Time
2. Allocated Taxi Time vs. Wheels Up Time
3. Departure Delay

4. Arrival Delay
5. Metering Area Usage

1.5.3 Database Query Reports

In addition to the established predefined reports, the System shall feature an advanced database query reporting capability that generates reports based on customizable User-defined criteria. This shall be a free-form query capability where Users will be able to generate reports identifying the operational situations and conditions that they would want to be aware of in real-time. For example, a Database Query Report could be run to identify stranded aircraft on the airfield, flights that required secondary deicing, unmet arrivals that had to wait at the gate, or flights that utilized a specific departure fix.

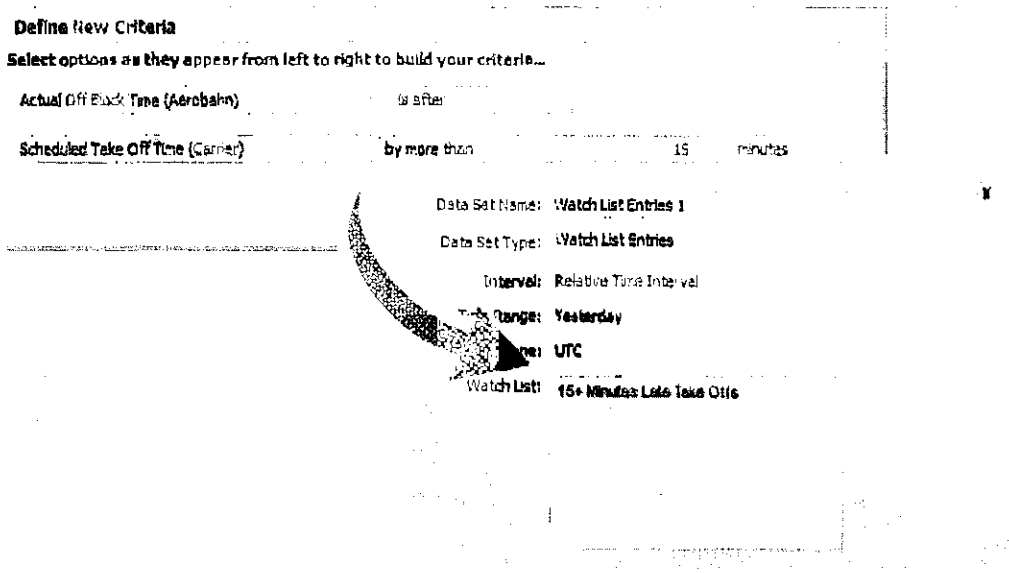
Database Query Reports shall be executed by defining the query criteria within the same GUI that is employed by the configurable alerts in the Base Map. Already defined criteria shall be automatically shared between the Base Map and Database Query Reports so that reports can easily be run to review past alert situations. After the selection criteria are defined, report execution shall return the list of all matching aircraft, vehicles, or flights depending on the report subject. The details shown for each element shall be completely customizable so that Users can expeditiously access the information they need.

The Contractor shall provide additional, custom reports, beyond those reports specified herein when requested by the Port Authority throughout the term of the contract period. Once the Port Authority identifies the content of the reports, the Contractor shall submit a report proposal that contains a scope of work, detailed labor breakdown, schedule and a cost proposal for approval by the Port Authority's Project Manager. The labor cost to provide custom reports shall not be included in the cost to provide the basic System and Services, but shall be compensated in accordance with the provisions stated in Section X.F. Supplemental Work

Integrating and storing data provides no value unless that data can be boiled down, mined, and turned into operational information. Built on top of the Aerobahn's Dynamic Rule Engine discussed in Section 1.3.5, Aerobahn Watch Lists and Watch List Reports allow users to define customizable criteria to identify a nearly limitless number of different situations on the airport surface in real-time and during post analysis. For any Dynamic Rule, the user can configure an action to populate a watch list when a flight matches the defined criteria. Every time a flight is added to or removed from a watch list, it is recorded in the Aerobahn database and made available for subsequent reporting (Figure 64).

Once the rule has run for sufficient time (over the desired reporting period), the user can create a custom report consisting of the watch list entries over a period of time. This will bring up a list of flights that met the report criteria including the time each flight started to meet the criteria and the time it stopped meeting the criteria. The user can then summarize the data using pivot tables or graphs.

Figure 64 From Rules to Reports



With built in standard reports and cutting edge Dynamic Rule Engine and Watch List System, Aerobahn far surpasses the reporting capabilities of any competing surface management system. Combined with a 6th generation region processing and state engine that leverages Sensis' unique and industry leading surveillance experience and understanding, Aerobahn provides the most accurate and beneficial reporting capability. Additionally, Sensis has been investing in significant performance and usability improvements so that the Aerobahn OpsView report suite will not only provides the best data, but provide it quickly, right when it is needed.

1.5.4 Summary Windows

Summary Windows shall provide Users the capability to display dynamic, real-time and forecasted status operation that is critical to their specific job function and needs. The System shall enable Users to choose trend indicators to illustrate whether the chosen values are increasing or decreasing and shall be capable of configuring the columns they want to see as well as the length of time that should be used to aggregate statistical trends (i.e. 30 minutes or greater, in multiples of 30).

a. Region of Interest Summary

Region of Interest (i.e. Departure Queue, Deicing Queue) Summary shall enable Users to monitor aircraft that occupy a defined Region of Interest (ROI). ROIs include Airport taxiways, runways, holding areas, parking areas, approach corridors, gates, concourses of gates, and other definable area in the movement and non-movement areas. This Summary Window shall provide a list of all aircraft that are currently within each ROI along with the time of entry, time of exit, and total occupancy time. Users shall have the ability to select the region they are interested in, along with the specific information to be displayed for each aircraft or vehicle in the region. The

Summary shall also optionally display a sliding queue depth graph depicting the number of occupying aircraft.

b. Surface Delay Summary

The Surface Delay Summary shall identify all established regions of interest and the corresponding delay. The delay shall be a calculated moving average of all delays recently incurred in each region respectively. Users shall have the ability to configure the table to show only regions with a delay above a certain threshold or to color code regions in the table with delays above a threshold.

c. Airport Demand Summary

The Base Map Airport Demand Summary shall display archived, predicted, and summarized arrival and departure rates at JFK. The Service shall calculate and forecast the total number of arrivals and departures that have occurred, or will occur, in fixed size time intervals. For each time interval, the predicted or actual (depending on whether the interval is in the past or the future) rate is plotted alongside the scheduled rate to visually illustrate how JFK's traffic is progressing in relation to scheduled operations:

d. Runway Configuration Summary

The Runway Configuration Summary shall graphically depict the current airport configuration. It shall be displayed as a simplified airport map with large colored arrows placed at the ends of the runways to indicate the current runway configuration. The colors shall be configurable and indicate if the runway is supporting arrivals, departures, or both. As the traffic patterns change, the arrows shall dynamically update to reflect the changes.

e. Arrival and Departure Sequencing Summary

The System shall predict the expected sequence of operations for the entire airport or an individual runway. Using predictive methods, the Arrival and Departure Sequencing Summary shall display ETA and ETD information using a condensed graphical timeline or other Port Authority Approved method. Users shall have the ability to add any number of predicted sequence charts to and arrange on a User's Base Map workspace.

f Taxi Time Summary

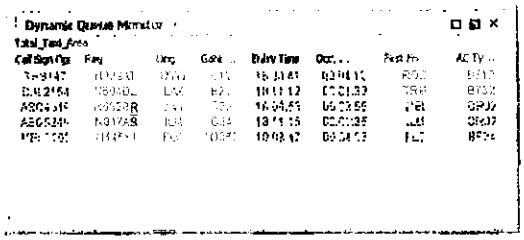
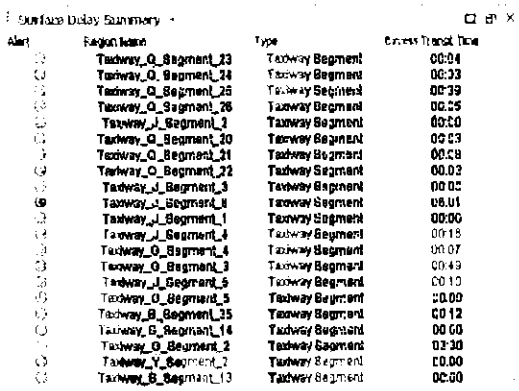
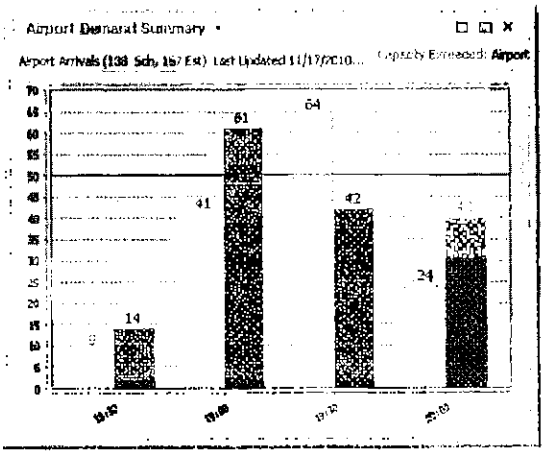
Taxi Time Summary shall display all active aircraft taxi times along with estimated total taxi time for the entire airport or a specific runway. In addition, the minimum time, maximum time, average time, and trend for the airport and each runway shall be shown.

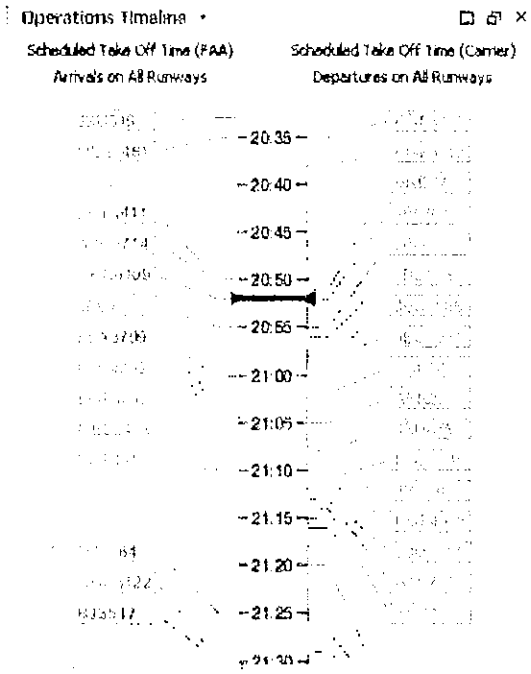
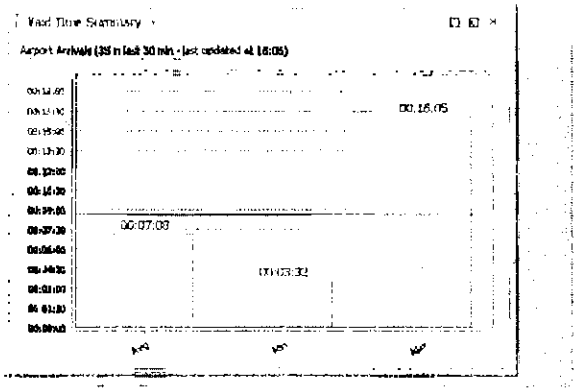
g. Active Flight Summary

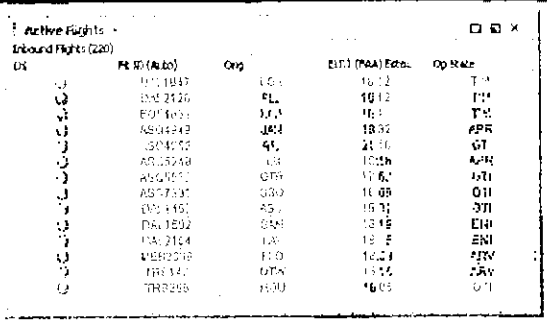
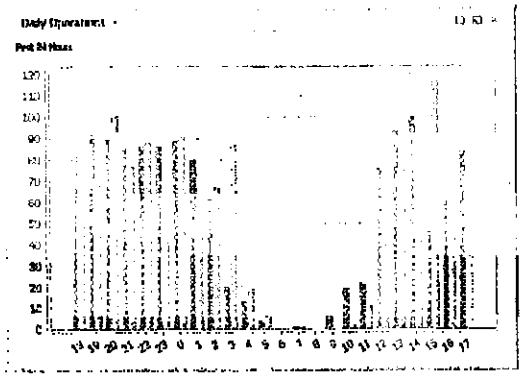
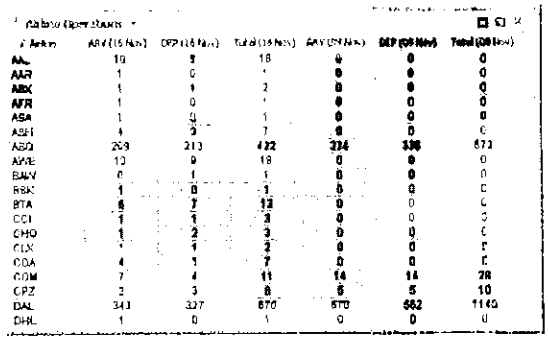
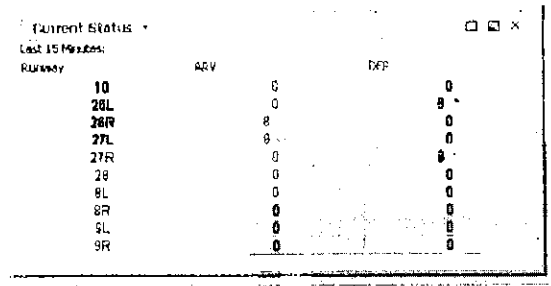
The Active Flights Summary displays all active flights along with the corresponding ETA or ETD, and a colored shape indicating flight progress. The thresholds used to determine status shall be configurable as shall the color and shape.

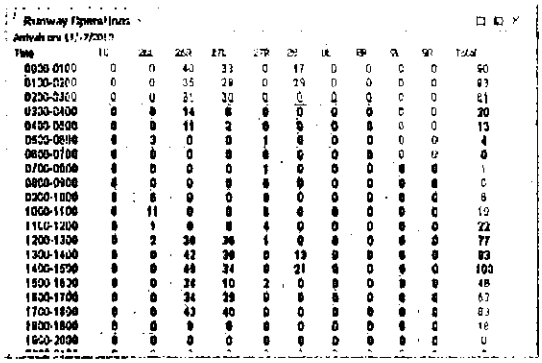
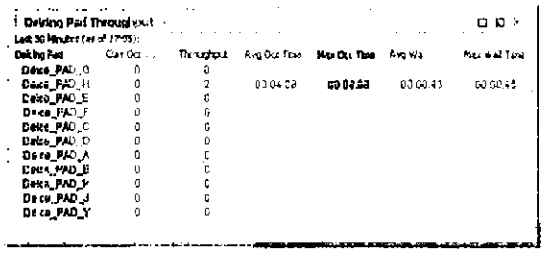
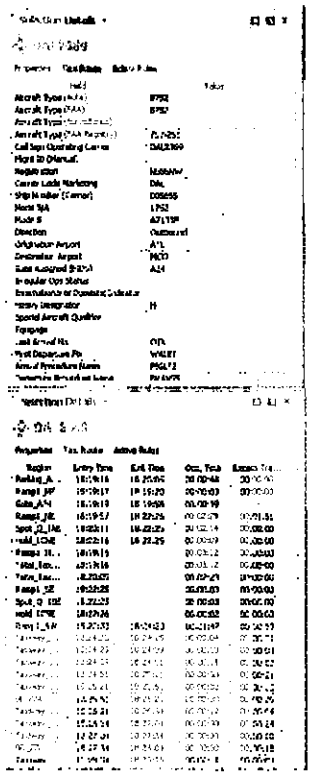
Aerobahn has a robust set of Real-Time Monitoring tools that are accessible from the Tools dropdown menu. Figure 65 details the tools available in Aerobahn.

Figure 65 Available Real-Time Monitoring Tools

Feature	Description	Example
Dynamic Queue Monitor (Region of Interest Summary)	Provides users with a real-time status of any defined region of interest on the airport. users can chose and sort by many available fields. This allows users to monitor the performance of critical areas on the airport surface.	
Surface Delay Summary	Provides list of regions and the excess transit time for each. Excess transit time is the average amount of time aircraft spent in the region over and above the minimum, or unimpeded, transit time. Allows user to set threshold on region types and alerts when the excess transit time exceeds the configured threshold.	
Airport Demand Summary	Provides predictions of the future state of the airport that will indicate the arrival and departure demand of the airport. Note: Archived demand is displayed in the Daily Operations Tool.	

Feature	Description	Example
Runway Configuration Summary	The **Runway configuration summary consists of semi-transparent, colored arrows at one end or the other of the** various **active runways**. The direction of the **arrows indicates** the direction of operations **on the runway** and the color indicates **whether the runway** is currently being **used for arrivals** or departures. Printed **on each** arrow is **the averaged** normalized (operations **per hour)** arrival/departure rate over **the last 10** minutes.	
Operations Timeline (Arrival/ Departure Sequencing Summary)	**Provides** flights associated **with schedule** according to **specified time fields. Each** side is individually **configurable** to show arrivals or **departures**, on any or all runways, **using any** time-oriented data field.	
Real-Time Taxi-Time Tool	A graphical real-time display of average taxi times. **Individual aircraft** taxi times are available **as a field in** the data block.	

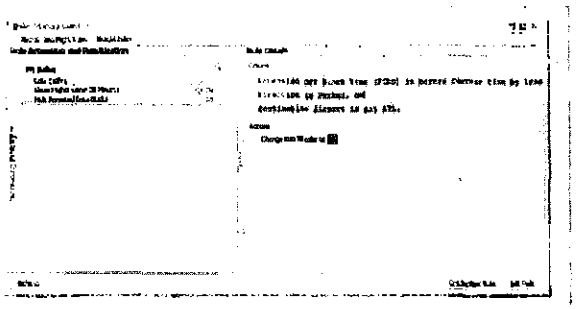
Feature	Description	Example
Active Flights	The Active flights tool provides a list of all the flights Aerobahn is currently tracking, their status on the surface, and other selectable information fields. Provides a quick reference list of flights where any anomalies can be quickly detected.	
Daily Operations	This tool provides a historical graph of arrivals and departures by the hour.	
Airline Operations	The Airline Operations Tools provides a listing by carrier of the number of operations completed in the current day and 8 days in the past.	
Current Status	The Current Status tool gives users an indication of arrival and departure activity within the last 15 minutes.	

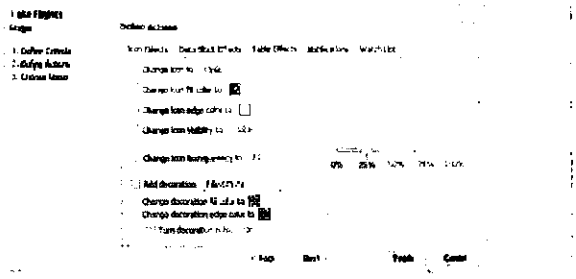
Feature	Description	Example
Runway Operations	The Runway Operations tool provides a historical snapshot of runway usage by hour for a 24 hour period.	
Deicing Status Tool	A new tool to indicate the following metrics for each deicing pad: • Last 30 min throughput • Average occupancy time • Current occupancy • Average wait last 30 minutes	
Target Details Tool	A new real-time monitoring tool that provides an expanded list of information about a selected target including flight and aircraft information, taxi route, and active rules that are applied to the aircraft. Can be docked like any other tool for ready access.	

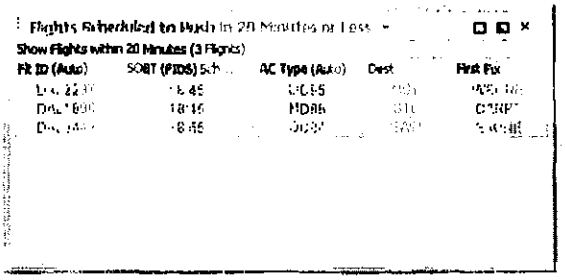
Dynamic Rules Engine

This powerful feature allows users to compose conditional **"rules" based on** the values of various aircraft and flight related information, and then specify actions that will occur if the conditions are met. Actions can modify the appearance an aircraft icon, send notifications via email or cell phone, or populate tabular **"watch lists" of flights** in the workspace.

This is useful for highlighting one or more flights of interest, keeping track of a group of flights with common characteristics, alerting controllers to critical operational situations, notifying the responsible authorities of airport-wide operational situations, and much more.



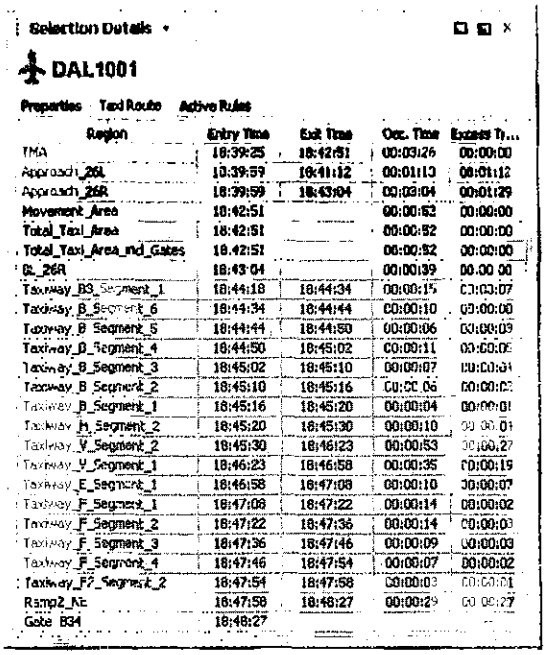




Surface Route Prediction Engine

Aerobahn's **ability to provide** situational Surface Route Prediction greatly expands situational awareness. Using historical route information and other key elements of the flight data, Aerobahn can determine the most likely route across the surface and predict the times the aircraft will arrive at each waypoint along the route.

From these predictions, Aerobahn will also calculate departure sequences, times, queues, and delays for runways and other resources; and aggregate demand information for the airport as a whole. This data is used to drive additional data and metrics which is used to augment the real-time tool set with additional or more accurate information.

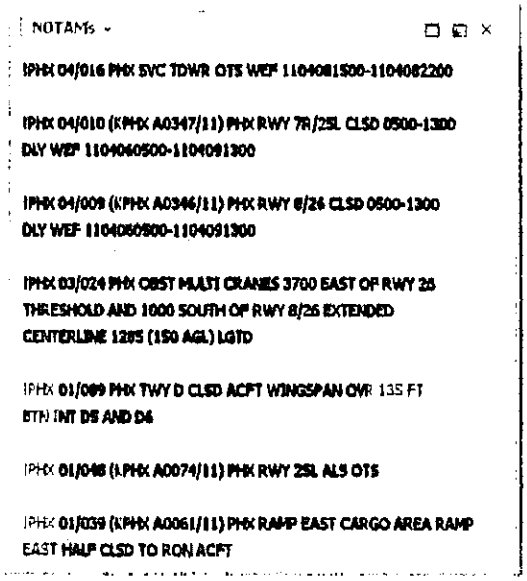


Region	Entry Time	Exit Time	Occ. Time	Excess Ty...
TMA	18:39:25	18:42:51	00:03:26	00:00:00
Approach_26L	18:39:59	18:41:12	00:01:13	00:01:12
Approach_26R	18:39:59	18:43:04	00:03:04	00:01:29
Movement_Area	18:42:51		00:00:52	00:00:00
Total_Taxi_Area	18:42:51		00:00:52	00:00:00
Total_Taxi_Area_and_Gates	18:42:51		00:00:52	00:00:00
RL_26R	18:43:04		00:00:39	00.00.00
Taxiway_B3_Segment_1	18:44:18	18:44:34	00:00:15	00:00:07
Taxiway_B_Segment_6	18:44:34	18:44:44	00:00:10	00:00:00
Taxiway_B_Segment_5	18:44:44	18:44:50	00:00:06	00:00:09
Taxiway_B_Segment_4	18:44:50	18:45:02	00:00:11	00:00:05
Taxiway_B_Segment_3	18:45:02	18:45:10	00:00:07	00:00:01
Taxiway_B_Segment_2	18:45:10	18:45:16	00:00:06	00:00:02
Taxiway_B_Segment_1	18:45:16	18:45:20	00:00:04	00:00:01
Taxiway_H_Segment_2	18:45:20	18:45:30	00:00:10	00:00:01
Taxiway_V_Segment_2	18:45:30	18:46:23	00:00:53	00:00:27
Taxiway_V_Segment_1	18:46:23	18:46:58	00:00:35	00:00:19
Taxiway_E_Segment_1	18:46:58	18:47:08	00:00:10	00:00:07
Taxiway_F_Segment_1	18:47:08	18:47:22	00:00:14	00:00:02
Taxiway_F_Segment_2	18:47:22	18:47:36	00:00:14	00:00:03
Taxiway_F_Segment_3	18:47:36	18:47:46	00:00:09	00:00:03
Taxiway_F_Segment_4	18:47:46	18:47:54	00:00:07	00:00:02
Taxiway_F7_Segment_2	18:47:54	18:47:58	00:00:03	00:00:01
Ramp2_NE	18:47:58	18:48:27	00:00:29	00:00:27
Gate B34	18:48:27			

Surface Route Predictions are shown in red.

NOTAMs

NOTAMs will be retrieved from the FAA's PilotWeb site and made available in both live and playback modes.



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1. General System Design Requirements

1.1 Overview of Application

For both phases of implementation, the System shall provide the following:

- *Secure access and protection of Port Authority data against intrusions and internal misuse of data*
- *Continuous operations in the event of a catastrophic failure*
- *Consistent user interface*
- *Interface with external systems through an open systems architecture*

The Contractor shall build the System to comply with the most current version of the Port Authority's Audit Department's Control Guidelines included in Exhibit S 5 and satisfy the checklists therein.

Aerobahn service is deployed and used operationally at 17 major airports, servicing airport, airline, and Air Navigation Service Provider (ANSP) stakeholders. Most importantly for the Port Authority, Aerobahn service has been operational for Sensis Airline customers since July 2008 and for the Port Authority since May 2009. This will allow for a smooth transition to the fuller, richer Aerobahn SMS service. Because Aerobahn Service has a rich history at JFK, it has profited from customer feedback and experience in operating at one of the nation's most challenging airports. The need for efficient, reliable operation has demanded a system that is open, available, secure and user-friendly.

Since Aerobahn relies on data feeds from a variety of sources, including airport surveillance, airline flight data, FAA feeds, and commercial data providers, Sensis uses an open architecture to make interface configuration relatively simple. The software is built using a mixture of open-source and widely available commercial Java libraries, and is modular to allow for rapid architecture evolution. Most of the data connections use XML formats and open messaging protocols such as Simple Object Access Protocol (SOAP) and Websphere Message Queue (MQ). In some cases connectivity is provided directly via TCP/IP or FTP connections. Physically, COTS hardware is used for networking, servers, and storage.

Redundant hardware and communications links are used to ensure high reliability and availability. The physical architecture of the system employs a system of virtual machines hosted on a bank of servers which utilizes a Network Attached Storage system to keep the data. These technologies are inherently redundant, so that if any given hardware device (server, hard drive, network component) fails, the system will continue to operate. It is conceivable, though improbable, that the entire data center could be compromised. Thus, the Aerobahn SMS service employs two SAS-70 compliant geographically separated data centers: one in Staten Island, and another in Philadelphia.

The secondary data center will maintain an up-to-date copy of the data stored at the primary site. In the event of catastrophic failure of the primary site, the secondary would be brought on line. Finally, all Sensis-controlled communications are fully redundant and geographically diverse. That way, if one line goes down, data flow will continue uninterrupted.

Sensis recognizes the importance of protecting sensitive flight data and ensuring system operation is not compromised by a malicious intruder. To this end, Sensis had provided layers of security protect the existing Aerobahn Service and the data it contain and will continue to improve and enhance the security measures for the Aerobahn SMS service.

The Aerobahn SMS Service employs an open system architecture using industry standard networking, processing, and storage technologies. The software is written predominantly in Java which is platform independent. This allows the Service to be fully interoperable with external systems.

Finally, Sensis engineers take great pains to ensure the user interface for the Aerobahn services is easy to learn and easy to use. Even as the software evolves in diversity and complexity to provide more comprehensive airport management services, the interface remains consistent and usable. New features are added so as to make maximum use of existing tools and ways of doing things. More commonly used features are kept in the forefront, while less-used and more esoteric functionality is kept out of the way, requiring one or two extra keystrokes or mouse-clicks to access. Wherever possible, the user interface is designed to allow for intuitive understanding of how to use it. Additionally, where the location or use of a feature is not immediately obvious, users may immediately access on-line help with a single mouse-click.

1.2 Security Requirements

1.2.1 Data Security

The System shall provide secured access and protection of Port Authority data against intrusions and internal misuse of that data. The techniques used to secure access and protect the data shall include, but not be limited to the following:

- *Transparent Data Encryption*
- *Compartmentalized system authorization*
- *Secure transmission of data*
- *Secure encryption of data*
- *Strong, best practices password policy*
- *Record all User activities*

The Aerobahn service is highly secure and protected from compromise of data and malicious intrusion through a diverse set of firewalls, passwords, encryption for external communications over public networks, and user activity logging.

With regard to network security, Sensis employs dedicated links over physically private networks and data encryption over public networks. Dedicated links are used for user access from a corporate or government network and for transmission of airline flight data from private networks. When users are connecting to the service or third party data sources are transmitting flight data via public networks such as the Internet the data is encrypted using Internet Protocol Security (IPSEC) within a virtual private network (VPN) connection. In both cases, firewalls and network intrusion detection systems (IDS) are employed between the external networks and the data center network to ensure only known and necessary data connections are being made.

Access to the system servers and to the application itself is guarded by a password policy that will be enhanced to fully comply with the Port Authority's specifications. On the servers, administrative access to data and system administration functionality is granted only to accounts belonging to users with the need for access, which generally is currently limited to Aerobahn administrators at Sensis. Access to the Aerobahn database requires knowledge of an additional password given only to users with the need to know. The only people able to log in to the Aerobahn application are those for whom user accounts have been created by Sensis and who have a password. Within the application access to functionality and proprietary data is limited by the permissions configured for each user by application administrators.

While permissions by themselves provide a large amount of control over user activity, Sensis, for the Aerobahn SMS release, will employ usage tracking to monitor what activities each user performs. See Section 1.8 for details.

1.2.2 Physical Security

The Contractor shall provide secured access and protection of the System against unauthorized physical contact to ensure that System operations are never compromised. Only authorized personnel shall be permitted access to the System to perform their designated assignments. The Contractor shall control, monitor and document access to the System and all System components. Protect the System and the building(s) where the System components are located from theft, vandalism, natural disaster, manmade catastrophes, and accidental damage and provide an appropriate environment that is conducive for proper System operation in accordance with the requirements stated herein.

Sensis is leveraging a Tier 4 data center for both the primary and the secondary Aerobahn data service facilities. This Tier 4 data center has multiple layers of physical access and monitoring to ensure tightly controlled access to the hardware.

Entry to the data center is controlled and monitored by the data center provider. Access to the racks of equipment hosting the Aerobahn service is controlled by the data center

provider, but this access is contingent on approval by Sensis Corporation and the Port Authority. All entry attempts (successful or failed) are logged by the data center provider.

Being a tier 4 provider, the data center has redundancy built into all of the power and cooling distribution paths, down to the level of redundant PDU's in every rack with all discrete, redundant hardware components split across the redundant PDU's.

Redundancy is inherent throughout the system design. All system subcomponents (disk storage, servers, routers, switches, etc.) are able to sustain a complete failure with no impact to system performance. The only failure that would manifest is service downtime would be a full site failure. In this event, a declaration of a full site disaster needs to be made, and a manual failover to the backup/secondary site is made. The system is designed to allow a full site failover to occur in less than 1 hour.

1.2.3 Security Submittal

The Contractor shall submit a description of all security features, policies and practices for Authority approval.

Sensis will deliver the Security Plan which specifies the security features, policies and practices required as specified in RFP Attachment C, Section IX.

1.3 System Architecture

The System shall be redundant and configured to provide for continuous operation in the event of the failure of any single System component. The redundant operation shall include, but not be limited to, all central computer system, software, network and Internet components that are used to fulfill the requirements of the Contract.

A fault tolerant computing solution shall be provided so that the system will continue to run upon detection of any type of failure. Once implemented, the hardware and application shall continue to operate if one server, the software or any single system component fails.

Any failures occurring in the primary application server (or database server if used), shall cause the system to automatically switchover, without operator intervention, from their primary central components to the secondary/redundant components upon detection of a hardware or software failure in any primary component without any loss of data or user control. The System shall instantaneously switchover the software processing to maintain continuous System operation. The operation of the System shall be transparent to the operator during and after the switchover. The system shall display an alert to the operators of the failover on all of the User Workstations to notify them of the condition. Once the primary server or component is repaired to full operation, all data shall be recovered on the primary server without any loss of data during the outage. Restoration of the primary server(s) into the fault tolerant configuration shall be performed without any loss of data.

The secondary/redundant components of the system shall be diversely located, both physically and logically, in an alternate computer site that is subject to Port Authority approval, to ensure

continuity of operations in event a catastrophic event adversely affects the site where the primary components are located.

Authorized Users shall access the application through a secure, web-enabled interface on normal desktop or laptop computers using standard Internet Browsers in their native operating systems, including, but not limited to, the following:

- *Internet Explorer, version 7 (and later)*
- *FireFox 3 (and later)*
- *Safari 4 (and later)*
- *Chrome (all versions)*
- *Opera 9 (and later)*

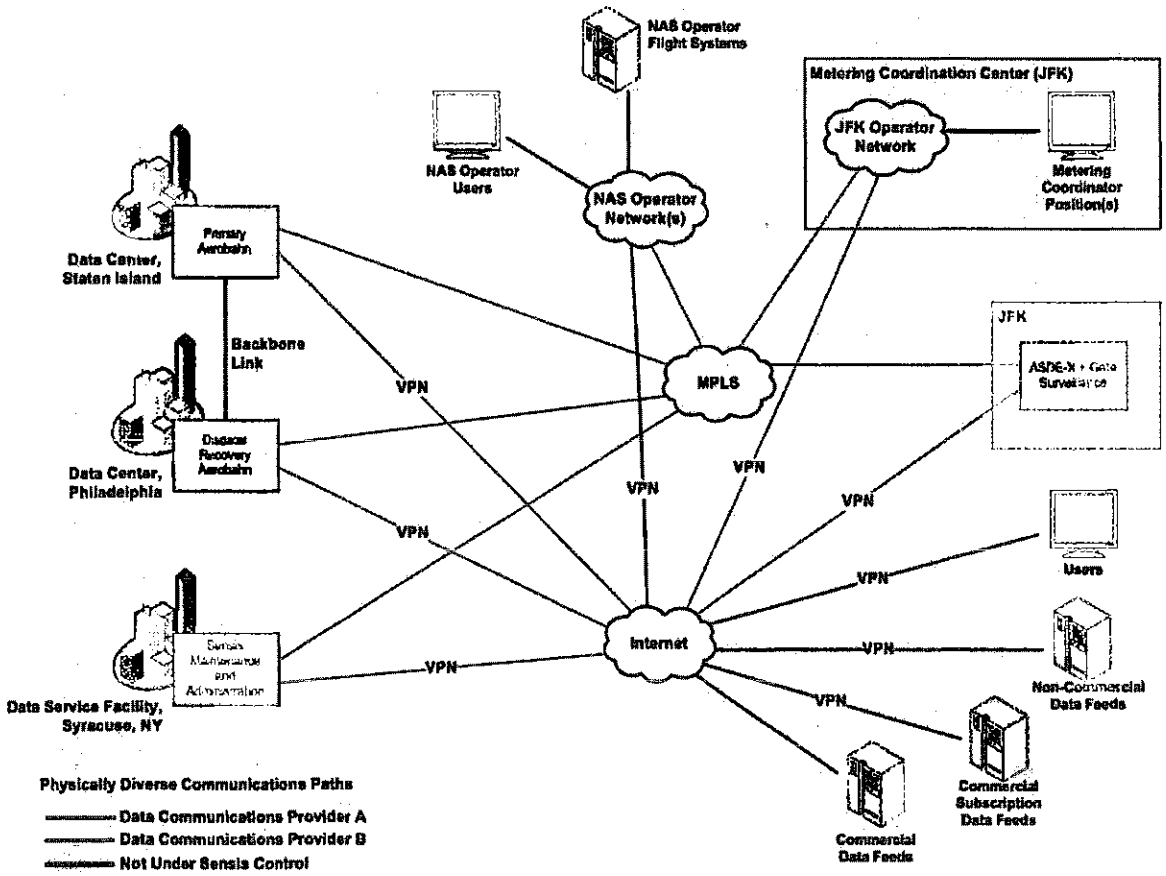
1.3.1 Overview

Sensis proposed architecture builds on the existing proven architecture already deployed for the Port Authority. The architecture leverages improvements in communications and disaster recovery to deliver the highest reliability surface management system in the industry. Key architecture points include the following:

- Sensis will relocate the primary Aerobahn Surface Management System (SMS) service to a data service center provider in Staten Island, NY.
- The current Sensis Data Facility Architecture would be leveraged as a testing environment.
- The existing communications infrastructure will be upgraded to a fully redundant, physically diverse architecture to improve reliability.
- A new geographically diverse data center in Philadelphia will be used for an additional layer of protection for the disaster recovery system. This system will have all of the same communications and hardware redundancy and performance aspects of the primary Aerobahn SMS.

The Aerobahn SMS architecture is shown in Figure 1 below.

Figure 1 Aerobahn SMS Architecture



Sensis will own or lease, operate, and maintain all the necessary hardware and software components of the Aerobahn SMS Service with the exception of any client hardware not in the Metering Control Center. Since the Service is a Web-based application, industry standard PC's with web browsers installed are required for the 400 client users. These PC's are to be provided by the clients. As part of the service, the standard method of connection to the service for the clients will be via VPN access over a broadband internet connection. There is also a priced option (based on the number of clients) for a direct connection via dedicated broadband connection which is already in use for several of the NAS operator clients with the current JFK Aerobahn Service. This is typically negotiated between Sensis and the NAS Operators.

Sensis will connect to external data systems either via direct broadband connections via dedicated bandwidth or via VPN connection over a broadband internet connection. These connections are used to gather the necessary flight, surveillance and status feeds necessary to drive the required functions of the Aerobahn SMS Service.

Lastly, Sensis will be providing a fully staffed, fully equipped Metering Control Center, used to run and execute the Departure Metering Program at JFK.

1.3.2 Primary SMS

The Primary SMS leverages the existing Aerobahn DSF Architecture already in place in East Syracuse, NY. This architecture utilizes a highly redundant and scalable virtualized environment to deliver the high-availability service the Port Authority has come to expect. In order to improve the disaster recovery, Sensis will be relocating the source of this virtualized environment to a data center provider in Staten Island. The existing JFK Aerobahn Service was migrated to this new virtualized architecture less than a year ago with the vision of moving the service to a commercial data center. This migration will allow Sensis to maintain a current hardware platform and allow for an easy and rapid growth path. In addition, Sensis will be able to leverage the data center provider's geographically diverse infrastructure and communications backbone for the disaster recovery system. Sensis will also be leveraging the data center provider's SAS-70 capabilities. Because the system is virtualized, if any individual hardware components fail, the service software and processing is automatically relocated to different hardware without any data interruption or the users aware of the failure.

1.3.3 Disaster Recovery SMS

The disaster recovery (DR) SMS will be located in a data center that is geographically separated from the primary Aerobahn SMS in Philadelphia. The disaster recovery SMS will only become necessary in the event of either a complete failure of the primary Aerobahn SMS (or its environment) or in the case of the isolation or destruction of the primary Aerobahn SMS location. As stated previously, the primary Aerobahn SMS has levels of redundancy and protection that is utilized to reduce the likelihood that the DR Aerobahn SMS will be invoked. Because this will be such a rare event, a more cost effective solution for the DR system can be provided. Sensis recommends a DR solution that will utilize frequent synchronization of data backup and manual invocation to reduce the interruption in a complete disaster recovery situation to less than 1 hour with a data loss of less than three hours.

1.3.4 Communications

The Aerobahn JFK Service currently leverages a commercial MPLS (Multiprotocol Label Switching) Communications Architecture at its core (used for the surveillance data and NAS operator data in addition to many NAS operator clients). MPLS is a mechanism in high-performance telecommunications networks which is a scalable, protocol agnostic, data-carrying mechanism. MPLS utilizes a highly redundant, highly available network architecture at its backbone. Aerobahn currently accesses this network via dedicated local loop communications circuits. These local loop connections will be upgraded to

higher bandwidth to support the higher number of users and data required. In order to improve the availability of the Communications infrastructure, additional connections through the Internet using VPN will be added via a physically diverse communications provider to provide a backup communications path in the case there is a failure of either the local loop or MPLS communications systems. Additionally, the communications link to Sensis' Internet providers (currently used for limited data links and VPN client access) will have the bandwidth upgraded significantly to accommodate the required 400 clients and data.

1.3.5 Surveillance

The real-time surface surveillance will be provided by the FAA Gate and Ramp Coverage Augmented ASDE-X system currently in place at JFK. This is the same system that is currently in use by the Aerobahn JFK Service. Since the Aerobahn team has been working with this feed for several years now, the Aerobahn team is confident in its ability to adapt to the various data quirks and anomalies than can be present in this or any surveillance system and utilize it to deliver the high confidence system the Port Authority expects. In order to improve the surveillance reliability, a redundant communications path via the Internet will be added in the case of a local loop MPLS failure.

1.3.6 External Data Feeds

The Aerobahn SMS Service architecture will interface with the external data feeds in the following manners:

- The NAS Operator data feeds are sent to Sensis via the MPLS network and a dedicated local loop connection to the NAS Operator Site. These connections are not currently redundant. Sensis will work with the NAS Operators to build a VPN Internet alternate path for these data feeds. For some NAS operators, certain data (schedules, actuals and gate assignments) may be provided to Sensis via an OAG aggregated data feed via a VPN over the internet connection.
- The surveillance data is currently sent to Sensis via a redundant local loop connection to the MPLS network. This will be augmented by an Internet VPN backup path.
- The various Non-Commercial data feeds (e.g. FAA, NWS) will utilize a VPN over the Internet.
- The various Subscription based commercial data feeds utilize a VPN over the Internet.

1.3.7 User Access

Aerobahn is a web-based application. There is no need for users or IT personnel to load additional software on the client PCs. Users simply browse to the web address specified by Sensis and run the application within a web browser. Aerobahn will run in any web browser that supports Java applets. The primary user access will be via a VPN connection over the Internet. Sensis can also offer users a priced option for a dedicated connection over the Sensis MPLS network.

1.3.8 Metering Coordination Center

The Metering Coordination Center will be located in a Port Authority building at the airport. It will have physically diverse redundant connections to the Aerobahn SMS, one via the MPLS network and one via a dedicated site-to-site VPN connection over the Internet. Pending a site survey, it is expected that there will be three working position stations supplied; one for the SMS Operator, one for the SMS IROPs Operator, and one spare position. Additionally there will be an office for the SMS Manager and an additional space for local Sensis Team computer access. Included will be a large screen monitor for surface situational awareness. For further details please refer to Section F-3, paragraph 1.5.2.1.

1.4 Database Requirements

Database integrity, performance, storage and management are at the heart of the Aerobahn SMS product. Sensis will perform routine maintenance to ensure optimal performance, and will manage the backup of the database, using the backups for regular internal testing as part of maintaining the high quality of the Aerobahn SMS product. Also, Sensis will have the database replicated to the disaster recovery server on a configurable interval, defaulted to every 10 minutes.

1.4.1 Data Ownership

The Contractor shall propose ownership rights of the data collected by and used for System operation. The Contractor shall include a detailed description of which data will be owned by the Port Authority and its appropriate Users and which data will remain in ownership of the Contractor. The Contractor shall take all appropriate actions and measures to protect the data from unauthorized access and submit its approach for Authority approval. Within 30 days of the end of the contract period including any extension periods, a copy of the data collected throughout the entire time period of the contract shall be provided in a digital format to be approved by the Port Authority.

Sensis proposes the Port Authority will own all data necessary to generate any Aerobahn SMS report and which is not proprietary to any airline. The Port Authority will not have ownership of any data in the real-time database, which is Sensis proprietary.

Sensis' approach to minimize unauthorized access to the database is twofold. The first is to ensure that the database will only allow connections from the local machine and a certain subnet that Sensis system administrators use from within the organization. The second means by which we protect the data is by using database permissions to ensure that only certain database users have access to data.

At the end of the contract Sensis can export a file from the database that will have all of the reporting data to a disk drive. This file will be very large, so an appropriate transfer medium will need to be chosen, preferably FTP or USB drive. However, Sensis could span the file across multiple DVD's and mail them.

1.4.2 Data Integrity

The integrity of the data used in the System, including frequency of exchange of the identified data, accuracy, timeliness and standardization of shared data, shall be proposed by the Contractor and is subject to Port Authority approval.

Data integrity is enforced at multiple levels in the existing Aerobahn system. Aerobahn processes will scrub the data that is received directly from an external source. Another set of Aerobahn processes scrub the same data again during the application processing in attempts to normalize this data within the existing system, and the application will do final checks on the data at the database level as the data is stored for historical purposes with database tools. All of these checks happen before a connected user will see any of this data. If the data cannot be processed correctly, the Aerobahn system will log this in the application log files and drop that particular piece of data.

Data exchanges rates to the client are based on the type of data. Surface surveillance data is updated every second. The flight data associated with surveillance data is updated at once per minute. Non surveillance targets are updated at configurable interval, with the default rate being once every 5 minutes.

1.4.3 Database Setup

The Contractor shall provide a fully functional system that includes the configuration, data entry and fine-tuning of a database and configuration of the system to meet the requirements of the contract.

The existing operational Aerobahn system already has a fully installed and configured database. Normal database maintenance is done in an automated manner at a regular interval by software that is installed with our database in order to maintain optimum performance. Manual database maintenance tasks will occur as needed, during scheduled maintenance periods and performed by System Administrators.

1.4.4 Database Replication

The System database(s) shall be replicated onto the backup application server, (and/or backup database server if a separate server is used), which is located in a different data center for diversity in order to maintain System operation in the event that the primary application server (or primary database server if used) fails without loss of data or user control. The replication process shall be performed in real-time, replicate each transaction and validate that the replicated data is accurate and complete.

Database replication will be done at the disk level every 10 minutes with the transactional data being stored by the database on a separate disk that can be used for startup in the event of a catastrophic failure that will cause failover to our secondary site.

1.4.5 Data Storage, Archive and Restore

The System shall provide online storage of data for a minimum of two (2) years of data without any degradation in System performance. For each month beyond the current two (2) years of storage, the system shall automatically archive the data for long-term storage to disk, and R/W-DVD if requested by the user, and deleted from the online database storage. The System shall provide authorized Users with the capability to retrieve the archived data for reports, analysis and playback for a minimum period of five (5) years and removed from normal access once the User indicates they completed use of the archived data.

The existing system is already storing data since the inception of the current JFK Aerobahn Service contract. Sensis is capable of storing the data on-line for the duration of the Aerobahn SMS Service contract without any loss of performance. There is no need for additional archival.

1.4.6 Database Backups

The Contractor shall backup all servers that are used as part of the application. The backup shall contain all data, application and system files and be performed as follows:

- *A full backup of each server shall be performed on a weekly basis.*
- *An incremental backup of each server shall be performed on a daily basis and backup all files that have changed since the last backup.*

The backup mechanism used is disk based, and always takes incremental backups at the disk level. These are then incorporated into previous backups making any backup appear to be a full backup. In addition to this, we do a nightly backup of the database, and log transactional activity to a separate server, so that our database can be restored to within 30 minutes of a catastrophic hardware failure.

With the addition of the secondary failover site, we will always be capable of restoring to a configurable window with a default of 10 minutes.

1.4.7 Testing the Restore Procedure

The Contractor shall verify that system backups can be used to successfully restore the backed up data. It is recommended that the test restore be performed on a single non-critical directory only, not the entire server. When incremental or differential backups are routinely used, the test restore procedure should incorporate the following:

- *Immediately prior to performing the test restore procedure, do a special full backup on the directory being tested.*
- *Testing a full restore shall only be performed on a non-production server.*
- *Testing shall be performed, at a minimum, at least annually.*
- *Test results shall be documented.*

Sensis' servers operate in a virtualized environment and as part of normal testing Sensis will use the backup to create "clone" servers of the current running production server. Sensis' restore procedure takes the current backup, creates another virtual server with all the data of the production server, and after some networking updates, start the newly created server as a clone for testing and shadow server access. This is done multiple times throughout the year for testing and shadow purposes. In addition to testing the entire backup, database backups are copied and used for internal testing purposes as well. All of this is and has been happening in a manner transparent to the end user of the existing Aerobahn system.

1.4.8 Data Analysis

The Contractor shall provide the User with the capability to analyze the data recorded by the System. The Contractor shall propose, for Authority approval, the methods of analysis.

Data analysis can be done through Aerobahn reports. There are multiple datasets available for different kinds of data, including flight data, gate occupancy and region occupancy. There are also different tools that can be used to analyze data, including pivot tables, and multiple kinds of charts, including bar charts, line charts, and pie charts. These reports can be configured to run on a schedule.

1.4.9 Data Playback

The System shall provide the capability to playback recorded data in sync with recorded radio transmissions.

The existing system currently provides a playback feature that will be integrated with ATC Radio for the Phase B release.

1.4.10 Data Extraction

The System shall provide authorized Users with the capability to extract all Port Authority data in an appropriate hierarchical XML format that matches the business model of the application.

The Contractor shall propose an XML structure, for Authority approval, based on the design of the application.

Sensis will be able to extract the Port Authority owned data to a text file in any format that is decided upon. However, XML may not be the best structure for this type of data due to the extra space of the xml tag structure. This might be best to put into a CSV, or tab delimited format.

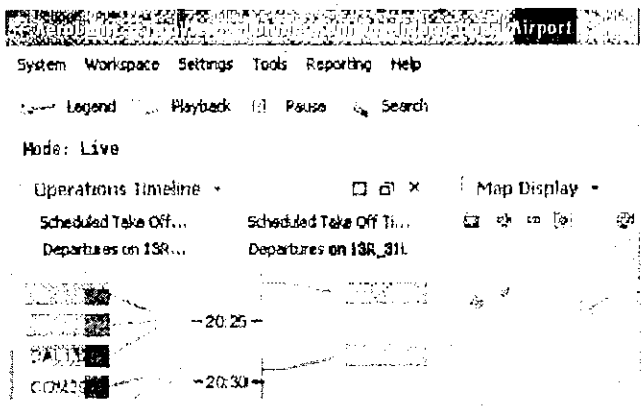
1.5 Screen Display and User Control

The System shall provide critical information on all screens to provide a context for users of the application (i.e. state Facility for which data being reported). Report headings shall be standardized, and shall appear in a consistent manner throughout all presentation formats of the application on both the real-time Screen or in archived Reports.

The System shall support a minimum of four (4) active windows operating concurrently and update the data in each window in accordance with the approved data refresh rate. The System shall also support the use of multiple monitors connected to the system unit of each workstation.

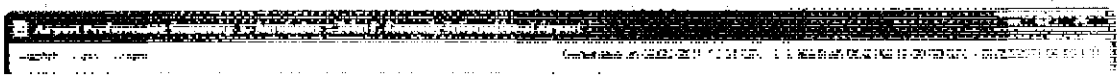
Aerobahn labels every real-time screen with the facility name (Figure 2).

Figure 2 Facility Context Labeling



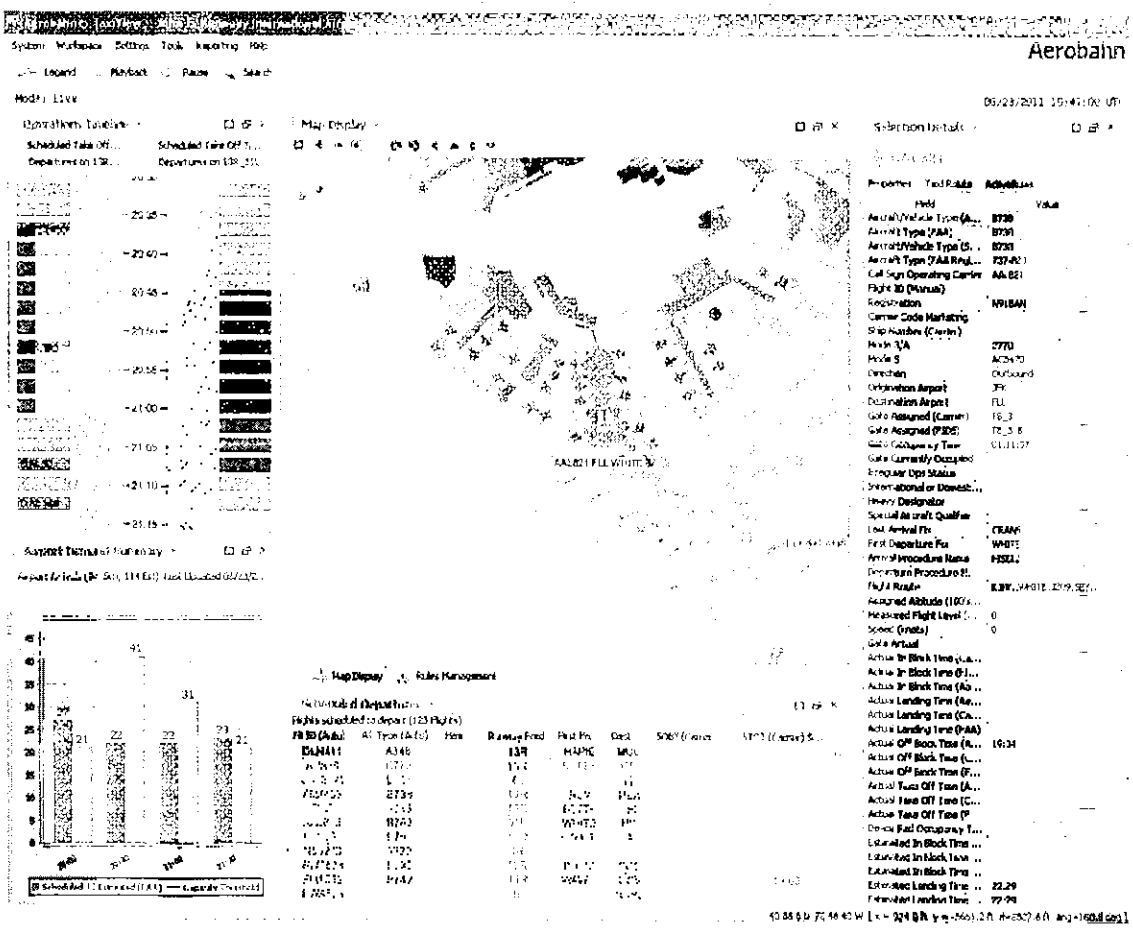
Report headings will be modified for this contract to comply with Port Authority specifications (Figure 3).

Figure 3 Report Headings



Finally, Aerobahn allows users to bring up a large variety and number of windows so as to customize the display for any given role (Figure 4).

Figure 4 Multiple Simultaneous Windows



For a complete description of the user interface see Section F-1-IV – Functional Requirements.

1.6 Access Privileges

1.6.1 User Access Permissioning

Security shall be role-based and the application software shall support a minimum of eight (8) levels of application access security, including one (1) for system administration, totaling nine (9) access security levels, and be capable of storing a user passwords, associated access levels and access permissions/restrictions for the number of users specified in Attachment C, Section 5, M., System Sizing. The access level shall determine which functions the User can implement, as

indicated below. The System shall allow each User's profile to be configured to allow Read-Only, Read & Write, or No Access permissions/restrictions to, at a minimum, the following resources:

- *airport terminal data*
- *ramp area data*
- *airline data, and*
- *special system capabilities, such as the display of real time flight tracking for 15 PANYNJ Users*

User access permissions/restrictions to application functions and resources shall be configured by the Contractor and approved by the Port Authority's Project Manager.

Aerobahn employs a sophisticated user access and permissioning system to customize in fine detail system access for an individual user or group of users. The Aerobahn Sys Admin tool provides permissioned users the ability to add, remove, view, and modify user and group accounts. Any user can be granted the privileges necessary to be an application administrator, but the user may only exercise these privileges on accounts at or below his own level in the group hierarchy. An application administrator can manage basic user information, user settings and permissions (access), and the user's ability to share data (see Figure 5, Figure 6 and Figure 7).

Figure 5 System Admin Interface – Settings and Permissions Tab

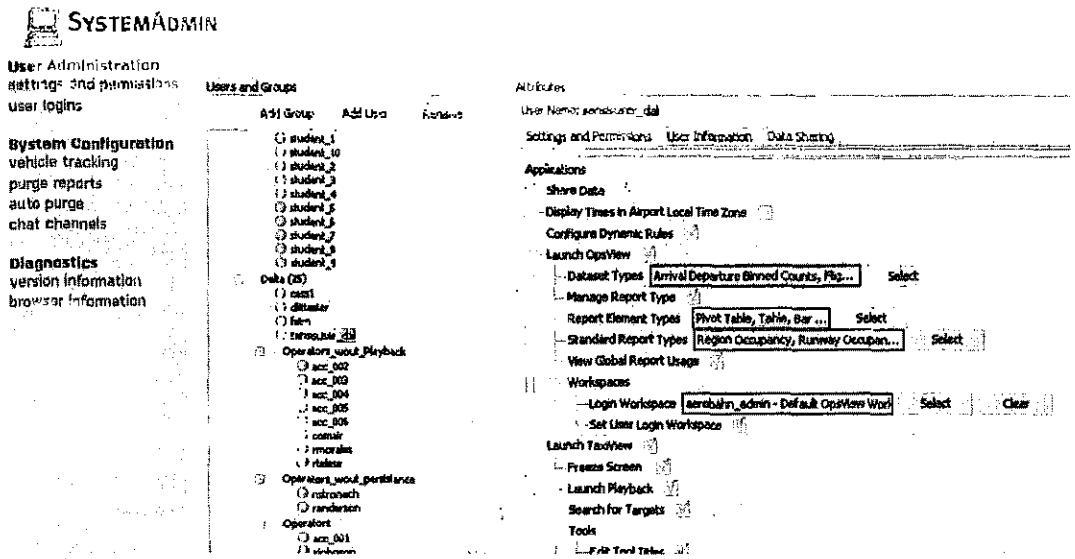


Figure 6 System Admin Interface -- User Information Tab

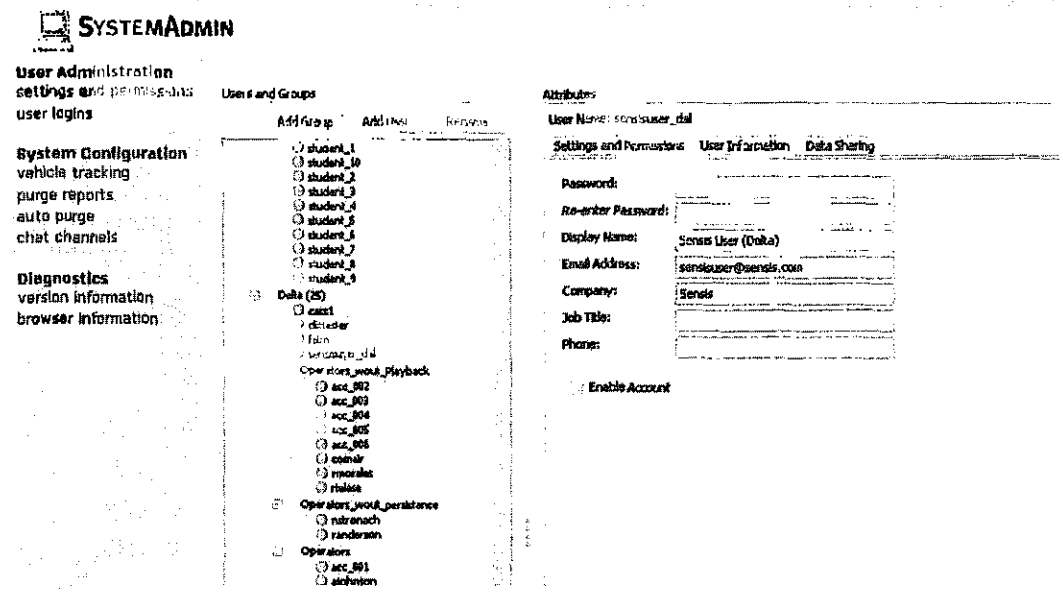
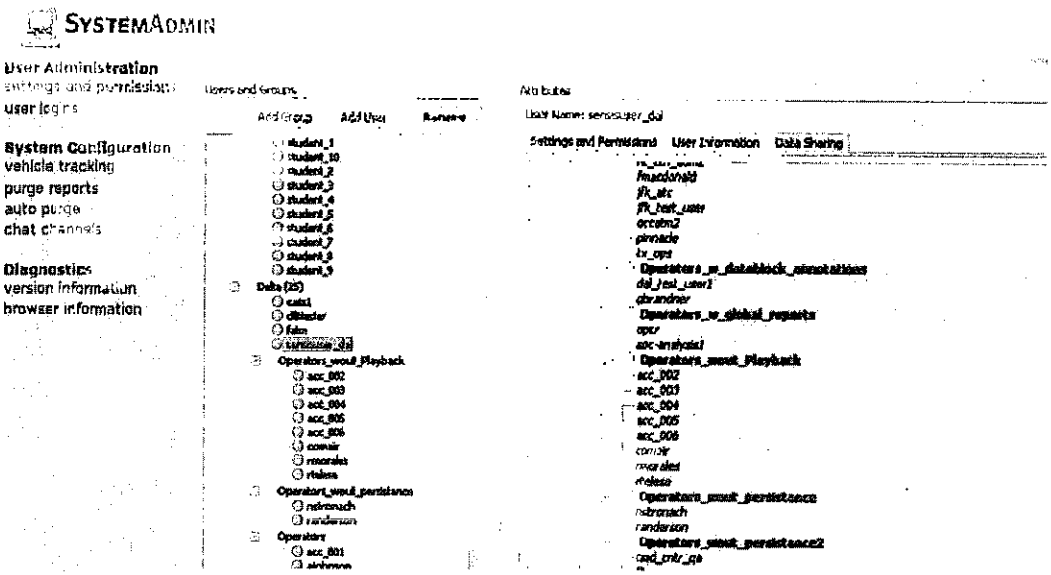


Figure 7 System Admin Interface - Data Sharing Tab



Application administrators may grant or remove permissions for items including, but not limited to, the following:

- Real-time display
- Each individual real-time tool
- Selected options with real-time tools
- Each manual data entry field
- Search Function
- Dynamic Rules
- All Reporting
- Individual reports
- Scheduling of reports
- Data Elements for individual carriers
- Individual data elements
- Data sharing
- Various system administration functions

- Access to flight tracking out to 100 nautical miles

These permissions can be assigned hierarchically by creating, in Sys Admin, groups of users, groups of groups of users, and so on to any level. Then, any permissions assigned to a particular group, flow down to all the groups underneath. Once done, the administrator can also go into each group or sub-group and modify permissions settings to suit the need of the mission. For example, perhaps a group of operators are given permissions to use the real-time display, but with no ability to configure rules or run reports. Every user in the group will receive the same permissions. However, the application administrator can permission one user to be able to create rule for everyone else, and perhaps create a sub-group of operator-analysts with permissions to run reports based on the output of the rules.

In this way, the application administrator may create any number of user access levels by combining individuals with like permissions into groups and customizing the permissions of each group.

Permissions may be assigned by the Sensis application administrator or by a customer application administrator who has been granted limited administration privileges.

1.6.2 Viewing and Modifying Access Permissions

The application software shall provide the capability to allow the Application Administrator to examine, modify and print the list of user access permissions/restrictions and functions associated with each access level and each of the above resources the User can access. This capability shall enable the Application Administrator to change the user access privileges assigned to each access level, and change the permissions/restrictions each User "may"/"may not" access online to the above resources, without requiring a compilation or regeneration of the application software.

Any application administrator can view and modify access permissions on groups and users at the administrator's level and below. Currently there is no built-in print functionality.

This tool is available while the application is running and the new settings take effect the next time the use logs in. There is no need to re-build or even re-start the system (see 1.6.1 for details).

1.7 Application Access Levels

The default user privileges associated with each access level arc defined as follows:

a. Level One — Monitor-Only Airline Data

This level will provide users with read-only access to monitor all airline data and obtain all reports for the airlines they are authorized to have access to. Users with level one access shall not be able to modify any data.

b. Level Two — Monitor-Only Terminal Data

This level will provide users with read-only access to monitor all terminal and ramp area data and obtain all reports that are related to the airport terminal they are authorized to have access to. Users with level two access shall not be able to modify any data.

c. Level Three — Monitor-Only Airport Data

This level will provide users with read-only access to monitor all airport data and obtain all reports that are related to all airlines and terminals at the airport. Users with level three access shall not be able to modify any data.

d. Level Four — Modify Airline Operational Data:

This level will provide authorized users with the ability to modify the operational data for the airlines they are authorized to access but not change any configuration data. Level four users shall have access to all level one functionality.

e. Level Five — Modify Terminal Operational Data

This level will provide authorized users with the ability to modify the operational data for the terminals ramps they are authorized to access but not change any configuration data. Level five users shall have access to all level two functionality.

f. Level Six — Modify Airport Operational Data

This level will provide authorized users with the ability to modify the operational data related to all airlines and terminals at the airport but not change any configuration data. Level six users shall have access to all level three functionality.

g. Level Seven — Flight Tracking Data

This level will provide authorized users with the ability to configure and access the flight tracking software that is provided as part of the Contract. Unlike most other users, once a Level Seven user logs into the System and invokes the flight tracking display, the System shall continually display the flight tracking software, even across staff shift changes, to ensure the continuity of the flight tracking display.

h. Level Eight — Application Administrator

This level will provide authorized users with the ability to administer and maintain the application. Its use is limited to changes that affect the application software, its setup and configuration, but not change any operational data. Level eight users shall have the ability to maintain a list of authorized users and their passwords, access to all Level three functions and to do the following:

i. Make operational adjustments to system thresholds and parameters.

ii. Examine, modify, print database entries and perform all database maintenance functions.

iii. Backup and restore the system configuration, libraries, database.

iv. Maintain user and password controls and application access permissions.

v. Assign User access permissions to terminals, ramp areas and air carriers.

vi. Access and maintain the event log

The ability to individually permission functionality and data makes it possible for the application administrator to create a variety of levels with tailored to fit individual user roles. Specifically, users with permissions matching the eight application access layers requested can be easily created though the Aerobahn SMS Service SystemAdmin tool. See 1.6 for details.

1.8 Event Logging

The System shall record all system activity and maintain the activity log for subsequent reporting. The System shall record all events and changes made by the users. Each record shall contain, at a minimum, the User name, time, date and location from which the event/activity occurred, and include the event or activity performed. The record shall include, but not be limited to the following information:

- *Log in and log out activity by each user,*
- *All events and changes made by the users to operational data,*
- *All changes made to the setup or configuration.*

Description for each change shall include the values of the data both before and after the changes were applied.

While permissions by themselves provide a large amount of control over user activity, Sensis, for the Aerobahn SMS Service release, employs usage tracking to monitor what activities each user performs. Note that this is done both for security reasons and to gain a better understanding of what features our customers find most useful and possibly what features they might not understand.

Monitoring software on each client tracks the following activities for each user:

- Types of reports run and how often
- Tools used and interacted with
- User login/logout time
- Playback usage

The client forwards these events to the server where Aerobahn stores them in the database. At any time, system administrators can extract them from the database for analysis and investigation.

Any manually entered flight data fields will be recorded with the user ID of the responsible user. This data can then be queried after the fact to determine which users modified what fields.

1.9 State of Common Usage

Furnished hardware, equipment, software, database and communications protocols shall be in a "state of common usage," or industry-standard, and shall be an open architecture. Computer software shall consist of all system, application, and utility software required to meet the requirements of this Contract. All off-the-shelf software shall be industry standard. The Contractor shall submit the latest commercially available release/version of all hardware and software products in general use prior to System acceptance and comply with the industry's best practices.

Sensis is furnishing the workstations in the coordination center. These are standard professional grade personal computers loaded with Microsoft Office software and web browsers such as Internet Explorer and Mozilla Firefox.

The hardware and software used to support the Aerobahn service will not be furnished to the Port Authority as it is owned and operated by Sensis Corporation. However, Sensis uses industry standard storage and networking equipment from companies such as Dell, Cisco, and VMWare.

1.10 Graphical User Interface

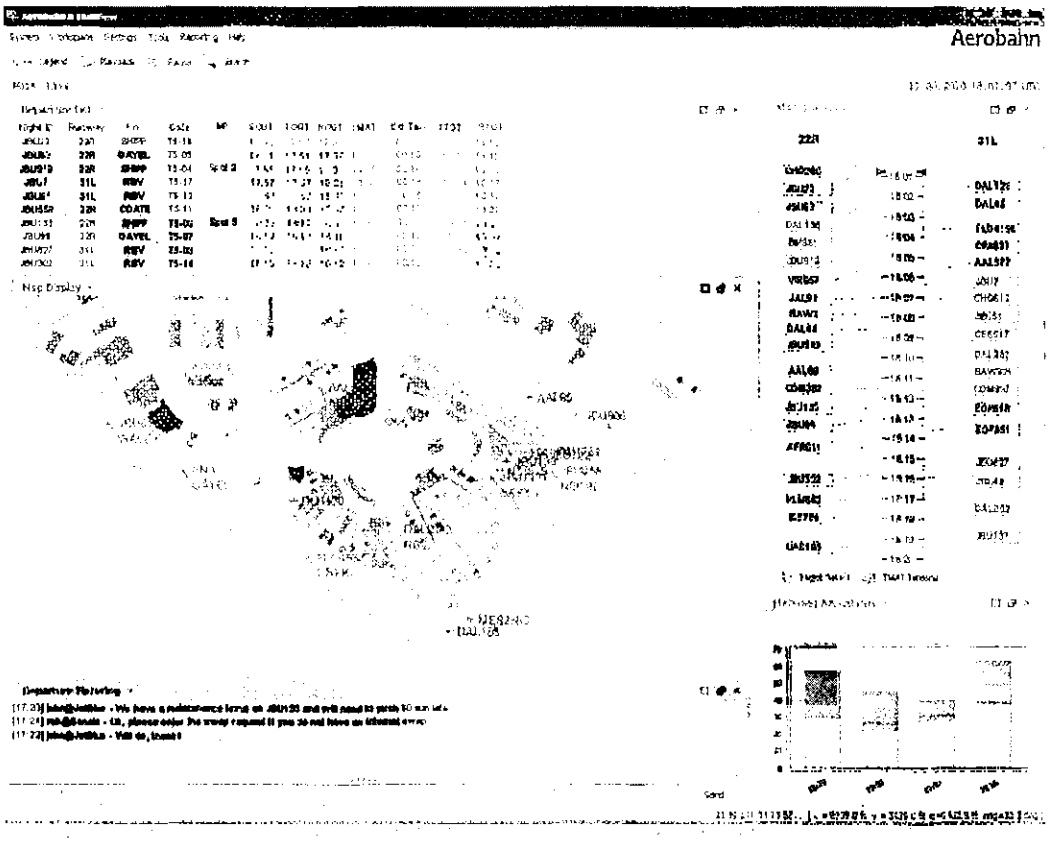
A user-friendly graphical user interface (GUI) shall be furnished that is ergonomically designed to facilitate user operation in an intuitive manner and to minimize operator actions for information retrieval and system operation. The user shall be able to invoke any action or command with no more than three (3) mouse clicks and any additional required data. The user interface shall be designed with streamlined business display screens to facilitate easy data entry and general viewing. Navigation tools/menus/keys shall be prominently displayed and provide consistent, easy movement within and between screens.

All control and reporting features shall have a logical hierarchical arrangement to engage the user through such features as pull-down menus, interactive graphics, dialog boxes, touch screens or other user-friendly means. The user interface shall prompt the operator with instructions or for additional information when user entry is required. The user interface shall not require the operator to memorize command sequences to perform operator controls. Context sensitive help or another form of on-line documentation for all functions and operations shall be provided.

All screen layouts shall be submitted for approval by the Port Authority's Project Manager. The Contractor may request in writing for the Authority to provide any drawings or graphics of the project area that are required for use in developing the system graphics.

Aerobahn has the most user-friendly, intuitive interface of any airport surface management tool on the market today. Over six years of user feedback and continuous improvements have produced an interface comfortable to use and fully responsive to the needs of airport and airline operators.

Figure 8 Aerobahn SMS Service – Conceptual Graphical User Interface



An example of the Graphical User Interface of the Aerobahn SMS Service is shown in Figure 8. Highlights describing the features and usage of the Graphical User Interface are provided in the following paragraphs.

Application menus are arranged at the top of the screen from left to right in order of how deeply into the application they reach. For instance, system and workspace settings can be found towards the left end, and tools and reports are on the right. Real-time tools can be selectively activated depending on the needs of the user. Each tool opens in its own frame and can be resized and positioned on the screen using simple drag-and-drop motions of the mouse. Tools can even be tabbed in layers behind each other to more efficiently use the available workspace. These features enable each user to create a working environment that works best for him or her. A user switches context between tools and reports simply by clicking on the tool he or she wants. Further, the display can be dragged across to fill two monitors when the client system is so configured.

Most features, including workspace and tool configuration, report creation, and manual data entry items can indeed be accessed in three mouse-clicks or less. Features requiring more than three clicks are typically used for in-depth configuration and then only rarely.

The controls and reporting features in Aerobahn are accessed using easy-to-understand dialog boxes and graphical widgets, intuitively labeled, organized and nested, getting more specific as the user goes deeper in, to lead to the desired action. Further, each tool is designed with a consistent look and feel to minimize the learning curve, putting Aerobahn users to work quickly. And, there are no command sequences to memorize.

In the case a user does not find the desired feature easily, Aerobahn features on-line help available at the click of the mouse. The help section is fully web-based, organized hierarchically just like the application itself, with a search feature and links from one section to another to enable the user find the right information quickly.

A detailed description of the graphical user interface is provided in Section F-1-IV – Functional Requirements.

Aerobahn is an existing tool already in use at JFK. Sensis welcomes any suggestions to the interface to improve its usability as we have been taking such comments for over 8 years from our various customers. Concept screens illustrating functionality new for the Aerobahn SMS Service contract are included in this proposal.

To the extent possible Sensis will engage the Port Authority for feedback in the creation of new menus and functions that are relevant to the Port Authority operation.

1.11 Start Up

The System shall automatically execute all site-specific configuration parameters required to start up and enter the operational mode of the application software upon system initialization.

Upon system initialization, the Aerobahn system is configured to start and enter operational mode. The Debian Linux operating system automatically starts the Aerobahn application when the server boots up. Aerobahn reads the site-specific configuration files loaded on the same server and configures itself based on those parameters.

1.12 Orderly Shutdown

The System shall be capable of being shutdown in an orderly fashion and in a manner that causes no anomalies in other subsystem components or software applications and no loss of data. Other subsystem components shall not report multiple errors nor be unavailable for shutdown. Just prior to shutdown, the System shall automatically notify connected Workstations that system shutdown is imminent.

Only authorized users, i.e. Application and System Administrators shall have the capability of shutting down the System.

Debian Linux, the operating system used on the Aerobahn servers, employs shutdown processes based on Unix System V. Thus, the operating system arranges for shutdown of

the various Aerobahn software components in an orderly fashion that causes no anomalies in other subsystem components or software applications and no loss of data.

The system DOES NOT notify connected users that a shutdown is imminent. However, customer support will have sent an email days before the action notifying users it will happen. Note that if a user is logged in and running Aerobahn at the time of shutdown, and the Aerobahn server is restarted before the user closes the client application, it will generally reconnect to the server automatically.

Access to the server and the permission required to shut it down is limited to a small number of Aerobahn site engineers and system administrators. Server access and functional privileges are protected by the operating system password.

1.13 Change Management

The application must be secured and all revision changes shall require prior Port Authority approval. All changes shall be tracked and implemented in accordance with the Authority's approved change management procedure.

Before deploying any new build, the Sensis Contract Manager will coordinate extensively with the central point of contact designated by the Port Authority to negotiate whether or not a new build should be deployed, and when and how it will be deployed.

1.14 System Sizing

The System shall be capable of supporting, at a minimum, the following:

- *1 airport location, supporting, at a minimum, 11 airline terminals*
- *400 concurrent Users on separate, independent Workstations.*
- *3200 Registered Users*
- *Licenses to use the flight tracking software at 15 PANYNJ workstation locations, concurrently.*

The sizing of the Aerobahn service, in terms of airport size, user accounts, simultaneous user logins, and feature permissioning and licensing depends, primarily, on the following factors:

- Server processing power
- Storage capacity
- Communications bandwidth
- User permissions
- Licensing restrictions

Of these, licensing restrictions are handled programmatically as a function of the contract. User permissions are easily configurable.

The remaining three factors are aspects of the system architecture. The current architecture deployed for JFK is capable of supporting the entire airport. Sensis will work with our data center provider to procure and maintain the appropriate level of hardware resources to meet the Aerobahn SMS needs. Currently, the system is limited 175 clients due to storage space and processing power. Storage space over and above the current JFK Aerobahn Service will be procured from the data center provider to allow growth to the 400 clients required. The amount of processing power can be increased by re-configuring the VM to allocate more processors and memory. To support the increased bandwidth requirements (higher number of users and additional data), Sensis will upgrade the existing data communication bandwidth for the VPN connections through the Internet from roughly 5 Mbps to 50 Mbps, which we will support the increase to 400 users.

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1. General System Performance Requirements

1.1 General System Performance Requirements:

For both phases of implementation, the System shall consist of readily available, proven hardware and software elements, which arc fully consistent with the System's design and operation as specified.

It shall have the throughput, capacity, and availability, as specified herein, to provide the required functionality.

It shall meet the performance requirements identified herein and under the maximum loading when all Users, as specified in Section V. M. System Sizing, are connected and interacting with the System and all System devices are engaged and performing their specified functions, with no loss of data or user control.

At a minimum, the System shall:

1. *Update User Workstation displays within 10 seconds of User action/request if Workstation is connected to the Internet through a broadband Internet connection, except for reports or database queries.*

2. *Use a maximum of 50 % of internal random access memory and disk storage in the servers and Workstations.*

3. *Use a maximum of 50 % loading on individual processors under worst case loading when all devices are engaged and all System elements arc in operation.*

4. *Provide the capability for the number of Users, specified in Section V. M. System Sizing, at different Workstations to access the same application concurrently without any degradation of system performance.*

The Aerobahn SMS system to be deployed for this contract will consist of a similar COTS hardware and COTS software platform to that being used for the JFK Aerobahn service today. The differences are that there will be more hardware redundancy, additional and higher speed data communication lines, and the software will be upgraded to support the SMS functionality.

The throughput and capacity will be scaled to support the sizing requirements discussed in Section F-1-V.1.14 – General System Design Requirements. Availability is address in Section 1.2 below.

Regarding responsiveness, as long as the client PC meets the minimum configuration specified by Sensis, any Aerobahn feature will appear less than 10 seconds after being activated by the user. This excludes functionality that needs to query the database, like Reports and Playback.

Sensis plans to meet all these performance criteria without exceeding 50 percent usage of the CPU or 50 percent usage of memory. Though it is conceivable more than 50 percent

of hard drive space will be used, Sensis monitors hard drive space continually and will be able to add more storage long before the system runs out of space.

Sensis intends to comply with all system sizing requirements by purchasing the necessary processing, memory and storage from the data center provider.

1.2 System Availability

The System shall be a redundant, fault tolerant architecture with an availability of 99.99%. The application software furnished and installed by the Contractor shall be designed and built so that the applications software always operates properly on an active server and meet the availability requirement of 99.99%.

During periods of outages, disruption and maintenance, periodic updates shall be emailed to approved Users highlighting the impact to the service. The updates shall include, at a minimum, the following information:

1. Work to be performed

2. Date and Time of Maintenance Activity

3. Anticipated impact on System performance

4. Notification about how the Contractor plans to capture information about the specific activity

5. Timeframe describing the forecasted outage, disruption or maintenance completion time

6. A follow-up message indicating completion of the event and System restoration.

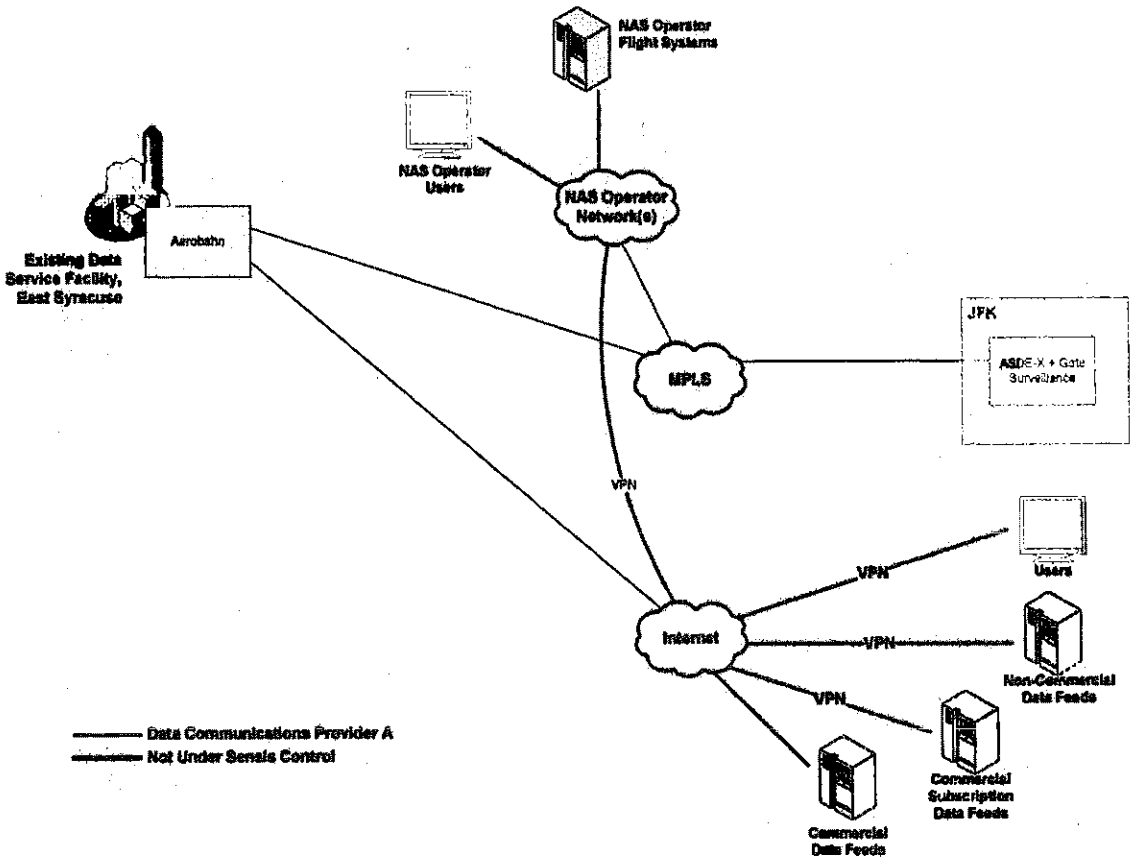
7. A phone number and email address where the User can call or write with questions regarding the activity.

The Sensis Aerobahn system currently deployed at JFK for the Port Authority (Figure 1), since inception, achieved a measured availability of 0.9966 according to the following breakdown:

Aerobahn JFK Service	**5/6/2009**	**Total Hours: 1114708**
	Hrs Downtime	% Availability
Surveillance	1176	0.9989
MPLS (SYR Local Loop)	680	0.9994
MPLS (JFK Local Loop)	1760	0.9984
Software/Server	126	0.9999
Including Surveillance	3742	0.9966
Not including Surveillance	2566	0.9977

- Surveillance refers to the FAA-owned ASDE-X system and Gate Surveillance system. The ASDE-X system is maintained by the FAA according to their service requirements and timelines. Maintenance of the Gate System is controlled by FAA policy (the gate augmentation system was purchased as a demonstration system) with access restricted to Monday through Friday, 8 a.m. to 5 p.m. In spite of these restrictions and limitations, Sensis is proud to have achieved such a high level of reliability.
- MPLS (SYR Local Loop) refers to the local communications connection between the Sensis data center and the Multiprotocol Label Switching (MPLS) network. The MPLS network itself is internally redundant for high availability.
- MPLS (JFK Local Loop) refers to the local communications connections between the JFK ASDE-X surveillance system and the Multiprotocol Label Switching (MPLS) network.
- Software/Server refers to the hardware and software configuration at the Sensis data center.

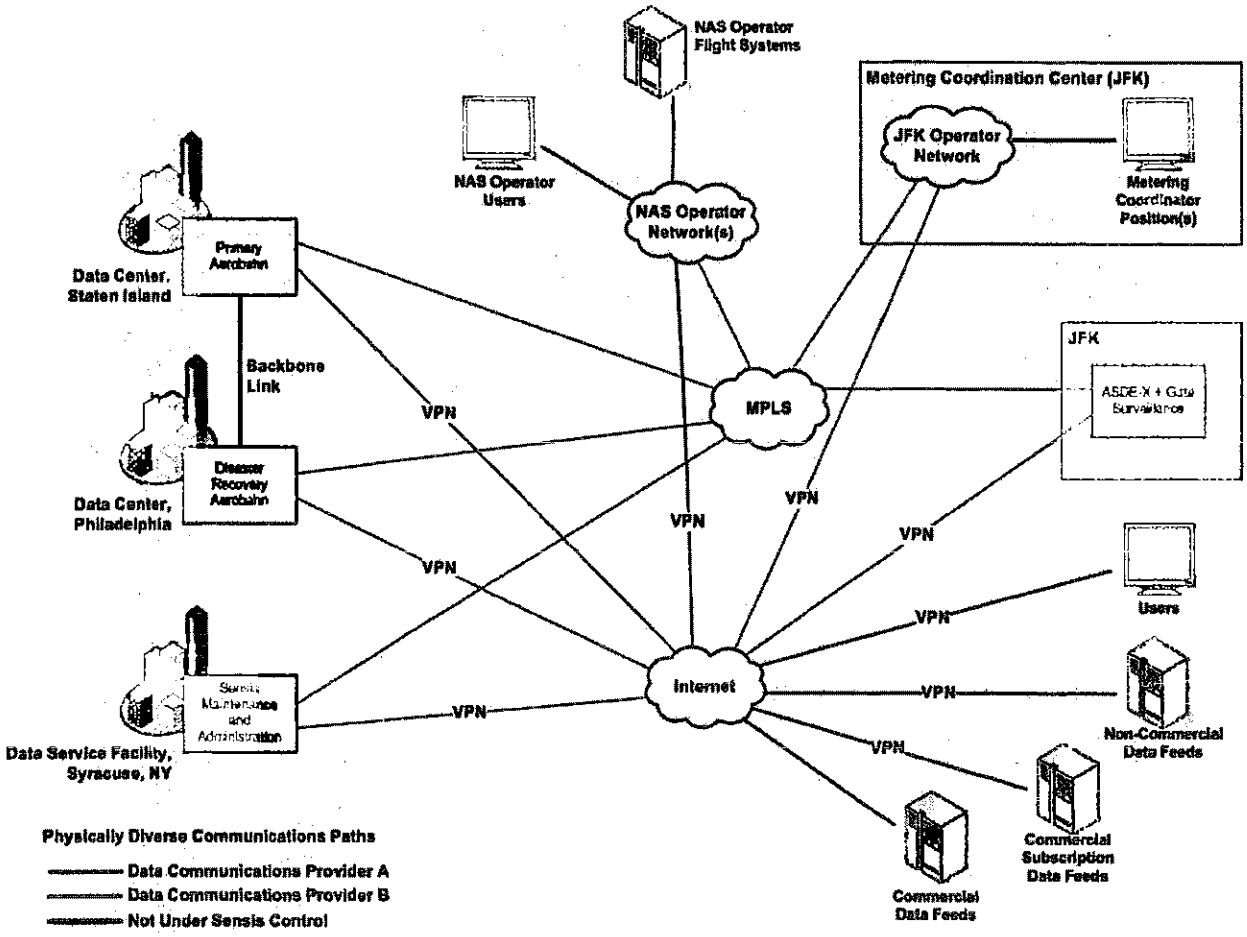
Figure 1 Currently Deployed JFK Aerobahn System Architecture



Sensis proposes the following to increase availability to at least 0.9999:

1. The commercial communication links are a major source of outage. These are under the control of Sensis. Thus, they will be upgraded making them both redundant and physically diverse. This will be achieved by providing an alternate VPN communications path through the Internet. The upgraded architecture with redundant communications would is illustrated in Figure 2.

Figure 2 JFK Aerobahn System Architecture with Redundant MPLS Local Connections



2. While the surveillance availability is not under Sensis control, and is therefore not part of the availability requirement, in the interest of improving overall system availability, Sensis recommends working with Sensis and the FAA to upgrade the ASDE-X Gate Augmentation Surveillance to a fully redundant production ready configuration.

3. Finally, Sensis will provide a geographically diverse second data center for disaster recovery. See System Architecture in Section F-1-V – General System Design Requirements for details. Note that 0.9999 percent availability is achieved even without the second data center.

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1. Users and Training

Sensis is uniquely equipped to satisfy the training needs for the Surface Management System at JFK. Since 2003, we have been installing and supporting Aerobahn systems in the US. In 2008, Sensis began providing Aerobahn training to the airline users at JFK. Since then, Sensis has conducted Initial Training, Refresher Training, Power-User Training and Upgrade Training courses and has trained more than 250 Port Authority and airline personnel, combined. Sensis surveys training participants to evaluate their responses to trainers, training materials, course content, etc. Collected surveys indicate that the overall satisfaction rating for Aerobahn training at JFK exceeds 90 percent.

A large base of experienced Aerobahn users means a training efficiency and cost savings advantage for the Surface Management project. With the Sensis solution, each group of users will be trained specifically for the system features and functions that are new to them. For example, new users with no Aerobahn experience will take the Online Introduction to Aerobahn and the Phase A Aerobahn Basic User's Training – while those 250 or more experienced users can bypass these introductory courses.

Sensis has multiple Aerobahn trainers, technical personnel, and project managers who are experienced with both the systems and the people at JFK. This provides Sensis with a unique understanding of the JFK airspace and the challenges that both Port Authority and airline staff face as they perform their various job functions.

In addition to the training program we are proposing, Sensis provides expertise in technical support, customer service, and Aerobahn project management. This expertise will benefit the Port Authority throughout the Surface Management System implementation.

1.1 Aerobahn Training Methodology

VII. Users and Training

VII. A. Types and Quantity

VII. The Authority currently has operational, supervisory and administrative staff that will use the application. Training shall be provided for up to 50 staff in all Port Authority facilities and up to 300 representatives of the various air carriers who will be using this system staff in accordance with the requirements of this section. The Contractor shall provide training for training of Users both who work at Port Authority facilities and training, using a separate methodology, for Users who do not physically work at Port Authority facilities.

VII. B. Training

VII. The Contractor shall provide operation and administrative training for the entire System to designated Authority personnel and representatives of the airline industry at several Authority facilities to be determined by the Port Authority's Project Manager, through the means of practical demonstrations, seminars and other related technical teaching procedures. Training

shall also be provided to airline staff working for the air carriers in locations off Port Authority facilities. The training program shall be implemented with formal classroom training and/or other forms of presentation as recommended by the Contractor. The curriculum shall be designed so that each group of trainees shall be trained in the full repertoire of system commands that they may have to use in the course of performing their designated functions. Students shall be provided with complete sets of training materials during the training sessions, which they shall retain for use on the job at the completion of training. Training shall be conducted on-site at the designated Airport facilities, and off-site for air carrier representatives who do not work at Port Authority facilities, in accordance with the approved training plan and methodology. Separate training classes shall be provided for each phase of implementation.

The training solution we propose includes a blended instructional approach that integrates e-learning, instructor-led courses, hands-on practice, on-site coaching, and refresher training to reinforce current skills and to offer instruction in new Aerobahn features. Instruction is modular in nature and is therefore simple to customize for different administrative, supervisory, and operational training groups who use Aerobahn technology.

Within this instructional framework, Sensis has developed a phased approach to training that provides effective development of both broad and job-specific competencies:

1. Online Introduction to Aerobahn
2. Phase A Aerobahn Basic User's Training
3. Phase A Metering Training
4. Phase B Metering Training
5. Phase B Aerobahn Upgrade Training

These courses—discussed in more detail below— provide a comprehensive training program that accommodates the 50 Port Authority and 350 airline carrier personnel specified in the Scope of Work. These courses allow Aerobahn users with different levels of experience and various job duties to learn the system commands and develop the system skills needed to perform their job functions capably.

To make the training as efficient and convenient as possible, Sensis proposes using the training lab already set up at PA Bldg 14. If it is not practical for all personnel to be trained at PA Bldg 14, Sensis will work with the Port Authority to find a suitable location for training or design a remote training program using some combination of online learning and a WebEx meeting format.

1.1.1 Phase A and Phase B Training

VII. For each implementation phase, the Contractor shall conduct two (2) independent sets of training sessions for appropriate users at each Airport at the scheduled times and locations designated by the Port Authority's Project Manager and consistent with the

approved training plan. Additional training courses shall be provided to the air carrier representatives in accordance with the approved training methodology.

Sensis will conduct Phase A and Phase B training courses, as described above, at the locations designated by the Port Authority's Project Manager. Course details, schedule, and training and testing methodology will be detailed in the Training Plan.

1.1.2 Training Time Constraints

VII. C. Training Time Constraints

VII. The Contractor shall complete all training on-site prior to the commencement of the 14-Day Operational Test.

A preliminary training schedule is outlined Figure 1. Sensis will work with the Port Authority project manager to set up a detailed on-site training schedule. This schedule will be documented in the Training Plan. All on-site training will be completed prior to the 14-day operational test.

Figure 1 Preliminary Training Schedule

Course	Phase	Details	Timing
Online Introduction to Aerobahn	A	Online/independent study. New users only.	Beginning of December 2011
Phase A Aerobahn Basic User's Training	A	Site training – new users only.	December 2011, after online training complete.
Phase A Metering Training	A	Site training – metering personnel only. Must have basic training.	Mid to Late December 2011.
N/A	A	Training Coaches at site	Mid-January 2012
Aerobahn Upgrade Training	B	All users.	Late May 2012
Phase B Metering Training	B	Metering personnel only.	June 2012
N/A	B	Training Coaches at site	Mid-July 2012
Refresher Training		On request	TBD

1.2 Aerobahn Training Courses

VII. 1. Training Schedule

VII. The Contractor shall conduct two complete set of training sessions to coincide with each phase of the project implementation. Each set of training sessions shall educate the Users on the features and functions that are placed into production with each of the two project implementation phases.

The Aerobahn training courses described here are designed to develop targeted skills and concepts for specific learner groups. The Port Authority, in consultation with Sensis, will designate which trainees attend which courses based on their current experience and job responsibilities.

1. **Online Introduction to Aerobahn.** This e-learning course provides an overview of Aerobahn functions, screens, commands, and tools. It is a one-hour course that new users complete before attending in-person Phase A and Phase B training. The course orients learners to Aerobahn technology and gives them a head-start on formal instruction.

2. **Phase A Aerobahn Basic User's Training**. This training course provides brand-new Aerobahn users (*no prior Aerobahn experience)*, with 4 hours of instructor-led, hands-on training. During this introductory course, students will learn how to:

   - Access their Aerobahn service
   - Launch and use workspaces
   - Work with real-time tools
   - Access SystemAdmin and Reporting functions
   - Use the online Help system to build personal Quick Reference Guides

   As noted in the example above, there are many experienced Aerobahn users at JFK, Sensis suggests that both the Online Introduction to Aerobahn and the Phase A Aerobahn Basic User's Training course be required only for personnel who have never used the service before. By offering this entry-level course to only the new user subset of trainees, the Port Authority will save both time and money.

3. **Phase A Metering Training.** This 2-hour course will accommodate airline, airport and Port Authority personnel actively involved in departure metering. As a prerequisite to this course, all students are required to take the Phase A Aerobahn Basic User's Training. During the metering course, students will learn to:

   - Navigate the departure metering interface
   - Understand flight allocations based on a "time bucket" concept
   - Adjust flights between their own allocations
   - Communicate with the departure metering desk to resolve flight allocation conflicts

4. **Phase B Metering Training.** This 2-hour course will accommodate airline, airport and Port Authority personnel actively involved in departure metering. As a prerequisite to this course, all students are required to take the Phase A Aerobahn Basic User's Training. During the metering course, students will learn to:
   - Navigate the departure metering interface
   - Understand flight allocations based on specific Call for Taxi (CFT) time concept
   - Adjust flights between their own allocations
   - Communicate with the departure metering desk to resolve flight allocation conflicts
5. **Phase B Aerobahn Upgrade Training**. This 4-hour course will teach Port Authority and airline personnel about the newest features and functions available to them. As a prerequisite to this class, all students must successfully complete the Phase A Aerobahn Basic User's Training. During the Upgrade Training, students will learn about:
   - Basic metering functionality (a summary only)
   - New playback with audio function
   - Enhanced real-time tools
   - New reporting features
   - When and how use the chat function

In order to efficiently train all 350 users, Sensis will use a combined approach to this training – offering both user-group sessions and an instructor-led remote option via WebEx or similar training technology. This approach allows users to choose the training method that is most suited to their needs.

1.2.1 Training Reports

VII. Upon completion of each training program, the Contractor shall prepare and submit to the Port Authority's Project Manager a training report that shall summarize the results of the training program, including a list of attendees and individual test results, course evaluation forms, and recommendations for follow-up training or modifications to the curriculum.

At the conclusion of each phase, Sensis will submit a Training Report to the Port Authority Project Manager. The Training Report will include a list of trainees and their test results, course evaluation forms, and suggested modifications to make the Aerobahn training more effective. Using the Training Report, as well as other means, Sensis will work with the Port Authority to ensure that all training objectives are met and that all

students have developed the Aerobahn skills and concepts that are central to their job performance.

1.3 On-Site Training Coach

VII. 2. Training Coach

VII. Contractor shall provide an on-site coach to work at each of the 9 terminal facilities to work directly with the terminal operators and coach them in the use of the system. Coaching shall be conducted concurrently at each terminal facility for a minimum of three days and provide coverage for each of the two (2) operational shifts. The time and dates for coaching the terminal operations staff shall be coordinated with each terminal manager and be conducted subsequent to implementation of the System at each terminal.

Sensis will provide training coaches who provide on-the-job support for each of the nine terminal facilities. Each terminal facility will receive coaching support for a minimum of three days.

Aerobahn coaches will cover each of the two operational shifts to ensure that all personnel are oriented to the Aerobahn system and are using it effectively. This coaching support provides trainees with a smooth transition from instruction to on-the-job use of Aerobahn and offers the opportunity to ask questions and reinforce newly developed Aerobahn skills and knowledge.

As a cost-saving option, the Port Authority can take advantage of the experienced Aerobahn users already existing within the JFK community. Sensis can provide fewer coaches, while working side-by-side with Port Authority or Airline-provided coaches during the three-day period after implementation.

1.4 Refresher Training

X. I. Training

X. The Contractor shall provide supplemental on-site refresher training twice a year, when requested by the Port Authority, using the training material already provided, for approximately 100 hours each 6 months. Refresher training shall also be provided to Users working in the airline industry in accordance with the approved training plan for off-site users. Payment for refresher training shall be separated from the overall maintenance costs (see Attachment D, Cost proposal Form)

Sensis has been providing Refresher Training at all of our Aerobahn installations since 2003. In the past year, we have conducted more that 10 sessions of refresher training at JFK alone, at the convenience of the users.

Sensis will provide refresher training on the Aerobahn service under supplemental services as requested by the Port. We suggest two formats to accommodate various users at the Port Authority site and those located elsewhere.

1. Refresher training held in a user-group meeting format, for up to 20 students at a time. User-group meetings are currently held in a conference room provided by the Port Authority and we request using the same location.
2. Refresher training sessions offered through WebEx sessions that trainees can attend at their own work area.

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1. Acceptance and Testing

VIII. *Acceptance and Testing*

VIII. *A. System Inspection & Tests*

1.1 System Test and Evaluation

Aerobahn undergoes a rigorous Test and Evaluation process to verify the system delivered meets the requirements of its Customers.

The Sensis Test and Evaluation process is designed to ensure the high-level of quality and Customer satisfaction expected from a leading global supplier of Aerobahn Systems. The test process is regulated by Sensis Quality Assurance personnel and a set of Standard Operating Procedures to maintain Sensis Quality standards. Following these Standard Operating Procedures has earned Sensis ISO-9001-2008 certification and helps achieve the highest Customer satisfaction possible.

1.1.1 Fully-tested Aerobahn Product

The Aerobahn Product, the basis of the current JFK Aerobahn Service, is a fully-tested and integrated product, reducing risk and cost to the program.

Product testing is performed independent of Customer programs and is governed by Sensis Standard Operating Procedures (SOPs) under Quality Assurance oversight. As the product is upgraded, Sensis internally performs thorough product acceptance testing of the modifications and performs a thorough regression test on the entire product to ensure its integrity remains intact through the modifications.

When Sensis is contracted to provide Aerobahn to a Customer, the latest software release version is obtained from Configuration Management (CM) and deployed to the Customer's server. Sensis then performs verification of the Customer's requirements using this software release.

1.1.2 The Port Authority Software Releases

A software release will be created for Phase A. Following Sensis internal integration and testing, the Customer System Inspection and Test will be conducted and once the release is approved by the Port Authority, the release will be installed on the Aerobahn SMS Service production server. The same process will be followed for the Phase B release.

1.2 Test Process

Verification activities are governed by Sensis Operating Procedure 4.103 (Test) which describes creation and review of test procedures, configuration management of the testing activities, and conduct of test readiness reviews, test execution, and submission of test reports.

1.2.1 Test Documentation

1.2.1.1 Verification Requirements Traceability Matrix (VRTM)

A VRTM is generated containing testable Customer requirements and a method of verification for each. The VRTM is used to track the verification of the requirements throughout the life of the project. A VRTM will be included with the distribution of the Acceptance Test Plan, providing the phase and test event (PAT or AT) when each requirement will be tested.

The following Verification Methods are used in the VRTM:

A – (Analysis) Qualification by analysis involves proving that an item meets specified requirements by a technical evaluation of equations, mathematical derivations, simulations, charts, graphs, diagrams, representative data, or significant calculations with measured test data and/or technical data of similar component units.

D – (Demonstration) - Qualification by demonstration involves the operation, movement, or adjustment of an item or performance of a function. Performance monitoring may define quantitative limits for acceptable operation. Data recording is recommended but not essential.

I – (Inspection) Qualification by inspection involves determination of inherent or physical characteristics by the use of sight, touch, smell, and hearing as appropriate or by the examination of documentation such as drawings, specifications, or design disclosures. Inspection is generally non-destructive and does not require the use of precision measurement equipment.

R – (Review) Qualification by review involves the use of a presentation, discussion, and/or review of design information such as theoretical calculations, engineering evaluations, algorithms, techniques, processes, simulations, and/or other data. Design information may originate from existing product design material, white papers, formal Design Reviews, or other design decision meetings.

T – (Test) - Qualification by test involves the operation of an item or performance of a function which requires evaluation of quantitative data resulting from instrumentation or recorded observations. Acceptability is determined by comparison of the data with pre-established quantitative values and tolerances.

1.2.1.2 Acceptance Test Procedures

VIII. C. Submittal Requirements for Testing

VIII. 1. An Acceptance Test Plan shall be submitted to the Port Authority's Project Manager for approval not less than 21 days prior to the proposed start of the System Inspection and Test and shall include, at a minimum, the following details:

VIII. a. A summary statement of the purpose and goal of each portion of the test plan.

VIII. b. The method of testing. A description of the overall test environment including block diagrams showing the total test environment, relevant equipment interconnection and test equipment hookup.

VIII. c. Hardware and software used for the test.

VIII. d. Detailed test procedures that demonstrate that every feature and function to be provided in the furnished hardware and software conforms to the requirements of the Contract.

VIII. 2. Identify the:

VIII. a. Steps for each test to be performed

VIII. b. Test purpose

VIII. c. Conditions which exist at the start of each test procedure

VIII. d. Conditions/results expected at the conclusion of each test procedure

VIII. e. The specification requirement that will be demonstrated by the test procedure.

VIII. 3. Include space for recording the following:

VIII. a. the actual test results

VIII. b. check boxes for the test outcome (pass or fail)

VIII. c. dated signatures of both the person performing the test and the Authority's authorized (witness) representative, and

At least three weeks prior to the start of testing, Sensis will provide Customer personnel with Acceptance Test Procedures for review and approval. They are comprised of a set of test cases, each of which includes the following information:

- Purpose and goal of each test
- Description and diagram of the test environment, including equipment interconnection descriptions and required test equipment
- Hardware and software descriptions
- Prerequisites for each test conduct
- Test scenario descriptions
- Sequential procedural steps describing actions to be executed and measurements to be taken

- Cross-references to the relevant requirements for each verification step
- Pass or fail criteria (expected results and tolerances)
- Space to record test outcomes, i.e., observed results/measurements and pass/fail disposition based on comparison of observed to expected results.
- Test Results page for each test procedure to record the dated signatures of the Sensis Test RI and the Port Authority's authorized witness.

The procedural steps are written to be understandable, unambiguous, and comprehensive to ensure that testing is adequate, traceable, and repeatable. Per Sensis Standard Operating Procedures, to ensure quality, all test documentation undergoes internal review prior to Customer delivery.

1.2.1.3 Acceptance Test Report

VIII. d. Comments of the test witness (es).

At the conclusion of each test event, Sensis generates an Acceptance Test Report which contains the following information:

- Test administration (identification, date, time, Sensis and Customer participants)
- Hardware identification (Product Configuration Document listing equipment under test)
- Software identification (Delivery Request listing CSCIs under test)
- Test Support Hardware and Software Identification
- Detailed test result summary covering each requirement under test
- Action Items
- Problem Reports created or observed during test
- As-Run Procedures signed by Sensis and Customer representatives
- Test Log including any comments from test witnesses
- Test Output File listing

1.3 System Inspection and Test

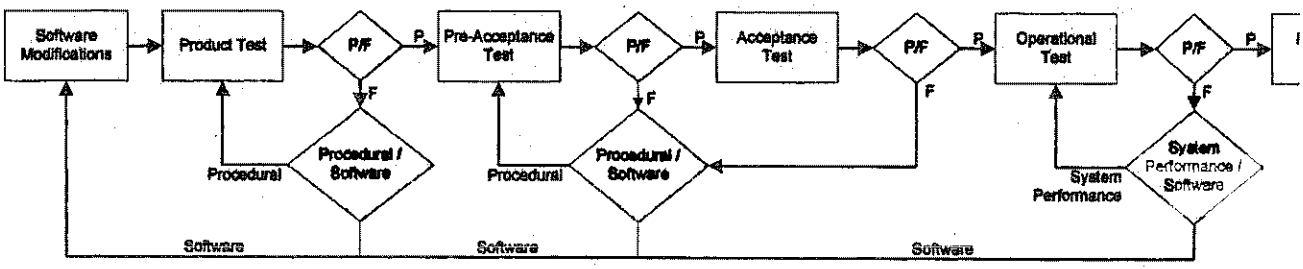
System Inspection and Test consists of three phases, Product Acceptance Test (PAT), Acceptance Test (AT) and Operational Test (OT). In order to focus the Acceptance Test on site-dependent operational use functionality, the PAT event is used to provide a comprehensive verification and validation test of site-independent functionality in a

controlled laboratory environment in order to maximize confidence in the system's capabilities.

1.3.1 Overview

Figure 1 below provides an overview of the test process. Each step of the process is described in detail in this section.

Figure 1 Test Process



1.3.2 Product Acceptance Test

VIII. 4. Each item of the System shall be tested in its entirety with the use of simulated inputs and simulated outputs, additional processors, or control equipment, shall only be used in the event that conditions cannot be replicated or to demonstrate requirements for future capabilities or expansion.

As a standard element of the Sensis development process, Sensis performs a PAT on each software build, prior to release. Product level testing is a comprehensive regression test of all system components to identify problems prior to the customer-witnessed test. The scripted testing approach using test scenario files of actual airport data will be utilized to verify expected results. The use of simulated inputs will be limited to capacity and system performance tests.

Sensis engineers execute the Tests in accordance with established test procedures under configuration control. A test log is kept during the execution of PAT to report progress and any anomalies observed. Sensis Quality Assurance personnel monitor the test conduct to ensure activities are consistent with standards. An Acceptance Test Report is prepared, approved and entered into CM for every PAT event, to provide a historical record of the test event. While PAT, as a contract-independent event, is not expected to be customer-witnessed, the Acceptance Test Report can be provided to any customer receiving the build under test.

Sensis PAT covers the following functionality and features:

- Surveillance and Tracking

- Service Access and Security
- Adaptation
- Target Display
- Data Feeds
- Tools
- Playback
- Dynamic Rules and Alerting
- Predictive Capabilities
- Reporting
- Capacity
- System Performance
- Data Backup and Restoration
- Primary Server Failover

1.3.2.1 PAT Acceptance

Following the satisfactory completion of the PAT testing, the software is archived into the Configuration Management system, to be available for future customer deliveries.

1.3.3 Acceptance Test

VIII. 3. Testing shall be conducted with all devices and components integrated as a System with use of simulation expressly limited to perform stress and performance testing. Testing shall demonstrate proper System operation in the fully integrated environment to validate the intended function and performance of all field devices and infrastructure components function in accordance with the Contract requirements and operate as a fully integrated system.

Sensis performs an Acceptance Test (AT) to verify that the customization of the Aerobahn service for a specific customer has been completed and that the Service is functional in the operational environment, according to the customer requirements. Appointed Customer representatives are expected to witness test conduct in support of the Customer's completion of an Acceptance Test Completion Letter.

1.3.3.1 Requirements and Performance Test

VIII. 7. The Inspection and Tests shall be conducted in their entirety in order to demonstrate that every feature and function of the hardware, software, firmware and network

components of the System is fully integrated and is in conformance with the Contract documents. Testing shall demonstrate end-to-end connectivity and full functionality of all System components. Testing shall include a stress test to demonstrate that the System meets the performance requirements when processing all devices in the final system configuration. Simulated inputs may be used to demonstrate that the full processing load can be achieved.

VIII. 8. The Contractor shall demonstrate that the automatic failover from the primary server(s) to the secondary (backup) server(s) and the complete restoration of the primary server(s) subsequent to the failover operates successfully.

VIII. 9. The Contractor shall demonstrate that Users can access all features of and control the System from a minimum of sixteen (16) User Workstations simultaneously, at least 8 of which shall be remotely connected to the System through an Internet connection.

Aerobahn testing is performed using approved procedures to provide compliance to specific Customer requirements. The focus of the Port Authority AT will be a high level validation of the accuracy, completeness and performance of the entire Aerobahn system, paying particular attention to operational use functionality. A scripted testing approach using live JFK data will be utilized. The use of simulated inputs will be limited to capacity and system performance tests. The Port Authority testing will cover the following service availability functionality and features:

- Capacity / Full Processing Load
- Daily Summaries
- Data Backup and Restoration
- Departure Metering
- Playback
- Predictive Capabilities
- Primary Server Failover
- Reporting – Departure Delay, Arrival Delay, Metering Location Usage
- Simultaneous System Use by 16 Users
- Sizing
- System Access to Geographically Dispersed Users
- System Performance
- Target Display
- User Workstation Page Display Within Required Limits
- Weather Data

1.3.3.2 Dry Runs and Formalization of Acceptance Test Procedures

VIII. 1. A pre-acceptance test shall be conducted by the Contractor in advance of the formal acceptance test, using the Inspection and Test procedures approved by the Port Authority's Project Manager to demonstrate that the system is ready for the formal acceptance test that will be witnessed by the Port Authority's Project Manager.

Once a test environment has been assembled and a preliminary software build has been created, dry runs of the test procedures can begin, to ensure the completeness and usability of the procedures and the system. When the test procedure document is considered suitable for release, it is entered into CM and delivered to the Customer. If necessary, a face-to-face meeting or teleconference is held with the Customer to discuss the document. Once agreement has been reached on how to address any comments that are received, the procedures are updated and re-dry run as appropriate prior to resubmission for approval.

1.3.3.3 Pre-Acceptance Test

VIII. 6. Certification that the System passed pre-acceptance tests using the approved test procedure and a copy of the pre-acceptance test report indicating the results shall be submitted to the Port Authority's Project Manager for approval, not less than ten (10) calendar days prior to the scheduled start of the System Inspection and Test.

When the Acceptance Test document is finalized and entered into CM, Sensis will conduct a pre-acceptance test which will be verified by the Sensis quality assurance organization. The results of the pre-acceptance tests will be submitted to the Port Authority for approval, in the form of a Pre-Acceptance Test Report. The Pre-Acceptance Test Report will be submitted not less than 10 calendar days prior to the start of the Acceptance Test. Customer approval of the Acceptance Test Report forms the basis for the Test Readiness Review.

1.3.3.4 Test Readiness Review

VIII. The Contractor shall notify the Port Authority's Project Manager that it is ready to schedule a System Inspection and Test of the System. The Port Authority's Project Manager has the right to include not more than two additional Port Authority professionals, who have been deemed the technical and operational experts to assist in witnessing the System Inspection and Tests.

VIII. A request to conduct the test shall be submitted to the Port Authority's Project Manager for approval, not less than 21 calendar days prior to the proposed start of the test. The request shall include the estimated length of time required to complete the testing and shall include an agenda that identifies when each of the tests are scheduled to be conducted. The Contractor shall also submit draft copies of all user manuals to enable test participants to become familiar with the System's operation.

A Sensis Test Review Board (TRB) pre-test meeting is held to review readiness for AT events. Test Readiness is determined by the completion of integration, successful

completion and Port Authority approval of the Pre-Acceptance Test and configuration control of all relevant documentation and test inputs. The Product Configuration Document (PCD) is provided, which identifies serial numbers of all hardware and software. All equipment, including test equipment, and applicable documentation, including draft copies of the user manual are available for inspection, review, and use.

When it is deemed the system is ready for test, Sensis will notify the Port Authority's Project Manager that the System Inspection and Test is ready to be scheduled and provide a proposed agenda. The request will be made not less than 21 calendar days prior to the proposed start date. Dates, participants and a location for the test event will be finalized at this time.

1.3.3.5 AT Execution

VIII. After the Contractor completes the development, internal testing and configuration of its application to meet the contract requirements, the System shall be formally tested in its entirety at a location approved by the Port Authority for each phase of the project implementation. Therefore, the Contractor shall conduct two complete sets of System Inspection and Test of the System to coincide with each phase of the project implementation.

VIII. Since the System will be operational and in a production environment subsequent to the initial implementation, the Contractor shall propose a methodology, for Port Authority approval, for testing the features and functions implemented for the second phase of the project without disrupting the operation of the on-line production System.

VIII. 2. Testing shall be performed by the Contractor and witnessed by the Port Authority's Project Manager using test procedures submitted by the Contractor and approved by the Port Authority.

VIII. S. The success (pass) or failure of each test and any detailed test results will be recorded by the Port Authority's Project Manager's designated representative.

VIII. 6. All hardware, software, network, equipment, external connectivity, licenses and labor required for the test shall be furnished by the Contractor.

An Acceptance Test will be conducted at a Port Authority approved location for each phase (A and B) of the project implementation. To avoid disrupting the production system, a shadow server located in the Sensis Data Service Facility (DSF), will be used for each phase of testing. The shadow server is a replica of the production server. All equipment that is required for AT, except personal computers of the Port Authority's users will be furnished by Sensis. Sensis will require the assistance of Port Authority users to conduct some of the test procedures, such as those requiring system access by geographically dispersed users or simultaneous system use by 16 users. Expectations for customer participation will be detailed in the Acceptance Test Procedures.

Tests will be executed in accordance with the established test procedures under configuration control. A test log is kept during the execution of the AT to report progress and any anomalies observed. The test outcome (Pass / Fail) will be recorded for each Expected Result and an overall Test Result (Pass / Fail) will be recorded for each Test

Procedure. Customer witnesses will observe and validate the running and outcome of each test by signing the Test Results form.

1.3.3.6 Security Policies

VIII. 13. Prior to the conclusion of the test, submit to the Port Authority's Project Manager an internationally recognized certification conforming to SAS-70 Level 2, or approved equivalent, that the security policies and practices employed in the System configuration, setup and operation provide the protections stated in Attachment C, Section V, B (Data Security) and C (System Architecture).

Subsequent to contract award, a copy of the SAS-70 Level 2 audit results will be provided to the Port Authority. See Section F-1-V-1.2 for details on the security policies and practices employed in the Aerobahn system.

1.3.3.7 Test Debrief

The Sensis TRB is convened for Test Debrief at the conclusion of AT to confirm acceptance of the release and to discuss any observations and issues that require additional action. Any deficiencies are identified and if necessary, a regression plan to correct them is established.

1.3.3.8 AT Acceptance

VIII. 10. In the event of a test failure, the Contractor shall make all repairs or modifications required for passing the test. The failed test shall be repeated until the results are satisfactory to the Port Authority's Project Manager. Any subsequent planned tests that, in the opinion of the Port Authority's Project Manager, are dependent on the satisfactory passing of the failed test shall not be performed until the failed test is repeated and has satisfactorily passed. To demonstrate a satisfactory resolution of a failed test, the Port Authority's Project Manager may require that the Contractor perform additional tests. These additional tests shall be made at the expense of the Contractor.

VIII. 11. If, in the opinion of the Port Authority's Project Manager, there are an excessive number of failed tests, the System Inspection and Test shall be halted and the Contractor shall repeat all or part of the Inspection and Test, at the discretion of the Port Authority's Project Manager, at a later date.

VIII. 12. Should it be necessary for the Port Authority's Project Manager to attend more than one System Inspection and Testing session due to Contractor delays, product failure, failure to pass approved testing procedures, inability to complete the test in the scheduled time period or failure to implement approved testing procedures, the Contractor shall bear all costs incurred by the Port Authority for each additional test session where up to two (2) Port Authority representatives may attend. Such costs for Port Authority representatives for each additional Inspection and Test session will be deducted from the Contractor's compensation.

VIII. 14. At the conclusion of the test, submit to the Port Authority's Project Manager an acceptance test report for the purpose of verifying and validating the accuracy and integrity of the System as installed. The Port Authority's Project Manager will review the report and

respond; indicating approval or noting changes required either in the performance of the Work or in the report. The Contractor shall make all changes and perform such necessary Work as the Port Authority's Project Manager may direct prior to the start of the 14-Day Operational Test.

VIII. 15. Neither the witnessing of a test by the Port Authority's Project Manager, or the waiving of a right to witness a test shall relieve the Contractor of the responsibility of furnishing the System that is in compliance with the Contract requirements. The witnessing of any tests by the Port Authority's Project Manager's designated representative, or the approval for shipment of System shall not be deemed as acceptance of the System, the associated control, electronics and communications equipment.

VIII. 4. Describe the documents to be provided to the Port Authority's Project Manager to validate the test results (reports, database listings, statistical analyses, message displays, etc.).

VIII. 7. A test report shall be submitted to the Port Authority's Project Manager after the completion of the test. The report shall include two (2) copies of the signed test document, including all annotations and notes from the actual tests and all failed test reports. The test report shall also state the test results and indicate the nature of any failure(s), the reasons for the failure(s), what corrective actions were taken and on which units the corrections were made, and a list of any outstanding items.

After completion of the AT, the Acceptance Test Report is prepared and two copies will be distributed to the Port Authority for review and approval. The report includes a list of the tested items / requirements and the pass/fail status for each. A recap of the test results by Test Case and the Acceptance Test Completion Letter is also included. Hard-copies of the As-Run Procedures, TRR Checklist, Test Log, Problem Reports Observed, Test Output Files (screenshots, Aerobahn generated reports, system performance reports, etc), Code Review Materials, if applicable and Supplemental Information (supporting validation materials, i.e., system performance analysis) will be included in the test report.

The system is considered service accepted by the Customer upon satisfactory completion of each Acceptance Test as certified by the relevant test records, when it is free of all discrepancies and the Acceptance Test Completion Letter is signed by a Customer appointed representative and counter-signed by a Sensis appointed representative.

If the system or subsystem fails to pass one or more of the tests (i.e., the test shows that the system is non-compliant with the requirements of the specifications), Sensis corrects the cause of the failure. The Customer reserves the right to have all the tests or any single test performed again until compliance is proven.

1.4 Operational Test

VIII. B. 14-Day Operational Test

VIII. Upon notification from the Port Authority's Project Manager of approval of the System Inspection and Test Report and the Contractor's certification that the System is ready for operational testing, an Operational Test phase shall commence for each phase of the project. The Port Authority operating staff with the advice and assistance of the Contractor shall perform the

Operational Test during a 14 consecutive day period. During this period, Port Authority staff and Users will operate the System using the latest version of all applicable manuals, printed guides and procedures. Therefore, the Contractor shall conduct two complete sets of 14-day Operational Tests of the System to coincide with each phase of the project implementation.

VIII. 1. Failures during Operational Test

VIII. If there is a major system or component failure during the 14 day Operational Test, the Contractor shall correct any malfunctions as they occur. After the Contractor corrects a malfunction, the 14-day test shall restart, at day one, and shall continue until the System and all associated control, electronics, and communications equipment have operated without interruption or malfunction for 14 days, and the results are satisfactory, with the written approval of the Port Authority's Project Manager.

VIII. 2. Performance Period

VIII. The Performance Period for operational testing shall begin on the date operational testing commences. It shall end when the System has met the 14 consecutive days of operation in conformance with the Contract requirements at the required availability level stated herein.

Upon approval of the Acceptance Test Report and Port Authority concurrence, the 14-day Operational Test will commence. To achieve limited exposure and acceptance of the Aerobahn system and to avoid disrupting the production system, a shadow server located in the Sensis Data Service Facility (DSF), is used for Operational tests. Customer representatives are provided the opportunity to use the system in a replica of the production environment.

To prepare the shadow server for the Operational Test, a backup of the production database is taken and installed on the shadow server. The database backup allows for synchronizing of the data between the two servers. After successful completion of the initial shadow verification, the shadow server is made available to a select group of the customer's personnel. During the Operational Test phase, Sensis and the customer representatives will verify the system is performing as expected.

1.4.1.1 Operational Test Acceptance

Upon satisfactory completion of the Operational Test phase (14 consecutive days of operation in conformance with the Port Authority contract requirements), a time is scheduled with the customer for deployment to the production server.

If a major system failure occurs during the Operational Test, the Port Authority reserves the right to request correction of the issue and restart of the Operational Test.

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1. Submittal and Documentation Requirements

1.1 Overall Requirements

IX. Submittal and Documentation Requirements

IX. Unless specifically stated otherwise, the Contractor shall submit to the Port Authority's Project

IX. Manager project management, design, testing, operational documentation and plan submittals, and

IX. System As-Built drawings as follows:

IX. A. General Submittal Requirements

IX. 1. Submittal Review

IX. Allow the Port Authority's Project Manager a minimum often (10) workdays to review each Contractor submittal and re-submittal. The Contractor is responsible for maintaining the approved schedule even if multiple review cycles are required for each submittal.

IX. 2. Submittal Format

IX. a. The Contractor shall submit all narrative text or tabular list-based submittals as follows:

IX. b. Bind all 8.5" x 11" documentation, except standard spiral bound materials, in logical groupings in 3-ring loose-leaf binders. Each bound grouping of documentation shall be permanently and appropriately labeled. No documentation shall be smaller than 8.5" x 11". Document pages shall be numbered sequentially. Revised documentation shall be identified with a version number and revision date on the cover and each page.

IX. c. Six sets of hardcopy documents

IX. d. One set in a machine-readable format that shall be viewable and easily modifiable with the Microsoft Office 2007 suite of tools.

IX. B. Submittal Schedule

Sensis provides Aerobahn performance-support documentation in both online and print formats according to contract schedule. Documents are marked for revision control.

Users typically access the *Aerobahn User's Guide* through the Aerobahn interface. Documents can also be accessed via electronic delivery mechanisms (e.g., PDF) or in hardcopy.

Printed documentation identified in this section is provided based on the following assumptions:

- 8.5" x 11" pages
- Spiral-bound or 3-ring binder

- Six sets of each printed document are provided to the Port Authority.
- Source files are provided in Microsoft Office 2007 or AutoCAD-readable format as appropriate.

1.1.1 Document Delivery Schedule

Sensis will provide required documents according to the schedule provided in Figure 1.

Figure 1 Document Delivery Schedule

Document	Delivery Schedule
Project Plan	5 Days ARO
Project Schedule	5 Days ARO
Progress Schedule	Bi-weekly ARO
Weekly Status Meeting Agenda	Weekly ARO
System Diagram	21 Days ARO
Security Practices and Policy Document	10 Days ARO
Aerobahn System Documentation	10 Days ARO
Manuals: • Aerobahn User's Guide • Aerobahn Quick Reference	21 calendar days prior to the start of the System Inspection and Test
Disaster Recovery Plan, Phase A	Prior to the completion and acceptance of Phase A System Inspection and Tests
Disaster Recovery Plan, Phase B	Prior to the completion and acceptance of Phase B System Inspection and Tests
Certification of the security policies and practices employed in system operation	Prior to the completion and acceptance of the System Inspection and Test
Training Plan	21 days prior to the intended start date for training

Document	Delivery Schedule
Database Documentation	Prior to the start of the 14-Day Operational Test
Final Versions of Documentation	Prior to certification by the Port Authority that the all work is completed

1.2 Project Plan and Schedule

IX. 1. Project Plan and Schedule

IX. Within five (5) days after award the Contractor shall submit a Project Plan and Schedule to the Port Authority's Project Manager. Elements of the Plan shall include, but are not limited to: installation plan drawings and product installation literature for all primary components of the System; a schedule and plan for the installation of all devices, communications conduit and cable, and computer hardware, development of custom software features and the loading of all software (with emphasis on what precautions shall be taken to minimize disruption of current operations); plans for the loading of the initial database; training; and, responsibilities for application administration during installation.

IX. The Project Schedule shall include Gantt charts and PERT charts with the critical path identified (using CPM) showing when tasks occur, when resources are required, and what task dependencies exist. The Project Schedule shall be of sufficient detail and clarity so that all work can be reviewed and the Port Authority Project Manager can monitor progress. The charts shall indicate a logical sequence of work and identify all dependencies, personnel resources, material, equipment, and work areas required for completion of the work. The Project Schedule shall be submitted both electronically and hard copy.

IX. The degree of detail shall be sufficient to identify at a minimum:

IX. a. All activities, tasks and stages of construction, milestones and deliverables as specified both within the Contractor's system development and installation methodology and those specifically identified herein.

IX. b. All the activities and tasks associated with the development, installation, integration, configuration and preparation of the System and all subsystem components, submittals, testing and training.

IX. c. Project activities with associated tasks and sub-tasks.

IX. d. Interfaces and dependencies with preceding, concurrent, and succeeding work effort.

IX. e. Resources needed and assignments down to the task level for staff, material, and equipment.

IX. It shall be noted that the development, installation, integration and testing of all Technology Components shall be coordinated with the Port Authority Technology Services Department through the Port Authority Project Manager.

IX. 2. Progress Schedule - Preparation, Updating & Reporting

IX. The Contractor shall prepare and submit updated progress schedules to the Contract Manager every other week, with a complete outline of all tasks and activities required for the execution of this project.

IX. The Contractor shall also schedule and conduct regular status meetings on strategic, tactical and operational issues via telephone conference calls or at an Authority-selected site no less frequently than on a weekly basis with the Authority, and other service providers as necessary for resolution of agenda items. At the sole discretion of the Authority, the frequency of meetings may be adjusted. The purpose of these meetings shall be, (but not limited) to:

IX. • tracking the status of the work activities;

IX. • reporting on the operational status of the services, infrastructure and communications links and availability of connectivity between the Authority and the Contractor, as well as connectivity between end-users and the managed environment via the Internet and Mobile devices

IX. • reviewing and reporting on any operational issues including service tickets;

IX. • reviewing the Contractor's performance to the contracted service level metrics;

IX. • reviewing Contractor's invoices for services provided;

IX. • reporting or communicating on all availability of services and the environment directly impacting the Authority's services, and

IX. • resolving disputes.

IX. The Contractor shall produce and deliver to the Authority, at least 48 hours prior to each status meeting, an agenda that includes a status report listing strategic, tactical, and operational items and issues and the status of each. The report shall at a minimum provide a complete statement of the system's status through performance measure reporting, and indicate progress made on operational, project or task issues or activities during the reporting period. Also included should be progress made on work to correct deficiencies, the status of activities to be undertaken in the next reporting period, activities/tasks behind schedule and identification of problems/concerns related to the services, statistics on problems encountered/resolved in the reporting period and year-to-date, as well as statistics on the Service Levels (SLA) standards and ad hoc reports as required by the Authority. Service Level Agreements are described in detail throughout Section X., Maintenance of the System.

The Project Plan includes the following:

- installation plan drawings
- installation instructions for all primary system components
- a schedule for the installation of all devices, communications conduit and cable, and computer hardware,
- a plan for development and release of custom software features (with emphasis on what precautions shall be taken to minimize disruption of current operations)

- a plan for the loading of the initial database
- a training plan
- guidelines for application administration during installation

The Project Schedule includes charts that identify the critical path, task timing, resource requirements, and task dependencies. Sensis provides sufficient detail so that the Port Authority Project Manager can monitor progress.

Following the commencement of the project, Sensis submits updated progress schedules to the Contract Manager every other week, with a complete outline of tasks and activities required for project execution.

Sensis schedules and conducts (via conference calls or at an Authority-selected site) weekly status meetings on strategic, tactical, and operational issues. At the discretion of the Port Authority, the frequency of meetings may be adjusted. The purpose of these meetings is to:

- track the status of work activities
- report on the operational status of the services, infrastructure and communications links and availability of connectivity between the Port Authority and the Sensis, as well as connectivity between end-users and the managed environment via the Internet and Mobile devices
- review and report on any operational issues including service tickets
- review Aerobahn performance to the service-level metrics
- review invoices for services
- report on availability of services and the environment directly impacting the Port Authority's services
- resolve any disputes

Before each weekly status meeting, Sensis provides an agenda that includes a status report listing strategic, tactical, and operational items and issues and the status of each. The report provides the following:

- a complete statement of the system's status through performance-measure reporting
- a progress report on operational, project, or task issues or activities during the reporting period
- a progress report on work to correct deficiencies

- a report on the status of activities to be undertaken in the next reporting period
- identification of activities/tasks behind schedule and of problems/concerns related to the services
- statistics on problems encountered/resolved in the reporting period and year-to-date
- statistics on the Service Levels (SLA) standards and ad hoc reports as required by the Port Authority

1.3 System Diagrams

IX. 3. System Diagrams

IX. Within twenty-one (21) days after Contract Award, the Contractor shall submit to the Port Authority's Project Manager for review and approval the following detailed system design documentation:

IX. a. System Block Diagram illustrating the interrelationship between all system components.

IX. b. Connectivity Diagrams to illustrate the connections among all system components including, but not limited to, the primary and backup application and database servers, Workstations, communications network and any proposed external connections. The connectivity diagram shall identify the use of all ports and communications protocols.

IX. c. Schematic diagrams to show the proposed locations of the equipment that are to be furnished and installed.

Sensis will provide system diagrams describing the service delivery, all communications and external interfaces, and interconnections between the primary and disaster recovery systems. Diagrams of the Metering Coordination Center will be provided giving locations of the equipment to be furnished and installed.

1.4 Security Practices and Policies

IX. 4. Security Practices and Policies

IX. Within ten (10) days after Contract Award a description of all system security features, practices and policies that are designed into the System to protect, control and monitor access to the System and its components (e.g., hardware, software and data) to achieve the security requirements as described herein.

Sensis follows strict Information Technology (IT) practices for computer security and network security, including the use of Firewalls, Intrusion Detection Systems (IDS), and Auditing. Network connectivity between the Aerobahn Service and the Port Authority, and other external connections is protected and monitored using these systems. Security-

in-depth is addressed at many layers of the Sensis Aerobahn Service architecture: physical, network/communications, and application. Only authorized personnel have access to this system. Sensis Aerobahn Service Users access the system through login to the application portal (or gateway).

As part of this project, Sensis will deliver a Security Practices and Policies document describing the security features, practices and policies utilized for the Aerobahn SMS Service.

1.5 System Documentation

IX. 5. System Documentation

IX. Within ten (10) days after Contract Award, the Contractor shall submit to the Port Authority's Project Manager for review and approval a detailed description of the products to be furnished for installation as part of this Contract. System documentation shall include comprehensive and detailed technical descriptions of the System hardware, software, and communications architecture that include, at a minimum, the following information:

IX. a. Executive Summary:

IX. This document is a summary of documentation material provided in this deliverable, an overview of the System describing all major components, and special features of the System that address performance, expansion, system security, ease of use, and maintainability.

IX. b. Design Overview:

IX. A description of the overall design. This shall include the advantages and disadvantages of the design, (e.g., modularity, flexibility, expandability), and an explanation of why the design is the best implementation to meet the Authority's requirements.

IX. c. Functional Description:

IX. This document is a detailed description of the overall system that provides a functional description of the major components and describes their operation.

IX. d. System Architecture:

IX. This document is a system-level graphic representation of logical components and their interconnections. This shall include identification of the interfaces between each application and each computer and the interfaces to all other external and future systems. The diagram shall include all communications ports and protocols that will be used as part of the system operation.

IX. e. Failure Handling and Recovery:

IX. This document is a failure/switchover/recovery matrix showing the types of failures, the process of reporting these failures and indicate whether the reporting mechanism is automatic or semiautomatic. This shall include descriptions of system diagnostics to detect and isolate failures and a detailed explanation of the fault tolerant solution.

IX. 1'. Narratives:

IX. The narratives shall describe all user functions to enable the System to operate as specified. The narratives also shall pay special emphasis to the requirements for operation and system administration, with an explanation including graphic descriptions that illustrate the proposed user interface, and shall describe the following:

IX. a. Operating features

IX. i. Report formats

IX. ii. Screen Layouts illustrating all user interface screens, graphical maps, pop-up windows, pull-down menus, etc.

IX. iii. Matrix that defines the access restrictions to all applications, by user and Workstation location.

IX. iv. Data Loading Analysis:

IX. A description that identifies the type, the amount, and the frequency of data transmission which originated from physical devices and logical processes, and traces the data flow through all communications paths from the origin of the data to its destination, including all intermediate processes or equipment. The analysis includes an estimate of the bandwidth required to support the aggregated data that is likely to traverse each of the communications paths in the system.

IX. v. Requirements Matrix:

IX. A chart that identifies the design requirements and approved design changes, and indicates the logical processes and physical system/subsystem components where the System's requirements will be implemented. As the design evolves, submit updated requirements matrix. Said chart, based on the approved requirements list, shall identify the location in the design submittals where all the design requirements and approved design changes will be implemented by the proposed logical processes and physical system/subsystem components.

IX. vi. Any other material, documentation or drawings, which the Contractor deems, appropriate.

The Aerobahn system documentation library provides comprehensive technical descriptions of the Aerobahn hardware, software, and communications architecture. The following documents will be available as part of the Aerobahn System Documentation Library:

- Aerobahn System: Executive Summary—A functional summary of how Aerobahn meets the evolving requirements of the Port Authority at JFK International Airport.
- Design Overview and Functional Description—A summary of the system design and its rationale.
- System Architecture—A system-level graphic display of logical components and interfaces.
- Failure Handling and Recovery Matrix—A guide to Aerobahn system processes for fault detection, corrective action, and reporting.

- Narratives—The *Aerobahn User's Guide* (online Help) provides comprehensive reference material on all user functions and guidance related to the user interface. The *Aerobahn User's Guide* (available as a PDF/print document) shall substitute for a separate Narratives document.

1.6 System Hardware Documentation

IX. 6. System Hardware Documentation

IX. Within twenty-one (21) days after Contract Award, the Contractor shall submit to the Port

IX. Authority's Project Manager for review and approval a detailed description of the system hardware.

IX. Hardware documentation shall include:

IX. a. Hardware Specifications

IX. Complete specifications for each hardware component of the System.

IX. b. Component Drawings

IX. Drawings that clearly and completely indicate the function of each System hardware component. The drawings shall indicate termination points of devices, and interconnections required for System operation, interconnection between modules and devices, spacing of components, and location, mounting and positioning details.

IX. c. Computer Hardware Requirements

IX. Provide detailed requirements of the computer hardware that is required by the applications software to satisfy the functional and performance requirements of the Contract. The requirements shall state all computer hardware considerations, and include, at a minimum the computer architecture, processor speed, memory, secondary storage and peripheral considerations. Subsequent to submission of Contractor's computer hardware requirements, the Contractor shall meet with TSD to review the Contractor's requirements, formulate system architecture, and finalize the computer architecture that will be used to run the application software.

IX. d. Commercial Off-the-Shelf Products

IX. The Contractor shall furnish a complete list of Commercial Off-the-Shelf (COTS) products furnished as part of the Contract. Include the name, manufacturer, part number and material specifications as applicable.

Sensis will provide, within twenty-one (21) days after contract award, documentation of any hardware that is delivered to the Port Authority as part of this program. Descriptions of hardware that Sensis retains as part of the delivery of the Aerobahn SMS Service will not be delivered in detail, however an overview of the equipment used will be provided as part of the System Architecture documentation. Client hardware requirements will be delivered within twenty-one (21) days after contract award. These specifications will include minimum CPU, RAM, all supported configurations, and network connectivity

1.7 Manuals

IX. 7. Manuals

IX. Within twenty-one (21) calendar days prior to the start of the System Inspection and Test, prepare and submit, for approval, six (6) sets of complete, separate manuals for Airport Operations' Staff and contract administrators that will use the System for Authority review and approval. A site-specific manual shall also be provided to document the specific site-related configuration and operations / maintenance. Additionally, all Manuals shall be available electronically for local and geographically disbursed Users.

IX. All manuals shall be specifically written for this installation. Pages from the original equipment manufacturers standard operations and maintenance manuals can be referenced in the manuals written for this Contract, provided all of the referenced items are included in the manuals.

IX. a. Operations Manuals

IX. A set of Operations Manuals shall be provided that clearly describes all User operations. The manuals shall explain all the features and functions of the System for day-to-day operations and how to use the system to manage more complex situations. A separate Quick Reference Guide for problems and/or exception conditions shall be included to enable the User to quickly resolve common operating problems, and address common configuration and replay techniques. The Quick Reference Guide shall be available in multiple locations; one source shall be within the electronic and hard copy Operations Manual and the other as a stand-alone electronic and hard copy version of the document.

IX. The Operations Manual(s) shall contain detailed description of system operations and procedures on how to perform all user functions, including but not limited to the following: Monitor equipment operation, Control all equipment (if applicable), Invocation and explanation of the System reports, Filter and sort the event log, Implement any special system features, and Error and alarm handling procedures, including recovery from all equipment failures.

IX. The Operations Manual shall be written for beginner computer users who are not familiar with detailed computer operations and terms. It shall contain step-by-step procedures with examples containing pictures of the computer screens, explanation of the user interfaces and graphics to illustrate the overall concepts. The manual shall be for instructional, study and refresher use.

IX. b. Application Administration Manual

IX. The Application Administration Manual shall include, but not be limited to all sections covering administration of the application, configuration functions, including but not limited to the following items:

IX. i. Detailed instructions and procedures for the installation and configuration of the software.

IX. ii. Detailed description and procedures for configuration of user access privileges and access levels to use of all application functions;

IX. iii. Detailed description and procedures for the configuration and management of the application and its databases;

IX. iv. Detailed description and procedures for installing, backing up and restoring the application software and include system generation procedures if software development tools are furnished as part of the Contract;

IX. v. Detailed description and procedures for event logs maintenance activities including downloading, sorting, printing and clearing.

IX. vi. Detailed description and procedures conducting system health check to ensure the operational health and vitality of the system.

IX. vii. A detailed procedure that describes all of the steps to manually switch over operation from the primary application and database servers to the backup application and database servers and to switch back to the primary application and database servers once the operation of the primary application and database servers are restored.

IX. c. System Administrator's Manual

IX. A System Administrator's Manual shall be provided which contains graphical depictions, written detailed descriptions and procedures of all functions that the Contractor will perform for the proper monitoring, maintenance and administration of the System, including but not limited to, the following topics, each described in a separate section of the document:

IX. • steps to manually switch over operation from the primary application Server to the secondary application server and to switch back to the primary application server once the operation of the primary application server is restored

IX. • archiving data and restoring archived data to the database

IX. • backing-up and restoring the database

IX. • changing the database to add or delete tables and or fields; installation and configuration of the software

IX. • backing up and restoring the application software

IX. • generating the system software from the source code

IX. • performance analysis

IX. • scheduled maintenance

IX. • audit and control

IX. • report production

IX. • contingency plan

IX. • configuration control

IX. • system diagnostics

IX. • database integrity checks

IX. A separate, removable section of the System Administration Manual shall contain information on the proper administration and control of the security features built into the

System. Some of the information to be contained in this section includes: maintenance of user identifiers, password control, and security policy review.

Sensis provides the Port Authority with three primary manuals that support Aerobahn users' on-the-job performance:

a) The first of two "Operations Manuals" is the *Aerobahn User's Guide*, which provides online access to comprehensive instructions on how to use all real-time, reporting, and a variety of system-level tools. The online *User's Guide* supports full-text search and provides a variety of reference tools, including a glossary and index. The *Aerobahn User's Guide* won the Society for Technical Communication's Award for Excellence in the 2010 International Online Communications Competition. With each major software release, the *User's Guide* is updated to reflect current Aerobahn functionality.

   Each user can create a customized online quick reference by using the online User's Guide's "Favorites" feature. This feature facilitates the building of job-specific quick reference guides.

b) The second of two "Operations Manuals" is a printed Aerobahn Quick Reference Guide that provides the following content:

   - common operating problems/FAQ
   - common workspace configuration techniques

The Sensis Aerobahn SMS is a service that is being provided to the Port Authority. It is Sensis responsibility to administer both the system and the application. As the Port Authority does not have a need to do any administration, neither a System or Application Administration document will be delivered.

c) The Aerobahn System Administration Manual provides instructions for the following client-side operations:

   - management of users and groups
   - configuration: settings and permissions
   - management of licensing
   - diagnostics
   - administration and control of the Aerobahn security features

1.8 Disaster Recovery Plan

IX. 8. Disaster Recovery Plan

IX. Prior to the completion and acceptance of the System Inspection and Tests for each project phase, Phase A and B, the Contractor shall obtain and submit, for the Port Authority's Project Manager's approval, a disaster recovery plan to recover all System components and data operating as part of this Contract, to ensure continuity of operations in case a catastrophic event eliminates one or more of the locations where the System is housed. See Exhibit 3 for Disaster Recover requirements.

Sensis will deliver a Disaster Recovery plan as specified prior to the Phase A deployment. Any updates to this document necessary for Phase B will be provided as specified prior to the Phase B deployment.

1.9 Audit Report

IX. 9. Audit Report

IX. Prior to the completion and acceptance of the System Inspection and Test, the Contractor shall obtain and submit, for the Port Authority's Project Manager's approval, an internationally recognized certification (such as SAS-70 Level 2 or an approved equivalent) of the security policies and practices employed in its System operation which demonstrate that the following protections are provided:

IX. • Physical access to the production environment, stored data, and documentation is restricted to prevent unauthorized destruction, modification, disclosure, or use

IX. • Logical access to the production environment, data files, and sensitive system transactions, is restricted to authorized users only

IX. • The production environment is protected against environmental hazards and related damage

IX. • Regularly scheduled processes that are required to maintain continuity of operations in the event of a catastrophic loss of data, facilities, or to minimize the impact of threats to data, facilities or equipment, are performed as scheduled.

IX. • System hardening measures have been adequately applied to protect the System against risks to which it is exposed

IX. • Logging of IT security events is enabled for the System, security logs are reviewed in a timely manner, and appropriate actions are taken by Contractor IT staff in response to System security events.

Sensis is leveraging a Tier 4 data center for both the primary and the secondary Aerobahn data service facilities. This data center is SAS-70 Level 2 certified. As such Sensis will provide a copy of the data center's SAS-70 audit report as part of this program.

1.10 Training

IX. 10. Training

IX. a. Training Plan

IX. Submit to the Port Authority's Project Manager for approval, not less than twenty-one (21) days prior to the intended start date for training, nine (9) hard copies and an electronic copy of the Training Plan that includes, but is not limited to the following for each training class:

IX. 1. Detailed description of the course curriculum;

IX. 2. Draft copies of the course material including but not limited to manuals, study guides, workbooks, technical reference material, etc.;

IX. 3. Technique that will be used to provide training to airline staff working for the air carriers in locations off Port Authority facilities.

IX. 4. Comprehensive schedule for the delivery of all training classes. The schedule shall include the dates, times and exact locations for the training courses. The training courses shall be held at one or more Authority facilities, in those locations designated by the Port Authority's Project Manager. The dates and times shall be coordinated with and approved by the Port Authority's Project Manager and Training shall also be provided to airline staff working for the air carriers in locations off Port Authority facilities.

IX. 5. Post-training and/or on-the-job technical reference guides.

IX. b. After completion of all Training Courses, submit the following:

IX. 1. One unbound, reproducible master set of all manuals and a copy of each manual in a digital format that may be edited using Microsoft Word 2007. These master sets shall include a written non-disclosure and copyright waiver allowing the Authority to make unlimited copies, for its own use, of any copyrighted material within, royalty free, for a period of 99 years.

IX. 2. Six (6) bound sets of operations manuals.

IX. 3. Six (6) bound sets of Applications Administration and System Administration

Sensis submits a comprehensive training plan to the Port Authority's Project Manager for review and approval prior to Phase A delivery. The training plan describes individual courses and teaching techniques, identifies the respective training-related responsibilities of Sensis and the Port Authority, and proposes a training schedule. Sensis also provides draft copies of course materials. (For more information on Aerobahn training, refer to Section F-1-VII.)

At the completion of training, Sensis submits manuals used to support the training. Sensis grants the Port Authority the right to reproduce training materials for its internal use and for use by designated subcontractors. Sensis retains the intellectual property rights to all Sensis-developed documents supplied with the system.

1.11 Change Management

IX. 11. Change Management

IX. Prior to the start of the 14-Day Operational Test, submit the form that will be provided by the

IX. Contractor and the procedures that will be performed before attempting to effect a change to any

IX. part of the system, whether hardware, software, database or network.

Sensis submits formal notification of procedures to be performed before effecting system changes (i.e., hardware, software, database, or network) and before starting operational testing.

1.12 Database Documentation

IX. 12. Database Documentation

IX. Prior to the start of the 14-Day Operational Test, the Contractor shall submit to the Port Authority's Project Manager for review and approval a detailed description of the database. Database documentation shall include:

IX. a. Database Schema

IX. Database schema is a description of the overall organization of the files and tables to be used in the System. This description shall include an identification of all data files, tables, and fields, and the relationships between fields and tables and demonstrate compliance with the data requirements specified herein. This description shall also include, but not be limited to full details regarding any third party database products including version, release, functional characteristics, operational requirements and any other relevant characteristics of the product.

IX. b. Data Dictionary

IX. A listing of all System data elements, including the size, definition, validation rules and other information pertaining to the data elements. If a commercially available data dictionary is to be used, also submit complete and current information about the product.

IX. c. Data Storage Analysis

IX. The techniques employed to ensure that the System can meet the storage requirements for on-line and historical data and expansion capabilities. The analysis shall include identification of all files

IX. (e.g., system, message, report files), databases, and their retention cycles and indicate the accessibility to the data, i.e. whether the information will be available for on-line retrieval or archived in off-line storage.

IX. d. Data Flow Diagram

IX. A graphical depiction of the logical processes that comprise the System and an illustration that depicts the data flow as the data moves between these processes. This description shall identify all of the System's functional processes and show the flow from the data's inception to its long-term storage. The documentation shall include data flow diagrams and other necessary documentation to understand how the data is handled and stored.

IX. e. Entity-Relationship Diagram

IX. A graphical illustration of the interactions between the various entities for which data is collected in the System that depicts the relationships between the entities and their

associated data. This description shall identify all significant System entities (person, object, place, events, etc.) and show the nature of all significant interactions from the data's inception to storage.

Sensis provides the Port Authority with a database schema, a data dictionary, a data flow diagram, and an entity relational diagram (ERD) consisting of the reporting tables and subsequent documentation of those tables.

Because disk utilization and access is monitored regularly, Sensis can meet the storage requirements for on-line and historical data and expansion capabilities.

1.13 Final Versions

IX. 13. Final Versions of the Documentation

IX. Prior to certification by the Authority that the Contractor has completed all work as specified in the Detailed Project Plan (except for maintenance), the Contractor shall submit all design documentation, manuals, and/or drawings, which have been revised to reflect the as-built conditions. System Documentation shall be provided in both a bound copy and an electronic version in a machine-readable form, which is viewable with the Microsoft Office 2007 suite of tools and Auto-Cad (if used). System documentation submittal(s) shall include but not be limited to versions of the System Drawings and System Documentation that have been updated to reflect the as-built conditions.

Sensis submits final revisions of design documentation, manuals, and/or drawings, reflecting the as-built system to enable the Port Authority to certify that Sensis has completed all work (except for maintenance) specified in the Detailed Project Plan.

Sensis provides these documents in bound copies and provides source files in formats readable in Microsoft Office 2007 suite of tools or AutoCAD as appropriate.

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1. Maintenance of the System

1.1 Overview

In order to meet the needs of its Service Customers, Sensis has chosen to remotely host the Data Service Facility (DSF) with a commercial company. The remotely hosted DSF will be fully redundant within the primary DSF, have fully redundant communication lines into the DSF, along with a fully redundant DSF at another location. In the past Sensis has hosted the DSF at its Syracuse facility with excellent results. Using a commercial DSF will allow Sensis to provide higher levels of service availability due to increased redundancy and communication bandwidth.

Most of the equipment necessary to provide the browser-based Aerobahn services are housed remotely and not at the airport. This increases the responsiveness and eliminates the maintenance costs associated with a system located primarily at a Customer facility.

All hardware that is required to deliver the Aerobahn service uses a redundancy approach to achieve fault tolerance. Servers, routers and similar equipment use a 1 of 2 required redundancy. RAID drives are typically n-1 redundant.

1.2 Maintenance Description

X. Maintenance of the System

X. A. Maintenance Requirements:

X. Upon certification by the Authority that the System has satisfactorily completed the 14-Day Operational Acceptance Test for Phase B and that the Contractor has completed all work as specified in the Detailed Project Plan (except for warranty and maintenance), the Contractor shall then provide the maintenance required for the System to perform in accordance with, but not limited to, the following requirements:

Sensis has a well established maintenance philosophy that has proven the Sensis DSF and the services provided to the Port Authority are capable of supporting high availability requirements. For a commercially hosted DSF, the equipment is constantly monitored and maintenance can be performed as required 24 hours a day, 365 days a year.

1.2.1 Maintenance Period

X. 1. Maintenance Period

X. The maintenance & support tasks identified in this section must be performed:

X. • Under the warranty period for the system which extends Twelve (12) months from the successful completion of the 14-Day Operational Test for each phase of the project.

X. • Under the maintenance provisions which start one (1) day after the one (1) year warranty period.

The Aerobahn service does not require the Port Authority to purchase any hardware from Sensis, nor does it require the Port Authority to perform any maintenance. Therefore, traditional maintenance and warranty period are not necessary. After acceptance, the Service will be fully supported through the existing Sensis Customer Service for the duration of the contract.

1.2.2 Maintenance Support Tasks

X. 2. Maintenance and support tasks

X. Maintenance and support tasks include all expenses (parts, labor, tools, equipment, software, travel, signage, shipping costs, etc.), without additional cost to the Authority, required to perform (but not limited to) the following:

X. • Host, operate and maintain the System in a secure and protected environment in order to meet the functional, performance and availability requirements as defined herein;

X. • On-call remedial and scheduled preventive maintenance in order to meet the availability requirements stated herein;

X. • Correct defects in the furnished applications software;

X. • Validate and correct (when necessary) the applications software furnished by the Contractor to ensure that it performs in accordance with the specifications of the Contract within ten (10) days after Microsoft and other software providers release patches and updates to the operating system, database and other third-party software that is furnished or used in the System;

X. • User support to administer the application;

X. • System Administration (See Exhibit 4 for the System Administration requirements);

X. • On-Call Help Desk Support by telephone during twenty-four (24) hours per day, seven (7) days per week is required.

X. Note: Help Desk Support is intended to User questions on the use of the application and is

X. independent of any notifications made to report errors or remedial maintenance issues with the System or application.

X. • Update and Test disaster recovery plan on an annual basis.

Sensis employs a proven support services infrastructure and adheres to a rigorous Service delivery approach that positions Sensis to extend outstanding Service to the Port Authority 24 hours per day, 7 days per week, 365 days per year (24x7).

The Aerobahn JFK Service offering is comprised of components that are owned and maintained by Sensis and components that are owned and maintained by the FAA.

Authorized Port Authority users and authorized sub-licensees will contact Sensis Customer Service in the event of an observed anomaly with the Service, and Sensis will make every effort to promptly identify and resolve the source of the anomaly. Sensis ensures optimum performance by executing a proactive maintenance plan for all of the hardware and software comprising the Sensis owned elements of the Service infrastructure. In the event of an unforeseen degradation in the quality of the Service element owned and maintained by Sensis, qualified experts are rapidly deployed to identify and resolve problems.

Sensis Customer Service stands ready to ensure optimum Aerobahn JFK Service performance and availability by:

- Acting as a single point of contact for all Users;
- Logging, tracking, and communicating the status of all problem resolution efforts;
- Providing information about how to use functions/features; and
- Capturing User suggestions for new features and sharing them with the Aerobahn Product Team.

All Aerobahn JFK Service Users have immediate access to subject matter experts at Sensis on a 24x7 basis.

1.2.3 Operational Availability

X. 3. Operational Availability

X. The Operational Availability of the System and Services shall meet the percentages stipulated below each calendar month for the term of this Contract:

X. System Hardware and Software: 99.99%

X. Applications software: 99.99%

X. User Services provided through the Worldwide Web: 99.99%

X. As used in this numbered Clause (and in this clause only) "Operational Availability" means the time during any twenty-four (24) hour period the System and communications network is Available to Users for Surface Management System operations. "Available" means that during any twenty-four (24) hour period, the furnished and installed software applications and any Contractor furnished equipment perform according to the manufacturer's specifications.

X. In the event that Operational Availability fails to meet the percentage stipulated herein, and is not responded to or repaired within the Service Level Agreement time requirements, damage amounts for unavailability for operation are as specified herein.

The Aerobahn JFK Service balances the cost and complexity of a highly available design with the requirements of a non-life critical application. The Sensis-owned and operated components of Aerobahn JFK Service make extensive use of proven, high availability hardware, warm standby backup hardware for rapid recovery from unplanned failures, and a team of experienced Sensis Customer support personnel to achieve a high level of operational availability. When selecting hardware components, a key factor in the decision is the long-term reliability of the component. For instance, all servers comprising the Aerobahn solution are equipped with Redundant Array of Independent Disks (RAID) storage. Sensis has developed estimates for system availability for unplanned outages and based on this analysis, the Aerobahn JFK Service operational availability, for Sensis-owned components of the Service, is conservatively forecast to be better than 99.99%

When calculating Service availability, the mean corrective maintenance time includes the logistics delay time plus the repair time. This approach provides a conservative, worst case estimate, however, even with this conservative approach, Service availability is excellent.

For a given item or redundant set of items, operational availability is calculated using the following formula:

$$A = \frac{MTBCF}{MTBCF + M_{CT}}$$

Where:

MTBCF is the mean-time-between-critical-failures of the item, or redundant items (hours). Note that all items in the supplied service are redundant.

M_{CT} is the mean corrective maintenance time to repair a failed item (hours).

Commercial Data Centers use highly reliable blade servers combined with RAID drives to achieve advertised availabilities of 99.999% (five nines). In the event of a blade server failure, the failover time to the redundant server is between 15 and 30 seconds. In the event of a Data Center outage, the failover time between data centers is 15 minutes.

Sensis has provided Aerobahn service to JFK for over two years and has averaged an availability of 99.99% as discussed in Section F-1-VI paragraph 1.2. With the transition to redundant DSFs and added redundant communications ability, it is expected the availability will increase.

1.2.4 Maintenance Program

X. 4. Maintenance Work

X. The Contractor shall perform complete scheduled preventive maintenance and on-call remedial maintenance so that the System meets the Operational Availability and may be operated twenty-four (24) hours a day, seven (7) days a week. The maintenance program shall be

performed with all reasonable care to keep the System in a proper, safe, and efficient operating condition capable of correct operation and reporting. The Contractor shall furnish all labor, travel, materials, supplies, parts, equipment, warning signs, other safety devices, and all other things necessary or proper for, or incidental to, such maintenance.

X. The Contractor, at its option, shall repair or replace System components maintaining all original specified performance requirements, within the time(s) stipulated in Attachment C, Scope of Work Section X.C titled "Time to Repair" herein, for any part, component, equipment item, software or firmware of the System that become unsuitable for continued use. Replacement parts or components shall be identical to the original, or equal, as approved by the Contract Manager.

X. The maintenance performed by the Contractor shall include, but not be limited to, scheduled preventive maintenance, on-call remedial maintenance, error correction, software and firmware diagnostics and corrections, validation that the applications software continues to work (in accordance with the Contract requirements) with manufacturer-released patches to third-party software and engineering updates of the System as described below. The Contractor shall submit to the Port Authority's Project Manager for review a schedule of preventive maintenance activities and a description of preventive maintenance procedures no less than 14 days prior to the Warranty Start Date and each anniversary thereof The Port Authority's Project Manager will review the submission, and make comments, within ten (10) working days.

X. In order to make replacements and repairs as expeditiously as possible, the Contractor shall stock, keep and maintain a sufficient supply of parts and materials, tools or other equipment as may be necessary to make such replacements and repairs.

X. In order to meet the service level agreements stipulated in Attachment C, Scope of Work Section X.C, Time to Repair, in this contract, the Contractor shall maintain an adequate number of qualified staff to provide the required technical support.

The Sensis Aerobahn service has no Sensis supplied equipment that is owned by the Port Authority. This reduces the need for on-site maintenance and on-site spares to zero as all maintenance is performed at the DSF. The DSF is monitored 24 hours a day and all maintenance is performed as required. Figure 1 lists the minimum preventative maintenance actions performed for the Aerobahn Service. None of the listed preventative maintenance actions are performed at the airport, or by the Port Authority. The list is provided for reference only, and to show the amount of attention and detail Sensis gives to the Aerobahn Service.

Figure 1 Preventative Maintenance

Frequency	Maintenance Action
Continuously	Software and Hardware monitoring to assess performance of Aerobahn service. Email and Pager alert sent to system administrators in the event of any issue.
Daily	General visual inspection of indicators
	Review system logs
	Check for Security Updates for Firewall, Encryption, and Intrusion Detection; and update as necessary
	Incremental System backup
Weekly	Test run Emergency Back-up Generators
	Full System backup
Bi-Weekly	Test Uninterruptable Power Source
Semi-Annually	Test the Fire Suppression System
As Needed	Repair or Replace non-operational Hardware

1.2.5 Maintenance Description

X. 5. Maintenance Description

X. All maintenance shall be performed in accordance with the equipment and component manufacturers' recommendations. The results from all inspections, tests, diagnostics, equipment repairs and corrective actions shall be reported to the Contract Manager on Authority approved forms.

X. The maintenance performed by the Contractor shall include, but not be limited to scheduled preventive maintenance, on-call remedial maintenance, error correction, and software and firmware diagnostics and corrections of the System as described herein.

X. a. Scheduled preventive maintenance

X. Scheduled preventive maintenance shall consist of all actions necessary to inspect, test, diagnose, repair equipment failures, correct System malfunctions and restore System operation to perform in accordance with the manufacturer's stated specification, performance and tolerances. Scheduled preventive maintenance shall include, but not be limited to adjustment, repairs, the replacement of field installable parts that are approaching unserviceable status, all actions necessary to prevent System failures and extend the System's useful life, verify adequate empty disk space available for program usage (i.e., temporary files, logs, etc.,), verify log files are saved to removable media and log files are purged on a regular basis, review reports on communications throughput and errors and perform communications diagnostics on each communications channel to identify equipment or cabling problems.

X. b. On-call remedial maintenance

X. On-call remedial maintenance shall consist of all unscheduled actions necessary to obtain the Operational Availability, diagnose and correct all System malfunctions and failures and restore the equipment in accordance with the manufacturer's stated specification, performance and tolerances and the System to perform in accordance with the Contract requirements. The Contractor shall provide a specified telephone number and FAX number and email address at no additional cost to the Authority, which shall be staffed 24 hours a day, 7 days a week, to enable the Users to report errors and malfunctions to the System.

X. Within twenty-four (24) hours of each reported on-call remedial maintenance problem, the Contractor shall provide written documentation of the reported problem and all actions performed related to the maintenance call in a computer-readable format to the Contract Manager.

The Sensis Aerobahn service has no Sensis supplied equipment that is owned by the Port Authority. This reduces the need for the Port Authority to provide scheduled preventive or corrective maintenance to zero. Figure 1 lists the minimum preventative maintenance actions performed for the Aerobahn Service by Sensis, and is provided for general reference only. Sensis Customer Service is on-call 24x7 and the DSF is monitored 24x7 ensuring the Port Authority of a service that will continually meet or exceed the availability requirements.

Sensis will capitalize on its existing proven process to promptly respond to Aerobahn JFK Service User requests for support. This process seeks to maintain accurate, timely communications between Sensis and authorized Aerobahn JFK Service Users. When an anomaly has been identified, Sensis Customer Service uses a Customer Problem Report (CPR) as its primary method for recording all Customer contacts. All issues and requests for assistance are assigned a CPR number and are reviewed in detail by the Product Team on a regular basis, until there is concurrence that the issue is "closed." A report of an Aerobahn Service outage is given the highest priority and work immediately commences to restore Service. A report of Aerobahn Service degradation is assigned to the appropriate technical resource within one business day. Notification is given within one business day through email of all reported problems that includes a description of the issue along with any actions that were taken to remediate the issue.

1.2.6 Loss of Service

X. 6. Loss of Service

X. The Users will notify the Contractor via the 24-hour telephone or fax number or email, described above, when the System does not perform in accordance with the Contract requirements due to a loss of service. The Contractor shall dispatch Trained Personnel and complete performance of such error correction to diagnose, debug, repair, replace and correct all malfunctions or restore lost services required for the System to perform in accordance with the Contract requirements within the time(s) stipulated in Section X.C. 1., "Time to Repair" herein.

Sensis employs a proven support services infrastructure and adheres to a rigorous Service delivery approach that positions Sensis to extend outstanding Service to the Port Authority 24 hours per day, 7 days per week, 365 days per year (24x7).

Sensis Customer Service stands ready to ensure optimum Aerobahn JFK Service performance and availability by:

- Acting as a single point of contact for all Users;
- Logging, tracking, and communicating the status of all problem resolution efforts;
- Providing information about how to use functions/features; and
- Capturing User suggestions for new features and sharing them with the Aerobahn Product Team.

All Aerobahn JFK Service Users have immediate access to subject matter experts at Sensis on a 24x7 basis via telephone. Email and fax communication is handled the next business day.

1.2.7 Error Correction

X. 7. Error Correction

X. The Users will notify the Contractor via the 24-hour telephone, fax number or email, described above, when the System does not perform in accordance with the Specifications stipulated in the Contract due to error in the applications software (including firmware) or any modifications thereto. Hardcopy documentation of the error condition will be mailed, faxed or emailed to the Contractor. The Contractor shall correct any such error in the System as identified by the Authority or through the Contractor's investigation of the reported error(s). Errors shall include, but not be limited to, flaws in operations and errors due to flaws in the design and coding of the System.

X. The Contractor shall dispatch his/her personnel and complete performance of such error correction to diagnose, debug, repair, replace and correct all malfunctions required for the System to perform in accordance with the Contract requirements within the time(s) stipulated in this Maintenance Section X.C.3, "Time to Repair" herein. The Contractor shall provide documentation in machine-readable format, if any, relating to the error correction. The Contractor in an off-line test environment shall test the corrected software. The Contractor shall then prepare a test report and submit it to the Authority for review and approval before the corrected software is installed into the System. Such corrections to the software shall be provided at no additional cost to the Authority.

X. The Contractor shall repair all software malfunctions maintaining all original specified performance requirements, within the time(s) stipulated in Attachment C, Section X.C.3, "Time to Repair," herein.

X. B. Time to Respond

X. In response to a call for maintenance by the Users, the Contractor shall contact the Contract Manager within fifteen (15) minutes of the initial notification by the Authority to the Contractor's designated telephone or Fax number, or email address for remedial maintenance, in order to document the need for service.

X. C. Time to Repair

X. 1. On-Call Remedial Maintenance

X. The Contractor's personnel shall return to full operation the System and all failed System components, services or operations in response to on-call remedial maintenance within the time period stipulated below after notification to the Contractor.

X. • The "Repair Time" includes the fifteen (15) response time.

X. • The Contractor shall respond, repair and return to full operation the System and all failed System components and services in response to on-call remedial maintenance within sixty 60) minutes.

X. 2. Validate and Correct Applications Software with Patches and Updates to Third Party Software

X. The Contractor shall complete performance of such testing, validation and correction to ensure that the software furnished by the Contractor performs in accordance with the Contract requirements with the released patches and updates within ten (10) business days from the date that Microsoft and other software providers used in the System release patches and updates to fix software defects or security vulnerabilities to the operating system, database and other third-party software that are furnished or used in the System.

X. 3. Error Correction

X. The Contractor shall dispatch Trained Personnel and complete performance of such error correction to diagnose, debug, test, repair, replace and correct all malfunctions required for the System to perform in accordance with the Specifications stipulated in the Contract within ten (10) business days from the date of notification of System malfunction.

X. D. Failure to Meet Service Level Agreements

X. 1. Failure to Repair

X. The Contractor's obligations for the performance and completion of on-call remedial maintenance within the time or times provided above and for achieving the Operational Availability stipulated in Section X.A.3 above are of the essence of the maintenance portion of this Contract. The Contractor guarantees that it can and will obtain the Operational Availability at or above the percentages hereinbefore stipulated and will complete the on-call remedial maintenance within the time(s) hereinbefore stipulated. Inasmuch as the damage and loss to the Authority for failure to repair within the time(s) hereinbefore stipulated will be incapable or very difficult of accurate estimation, the damages to the Authority shall be liquidated in accordance with Attachment B, Part 1, Section 17 entitled, "Non-Performance of Contractor's Duties - Liquidated Damages."

X. 2. Failure to Correct Error

X. The Contractor's obligations for the performance and completion of error correction in order to ensure that the System performs in accordance with the Contract

requirements within the time provided for in the above are of the essence of the maintenance portion this Contract. The Contractor guarantees that it can and will obtain the Operational Availability at or above the percentages hereinbefore stipulated and will complete the error correction(s) within the time(s) hereinbefore stipulated. Inasmuch as the damage and loss to the Authority for failure to correct errors within the time(s) hereinbefore stipulated will be incapable or very difficult of accurate estimation, the damages to the Authority shall be liquidated in accordance with Attachment B, Part 1, Section 17 entitled, "Non-Performance of Contractor's Duties - Liquidated Damages," Section E.

X. 3. Failure to Validate and Correct Applications Software with Third-Party Software Patches and Updates

X. The Contractor's obligations for the performance and completion of testing, validation and error correction in order to ensure that the applications software performs in accordance with the Contract requirements with patches and updates to third-party software within the time provided for in the above are the essence of the maintenance portion this Contract. The Contractor guarantees that it can and will obtain the Operational Availability at or above the percentages herein-before stipulated and will validate and correct the applications software to work as described hereinbefore with the updates and patches to third-party software within the time(s) hereinbefore stipulated. Inasmuch as the damage and loss to the Authority for failure to validate and correct the applications software within the time(s) hereinbefore stipulated will be incapable or very difficult of accurate estimation, the damages to the Authority shall be liquidated in accordance with Attachment B, Part 1, Section 17 entitled, "Non-Performance of Contractor's Duties - Liquidated Damages," Section F.

Sensis is committed to keeping the Port Authority and its designated sub-licensees informed about the status of Aerobahn JFK Service. Our process requires that reported outages are confirmed with the Customer within one hour of receipt, and authorized Users are informed of the outage via email and/or telephone. Further, progress toward resolution of an outage is provided within four hours and again at twenty-four hour intervals until Service is restored. When a degradation of Aerobahn Service is reported, Sensis confirms receipt within one business day and follows up with regular updates to the Customer until the degradation is resolved. Inquiries about using specific product features or functions are confirmed within one business day and followed up with regular updates to the Customer. Suggestions for new features are confirmed with the Customer and reviewed by the Aerobahn Product team on a quarterly basis. New features, software patches, and updates to Third Party Software are incorporated as stated below.

1.2.8 Upgrades

X. E. Upgrades and Enhancements

X. The Contractor shall notify the Port Authority's Project Manager whenever upgrades and/or enhancements to operating system, the software provided under the Contract or third party software become available and provide a proposal for the proposed enhancement and upgrade. The proposal shall describe the work to be performed, contain a detailed estimate of the labor involved by labor category, a lump sum price and a proposed schedule for the work. The Contractor shall also provide the Port Authority's Project Manager with an analysis of the

potential effects of such upgrades/enhancements on the System. This analysis shall include, at a minimum, the following:

X. • Compatibility of the application software with the new operating system or third-party software

X. • Potential increases or decreases in operating System performance

X. • The availability of product support for the current (older) version of the operating system or third party software

X. • The testing required ensuring that the upgrade will perform as expected

X. • The cost of the software upgrade, including testing and any other tasks which may be associated with the upgrade

X. The Port Authority's Project Manager will then determine whether to install the upgrade. If the Port Authority's Project Manager selects the upgrade, the Contractor shall perform the recommended testing, prepare the test report, and perform the upgrade on the System.

Sensis will provide one software upgrade per year to the Aerobahn service at no additional cost to the Port Authority. The upgrade is expected to include some combination of minor bug fixes, patches to the current release of software employed within Aerobahn, as well as enhancements to existing product features or new features for existing products. In the event of a security vulnerability that has a significant risk of materially impacting the Aerobahn service, an "out of cycle," patch release will be implemented on an as-needed basis, again at no additional cost to the Port Authority.

The Port Authority will be apprised of any upgrade or patch releases well in advance of deployment. A detailed description in the form of "Release Notes" will accompany any new Aerobahn release. This document will contain a list of new features and any bug fixes with references to customer CPR's.

An exhaustive test period will take place prior to migrating any new Aerobahn release from the test, shadow servers to the production servers. During this test period, the Port Authority user community will have ample opportunity to test out the new features and verify software bugs have been resolved per the Release Notes.

Any upgrade will be scheduled for installation during non-peak hours, and all deployment activities will be well coordinated by the Sensis Service Delivery Manager, with the appropriate Port Authority personnel.

1.2.9 Supplemental Work

X. F. Supplemental Work

X. The Port Authority's Project Manager will notify the Contractor whenever Supplemental Work is requested. In response to the request, the Contract Manager shall submit a proposal that describes the work to be performed, contain a detailed estimate of the labor involved by labor category, a lump sum price and a proposed schedule for the work. The

Contractor shall also provide the Port Authority's Project Manager with an analysis of the potential effects of the requested supplemental work on the System.

X. Supplemental work includes but not limited to the following categories:

X. • Refresher training classes as part of the on-going maintenance contract

X. • Design, development and implementation of custom reports

X. • Staffing to support irregular operations.

X. This Supplemental Work ordered and approved by the Port Authority's Project Manager shall be paid as per Attachment D, Cost Proposal Tables, Compensation for Supplemental Costs, as accepted by the Port Authority.

X. In response to the Authority's Directive, the Contract Manager shall submit a written proposal that describes the work to be performed, contain a detailed breakdown of the labor involved by labor category, and state a firm lump sum price and a proposed schedule for the Work. The Work expended to prepare proposals is not a reimbursable expense. Labor costs to perform the work shall reflect the unit cost for labor itemized in the Attachment D Cost Proposal Tables for Unit Costs for Supplemental Work. Prior to performance of any supplemental work, the Port Authority's Project Manager shall approve any such Work in writing prior to execution.

Sensis has included rates for the indicated labor categories in the pricing table. When required, Sensis will provide a quotation for supplemental work that describes the scope and required labor categories. Prior to commencing work, Sensis will await authorization of the Port Authority's Project Manager.

1.2.10 Scheduled Maintenance

X. G. Hours of Scheduled Maintenance

X. Scheduled preventive maintenance of System components shall be conducted between the hours of midnight and 0500 EST.

Preventive maintenance will be conducted in off hours, between midnight and 0500 EST and will not impact service availability.

1.2.11 System Administration

X. H. System Administration

X. The Contractor shall perform all system and application administration functions in accordance with the requirement stated in Exhibit 4.

System administration will be done in compliance with Exhibit 4.

1.2.12 Training

X. I. Training

X. The Contractor shall provide supplemental on-site refresher training twice a year, when requested by the Port Authority, using the training material already provided, for approximately 100 hours each 6 months. Refresher training shall also be provided to Users working in the airline industry in accordance with the approved training plan for off-site users. Payment for refresher training shall be separated from the overall maintenance costs (see Attachment D, Cost proposal Form);

Refer to Section F-1-VII Users and Training for all training related requirements.

1.2.13 Disaster Recovery Plan

X. J. Disaster Recovery Plan

X. The Contractor shall create, review and test the disaster recovery plan in accordance with the requirements stated in Exhibit 3. In the event a catastrophic event causes damage to the System or a portion of the System's components, the Contractor shall restore the System and its operation in accordance with the approved Disaster Recovery Plan.

Refer to Section F-3 – Management Proposal, paragraph 1.6.1 for the Disaster Recovery Plan.

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1. SECTION C - COMPLIANCE MATRIX 1

1. Section C - Compliance Matrix

The following matrix provides the proposed Sensis compliance to Phase A and Phase B, related comments, a cross-reference to the appropriate proposal section, and a preliminary view of the test events and test methods.

Please note, Sensis is not proposing any software development specific to this procurement. Aerobahn is a commercial product that is undergoing continuous improvement and development, as outlined by the Aerobahn product roadmap. Some functionality will be available in the COTS product that is available for the Phase A deployment, other functions are on the Aerobahn roadmap for future releases, one of which will be available for Phase B.

Section	Requirement	Phase A	Phase B	Proposal Cross Reference	Comments	Test Phase	Procedure Only	Verification Method	FAT Only
	SCOPE OF WORK AND SPECIFICATIONS								
I.	**General Description of Services**								
I.	**Summary of Services**			Section F-1-I					
I.	The Contractor shall design, furnish, and install, and maintain a Surface Management System (SMS), hereafter referred to as the "System," host, operate, maintain and support the System, hereafter referred to as the "Services," that will provide the foundation for an information sharing, processing and display platform and service for the airline industry at John F. Kennedy International Airport (JFK). Elements of the service shall align with the FAA best practices and be adapted to meet local airport needs. The Contractor shall furnish and install necessary hardware and software in facilities selected and provided by the Contractor to host the System, subject to Port Authority approval, and establish connectivity between the System and external systems, and enable remote access through the Internet. The Contractor shall	C	C	Section F-1-I, General Description of Services, 1. Summary of Services					

Section	Requirement	Phase A	Phase B	Proposal Cross Reference	Comments	Test Phase	Procedure Only	Verification Method	FAT Only
	provide all hardware, software, specialized equipment, communications, tools, transportation and labor required to design, build, install, host, connect and integrate the System with other systems in order to make the System operational and provide the services as described herein.								
I.	The Contractor shall operate, maintain the System and provide system administration, train the Users and provide User support as per the requirements described in Attachment C Section X Maintenance of the System, which will begin upon completion of the 30-day operational test.	C	C	Section F-1-I, General Description of Services, 1. Summary of Services					
I.	References			Section F-1-I, General Description of Services, 2. References					
I.	All Work shall conform to the latest edition of the regulations, codes, standards and specifications listed below and all local codes, which would be applicable if the Authority were a private corporation. Where specific requirements are not listed the Contractor shall, at a minimum, conform to the latest revision of the references, standards, and publications listed below. In the event of a conflict, the more stringent criteria shall govern.	PC	PC	Section F-1-I, General Description of Services, 2. References	The Aerobahn SMS Service will conform to the specified references as detailed in the appropriate sections of this proposal.				
I.	• FAA 7233-1 Form, Exhibit 1	PC	PC		ASDI provides all the specified information except for the Remarks field. Sensis will include this information if a source is identified				
I.	• Data Elements Sheet, Exhibit 2	PC	C		Sensis will add data				

Section	Requirement	Phase A	Phase B	Proposal Cross Reference	Comments	Test Phase	Procedure Only	Verification Method	FAT Only
					fields as they become available from the various data feeds; full compliance is anticipated by Phase B.				
I.	• Statement on Auditing Standards No. 70-Level 2 (SAS-70 Level 2)	C	C						
I.	• Port Authority Audit Department Check lists, Exhibit *5*	C	C						
II.	**Project Delivery Guidelines**	C	C	Section F-1-II Project Delivery Guidelines					
II.	**Implementation Schedule**	C	C	Section F-1-II Project Delivery Guidelines					
II.	The project shall be delivered in two phases or "Implementation Periods". The two Implementation Periods are Phase A and Phase B. Phase A shall be the implementation and commencement of a system to replace the existing system and services that presently exist and are being performed at JFK as described in Attachment C. Section IV.B. Functional Requirements, with a final delivery/completion to be on or before January 15, 2012 (Base Date of Operational Usage).	C	C	Section F-1-II Project Delivery Guidelines					
II.	Also beginning on the Base Date of Operational Usage, the Contractor shall assume responsibility for hosting, operation, administration and maintenance of the system, which shall continue, to the end of the contract.	C	C	Section F-1-II Project Delivery Guidelines					
II.	Phase B shall consist of the design, deployment and operation of the System and Services, which shall include the expanded functionalities and capabilities stated in Attachment C, Section IV.C. Functional Requirements of Enhanced	C	C	Section F-1-II Project Delivery Guidelines					

Section	Requirement	Phase A	Phase B	Proposal Cross Reference	Comments	Test Phase	Procedure Only	Verification Method	FAT Only
	System and Services Phase B, and must be fully operational on or before July 1, 2012.								
II.	The successful Contractor shall provide the System and Services as described herein through a web-based platform that will be hosted, operated, administered and maintained by the Contractor in a location approved by the Port Authority.	C	C	Section F-1-II Project Delivery Guidelines					
II.	The Contractor may, at its option, elect to deliver any or all of the functional capabilities identified in Phase B as part of Phase A, as long as the Base Date of Operational Usage is achieved.	C	C	Section F-1-II Project Delivery Guidelines					
II.	The Proposer shall provide a Detailed Implementation Plan that addresses all the requirements of Attachment C, Scope of Work, and anticipates a short-term transition from the current hosting vendor and environment to the proposed implementation for hosted managed services and administration of the Surface Management System. The Proposer should describe the methodology they have used successfully in the past and describe how existing system integrity will not be lost. The Contractor must propose how they will guarantee the Authority's access to all data in the event of the termination or expiration of the current contract.	C	C	Section F-1-II Project Delivery Guidelines					
II.	The Contractor must propose how it will assist with the transition to a new vendor to minimize service interruption to the Authority in the event of termination or expiration of contract.	C	C	Section F-1-II Project Delivery Guidelines					
II.	**Base Date of Operational Usage**	C		Section F-1-II Project Delivery Guidelines					
II.	The Base Date of Operational Usage is on or before January 15, 2011. The Contractor shall	C		Section F-1-II Project Delivery Guidelines					

Section	Requirement	Phase A	Phase B	Proposal Cross Reference	Comments	Test Phase	Procedure Only	Verification Method	FAT Only
	complete all work, finish the Operational Acceptance Test and begin to provide the System and Services as described herein prior to the Base Date of Operational Usage. Failure to provide the System and Services by the Base Date of Operational Usage will result in liquidated damages as described in the Contract, Section 16, Liquidated Damages.								
III.	**Requirements for Staffing**	C	C	Section F-1-III-Requirements for Staffing, 1. Requirements for Staffing/Staffing Plan					
III.	The contractor is required to provide Staffing as described herein and in the Contract Specific Terms and Conditions. Staffing/Personnel arc required to operate, interact, and maintain the System provided by the Contractor, therefore the proposed staffing level plan and Pricing Sheet provided by the Port Authority shall be included in the Contractor's proposal. The proposal shall have a detailed layout describing the experience levels of the staff in relation, where applicable, to their knowledge of Air Traffic Operations in the Northeast Region and the National Airspace System. The proposal shall reflect pricing for all staff necessary to host, operate, maintain and support the project , including an FCC licensed person who may operate a 'Metering Frequency" on site at JFK, and interface via radio with the Aircraft to communicate appropriate information if the Port Authority deems it necessary. If the Port Authority decides to implement a procedure where the Contractor will communicate directly with Aircraft, it shall provide the Contractor with 30 days notice prior	C	C	Section F-1-III-Requirements for Staffing, 1.2 Coordination Center Staffing					

Section	Requirement	Phase A	Phase B	Proposal Cross Reference	Comments	Test Phase	Procedure Only	Verification Method	FAT Only
	to the implementation of the 'Metering Frequency" option. The Port Authority reserves the right to invoke the option for various staffing levels to include or not include the FCC licensed radio operator. Staffing will be necessary at all times demand typically exceeds capacity, between 0700-1000 and 1400-2300 EST, and during irregular operations such as a severe weather event. Staffing during Irregular Operations requires coordination with Airport Operations. Any increases or decreases in staff to support the operation shall require written approval by the Port Authority's Project Manager.								
IV.	**Functional Requirements**			Section F-1-IV-Functional Requirements					
IV.	**A. General Description of Services**			Section F-1-IV-Functional Requirements					
IV.	The Contractor shall provide the Services to the Port Authority as described herein this Scope of Work. The essence of the work is to provide a Surface Management Solution with predictive capability enabling efficient queue management and sequencing on an allocation basis, and conflict alerting for arrival aircraft, operating at JFK. The allocation method shall be determined and approved by the Port Authority. The proposed solution shall take into account current and forecasted FAA, airfield, capacity and weather restrictions and combine with rationing principles to issue appropriate taxi times for departing aircraft. The intent of such procedures is to enable efficient management of flights by maximizing departure opportunities through	PC	C	Section F-1-IV-Functional Requirements, 1.1 General Description of Services	See detailed comments below.	N/A			

Section	Requirement	Phase A	Phase B	Proposal Cross Reference	Comments	Test Phase	Procedure Only	Verification Method	FAT Only
	supply of appropriate and sufficient aircraft to the departure queue. Additionally, the System shall allocate taxi times that reflect current and forecasted constraints to maintain departure queue lengths to multiple runways, as deemed appropriate by the Port Authority. This shall enable departing aircraft to minimize the amount of time spent on the taxi-out by absorbing most of the departure delay at the gate, or on other areas of the airfield, instead of absorbing it in the departure queue. The underlying system will also provide strategic, pre-tactical and tactical efficiency, post operations metrics and performance analysis of surface operations. The Service shall focus on improving overall safety, efficiency and predictability of surface and surrounding airspace by providing the necessary information to Users for the benefit of the entire airport and the national air traffic system.								
IV.	The Users include but are not limited to Th~ Port Authority of NY & NJ, Federal Aviation Administration (FAA), and other entities that utilize the Port Authority Airports to conduct business such as Airlines, Air Cargo Operators, Business and General Aviation Operators, Military, Ground Handling Companies, Flight Plan Service Providers and any other Stakeholder deemed appropriate by the Port Authority.			Section F-1-IV-Functional Requirements, 1.1 General Description of Services		N/A			
IV.	The Services provided through the System shall support, at a minimum, the following processes and fields:			Section F-1-IV-Functional Requirements, 1.1 General Description of Services					
IV.	• Strategic, pre-tactical and tactical traffic flow management through allocations of taxi times	C	C	Section F-1-IV-Functional		N/A			

Section	Requirement	Phase A	Phase B	Proposal Cross Reference	Comments	Test Phase	Procedure Only	Verification Method	FAT Only
				Requirements, 1.1 General Description of Services					
IV.	• Pre-tactical and tactical departure management for merging into an en route stream or to a common departure fix(es) from multiple runway configurations;	C	C	Section F-1-IV-Functional Requirements, 1.1 General Description of Services		N/A			
IV.	• Pre-tactical and tactical aircraft sequencing, scheduling and runway allocations to meet airport arrival and departure operating constraints; this method to achieve this function must be proposed by the Contractor and must support the needs FAA traffic management initiatives, weather constraints and other operational constraints. The proposed method is subject to Port Authority approval.	C	C			A	Y	T	
IV.	• Provide situational awareness through real-time surface surveillance in movement and non-movement areas;	C	C	Section F-1-IV-Functional Requirements, 1.1 General Description of Services		A		T	Y
IV.	• Fuel and emissions impact modeling and reporting;	C	C	Section F-1-IV-Functional Requirements, 1.1 General Description of Services		N/A			
IV.	• Operational and post operations metrics and performance analysis and prediction summaries.	C	C	Section F-1-IV-Functional Requirements, 1.1 General Description of Services		A & B	Y	T & A	Y
IV.	• Gate conflict forecasting and alerting	C	C	Section F-1-IV-Functional Requirements, 1.1 General Description of		A & B	Y	T	Y

Section	Requirement	Phase A	Phase B	Proposal Cross Reference	Comments	Test Phase	Procedure Only	Verification Method	FAT Only
				Services					
IV.	• Surface saturation prediction	C	C	Section F-1-IV-Functional Requirements, 1.1 General Description of Services		A & B	Y	T & A	Y
IV.	**B. Description of Work**			Section F-1-IV-Functional Requirements, 1.2 Description of Work					
IV.	The Work requires the design, development, installation, hosting, operation, administration, maintenance and management of a System, as well as training and supplying an ongoing Help Desk support to the Users, for a predictive surface management capability, which shall calculate, at a minimum, forecasted operations for flights, including off block and in block times, runway times, spot times and taxi times. Using these predictions, the Service shall provide a display of predicted runway queues along with the anticipated delays for each queue. Such features shall support not only tactical control of surface operations to result in optimal queuing of aircraft to ensure constant pressure on the runway when demand exists. The System shall also support strategic surface planning and forecasting for the Users who include, but are not limited to various department heads and staff from The Port Authority of NY & NJ, the FAA, Airlines, Air Cargo Operators, Business and General Aviation Operators, Military, Ground Handling Companies, Flight Plan Service Providers and any other Stakcholder deemed appropriate by the Port Authority.	C	C	Section F-1-IV-Functional Requirements, 1.2 Description of Work		A & B	Y	T & A	Y
IV.	The Service shall enable active management of	C	C	Section F-1-IV-		A & B	Y	T & A	Y

Section	Requirement	Phase A	Phase B	Proposal Cross Reference	Comments	Test Phase	Procedure Only	Verification Method	FAT Only
	surface gridlock and terminal/gate congestion through predicting surface saturation and providing alerts to the Users. The gate terminal/gate conflict alert shall be configurable to support a variety of User work processes. Through surface saturation management, the Service shall support the Users during development and execution of pre-tactical plans to maintain the number of flights at the airport within manageable bounds. The Service shall be configurable to allow for the design of an airport, airline and/or terminal-specific flow rate program, tailored to the anticipated and predicted surface problem. Using specified parameters, the service shall assign recommended aircraft arrival and departure times to balance the distribution of flights on the surface and alleviate predicted congestion issues.			Functional Requirements, 1.2 Description of Work					
IV.	1. Hosting the System								
IV.	The Contractor shall host the System and its components in a protected, secure environment that is not on Port Authority property, subject to Port Authority approval, and in compliance with the requirements stated in Section V. B. Security Requirements. The System shall be built using a fault tolerant architecture in compliance with the requirements stated in Section V. C. System Architecture, and the backup or failover servers and components shall be installed in a diversely located data center to support disaster recovery and protect the System, and prevent any disruption of Services due to a catastrophic event in the primary data center.	C	C	Section F-1-IV-Functional Requirements, 1.2.1 Hosting the System		N/A			
IV.	**C. Functional Requirements of Initial Implementation-Phase A**			Section F-1-IV-Functional					

Section	Requirement	Phase A	Phase B	Proposal Cross Reference	Comments	Test Phase	Procedure Only	Verification Method	FAT Only
				Requirements, 1.3 Functional Requirements of Initial Implementation-Phase A					
IV.	The requirements listed below represent, at a minimum, the Services that shall be provided by the Contractor as part of the Initial Implementation, in accordance with the implementation phasing stated in Attachment C, Section II.A.2. entitled, Implementation Schedule. The proposed methods to achieve this functionality are subject to approval by the Port Authority.			Section F-1-IV-Functional Requirements, 1.3 Functional Requirements of Initial Implementation-Phase A					
IV.	1. Departure management capability utilizing rationing principles	C	C	Section F-1-IV-Functional Requirements, 1.3.2 Departure Management Capability		A	Y	T & D	Y
IV.	2. Allocate "call-for-taxi" times (CFT's) based on set rules and protocols using rationing principles and calculation under the guidance of the Port Authority	C	C	Section F-1-IV-Functional Requirements, 1.3.2 Departure Management Capability		A	Y	T & D	Y
IV.	3. Automatically populate scheduled flight information through a Port Authority approved source, such as ETMS (Enhanced Traffic Management System) into the departure management capability of the System. Additionally, the Service shall have the capability to manually input and add flights, which are not automatically populated. Such type flights may include nonscheduled, ad hoc,	C	C	Section F-1-IV-Functional Requirements, 1.3.2 Departure Management Capability		A	Y	T & D	Y

Section	Requirement	Phase A	Phase B	Proposal Cross Reference	Comments	Test Phase	Procedure Only	Verification Method	FAT Only
	ferry flights and general aviation flights.								
IV.	4. Automatically populate a "call-for-taxi" time based on Port Authority approved parameters.	C	C	Section F-1-IV-Functional Requirements, 1.3.2 Departure Management Capability		A	Y	T & D	Y
IV.	5. As conditions and demand require, monitor and process substitution requests for eligible flights based on Rationing principles and other variables deemed appropriate by the Port Authority	C	C	Section F-1-IV-Functional Requirements, 1.3.2 Departure Management Capability		A	Y	T & D	Y
IV.	6. Provide an interface enabling instant communication, textual and otherwise, with all parties (i.e. a chat function) for information sharing or another Port Authority approved method	C	C	Section F-1-IV-Functional Requirements, 1.3.3 Chat		A	Y	T	Y
IV.	7. Gain knowledge of and distribute the forecasted operational plan for the airport, airspace, expected arrival and departure rates and runway usage, expected/known delays, weather forecast, and challenges either by participation in strategic teleconference with the FAA or an approved equivalent source.	C	C	Section F-1-IV-Functional Requirements, 1.3.9 Operational Support		N/A			
IV.	8. Monitor status of departure queues by runway and departure fix, and current taxi-out times, then predict and mitigate imbalances prior to development	C	C	Section F-1-IV-Functional Requirements, 1.3.6 Airport Status and Summary Display		A	Y	T & D	Y
IV.	9. Provide a graphical, dynamic, user-friendly snap shot indicating the actual and forecasted departure demand of the airport. This graphic shall include current and forecasted, configurable delay criteria	C	C	Section F-1-IV-Functional Requirements, 1.3.6 Airport Status and Summary Display		A		T	Y
IV.	10. Monitor aircraft that are experiencing	C	C	Section F-1-IV-		A		T	Y

Section	Requirement	Phase A	Phase B	Proposal Cross Reference	Comments	Test Phase	Procedure Only	Verification Method	FAT Only
	excessive time off the gate or stand and provide configurable alerts to notify the flight operator or other approved User of the flight status.			Functional Requirements, 1.3.5 Flight Alerting					
IV.	11. Provide carriers access to current taxi delays. This is to assist in gate planning decisions regarding whether to take departure delays at the gate or in a metering location	C	C	Section F-1-IV-Functional Requirements, 1.3.6 Airport Status and Summary Display		A		T	Y
IV.	12. Recommend departure delay parking locations as requested by ramp controllers ("metering" locations are subject to approval by the Port Authority). An example of the metering locations is provided in Exhibit 7, Available Holding Spots Overall. The "metering locations" provided in Exhibit 7 are subject to change.	C	C	Section F-1-IV-Functional Requirements, 1.3.2 Departure Management Capability		A	Y	T & D	Y
IV.	13. If departure delay is taken at the gate, movement area metering location, or other non-movement area metering location, continue to actively manage flights in the program	C	C	Section F-1-IV-Functional Requirements, 1.3.2 Departure Management Capability		A	Y	T & D	Y
IV.	14. Data and shared information shall be warehoused and made easily accessible and available for retrieval, analysis and playback	C	C	Section F-1-IV-Functional Requirements, 1.3.7 Data Archival and Reporting		A		T	Y
IV.	15. The System shall provide the capability to view live, current data and archived, warehoused data, both on separate screen displays and in reports.	C	C	Section F-1-IV-Functional Requirements, 1.3.4 Traffic Display		A		T	Y
IV.	16. Provide live flight tracking of inbound and outbound flights from the surface to 10,000 feet and within a 100-mile radius of the airport for 15 Port Authority Users.	C	C	Section F-1-IV-Functional Requirements, 1.3.4 Traffic Display		A	Y	T	Y
IV.	17. Automate alerts for critical events such as: aircraft arriving at key locations both Enroute	C	C	Section F-1-IV-Functional		B		T	Y

Section	Requirement	Phase A	Phase B	Proposal Cross Reference	Comments	Test Phase	Procedure Only	Verification Method	FAT Only
	and/or on the ground (such as a metering location or arrival fix), arrival aircraft assigned to a gate that is currently occupied, and when the taxi time of an aircraft exceeds a user-defined number of minutes. Users shall select the method of notification, to include, but not limited to: on screen display highlighting the aircraft that triggered the alert condition, audible workstation alarm and electronic methods such as email, text message, etc.) to an individual or groups.			Requirements, 1.3.5 Flight Alerting					
IV.	18. Provide a Graphical User Interface displaying surface surveillance. This feature shall display real-time information and have historical playback capability	C	C	Section F-1-IV-Functional Requirements, 1.3.4 Traffic Display		A	Y	T	
IV.	19. The system shall automatically retrieve published airline schedules from a Port Authority approved source for 48 hours in advance of the current time and should save any changes i.e. cancellations, time changes, etc.) input by the Users. The Airline schedules shall be displayed in an orderly manner, based on the scheduled time of departure.	C	C	Section F-1-IV-Functional Requirements, 1.3.1 Airline Schedules (C19)		B	Y	T	Y
IV.	20. The Users shall have the capability to input a time reflecting the earliest time that an aircraft can be ready to taxi for departure. The System shall receive this information and allocate taxi times respectively.	C	C	Section F-1-IV-Functional Requirements, 1.3.2 Departure Management Capability		A	Y	T & D	Y
IV.	21. The Users shall have the capability to swap flights under their control to self-prioritize based on the rationing principles set forth.	C	C	Section F-1-IV-Functional Requirements, 1.3.2 Departure Management Capability		A	Y	T & D	Y
IV.	22. Warehouse and make easily accessible data	PC	C	Section F-1-IV-	The Aerobahn	N/A			

Section	Requirement	Phase A	Phase B	Proposal Cross Reference	Comments	Test Phase	Procedure Only	Verification Method	FAT Only
	and shared information as presented in the Metrics section of this document, to produce approved, appropriately designed reports.			Functional Requirements, 1.3.7 Data Archival and Reporting	product roadmap provides for this functionality to be complete prior to the beginning of Phase B service.				
IV.	23. Use any other supporting tools provided for use by the PANYNJ, FAA, Air Carriers, Terminal Operators or other Users deemed appropriate by the Port Authority.	C	C	Section F-1-IV-Functional Requirements, 1.3.11 Third-Party Tool Support		B	Y	T	Y
IV.	24. The system shall provide the capability to add flights to the schedule. Examples of such flights include but are not limited to non-scheduled, ad hoc, ferry flights and general aviation flights.	C	C	Section F-1-IV-Functional Requirements, 1.3.2 Departure Management Capability		A	Y	T & D	Y
IV.	25. Support and Maintain adherence to the Code of Conduct established by the Port Authority	C	C	Section F-1-IV-Functional Requirements, 1.3.10 Administration and Customer Support		N/A			
IV.	26. Conduct quarterly meetings to review said Code of Conduct and support changes.	C	C	Section F-1-IV-Functional Requirements, 1.3.10 Administration and Customer Support		N/A			
IV.	27. Attend, participate in and support User interface meetings on a bi-weekly basis at JFK.	C	C	Section F-1-IV-Functional Requirements, 1.3.10 Administration and Customer Support		N/A			
IV.	28. Provide 24 x 7 User support to provide information regarding system functionality and troubleshooting	C	C	Section F-1-IV-Functional Requirements, 1.3.10 Administration and		N/A			

Section	Requirement	Phase A	Phase B	Proposal Cross Reference	Comments	Test Phase	Procedure Only	Verification Method	FAT Only
				Customer Support					
IV.	29. Administer new Users	C	C	Section F-1-IV-Functional Requirements, 1.3.10 Administration and Customer Support		N/A			
IV.	30. Track and report service irregularities to the Port Authority and Port Authority authorized recipients. Describe the process for reporting, tracking and resolving problems encountered by Users.	C	C	Section F-1-IV-Functional Requirements, 1.3.10 Administration and Customer Support		N/A			
IV.	31. Terminology and nomenclature used to describe the data elements in the Service shall support interoperability with current Surface Management Systems to the extent practical and shall be approved by the Port Authority.	PC	C	Section F-1-IV-Functional Requirements, 1.3.8 Data Element Terminology	The Aerobahn product roadmap provides for this functionality to be complete prior to the beginning of Phase B service.	N/A			
IV.	32. Issue Daily Summaries of the operation including the following information: weather, runway configuration, ATC programs, hourly snapshots of the number of aircraft in the departure queue(s), hourly stats (i.e. number of actual departures and arrivals vs. the three-month average), list of non-compliant aircraft, and Summary of the operation.	PC	C	Section F-1-IV-Functional Requirements, 1.3.6 Airport Status and Summary Display	The Aerobahn product roadmap provides for this functionality to be complete prior to the beginning of Phase B service.	A	Y	T	
IV.	**D. Functional Requirements of Enhanced System and Services-Phase B**								
IV.	In addition to the above Functional Requirements of Initial Implementation, the requirements listed below represent, at a minimum, the enhanced functionalities and capabilities that shall be provided by the Contractor in accordance with the implementation phasing stated in Attachment C, Section II. A. Implementation Schedule. The			Section F-1-IV-Functional Requirements, 1.4 Functional Requirements of Enhanced System and Services-Phase B		N/A			

Section	Requirement	Phase A	Phase B	Proposal Cross Reference	Comments	Test Phase	Procedure Only	Verification Method	FAT Only
	proposed methods to achieve the required functionality are subject to approval by the Port Authority.								
IV.	1. General Requirements for Enhanced Operation								
IV.	a. Forecast airport capacity and demand information for the JFK operation and surrounding airspace in a rolling time window, for a minimum of four hours ahead.	PC	C	Section F-1-IV-Functional Requirements, 1.4.1.4 Capacity and Demand Forecasting and Alerting	The Aerobahn product roadmap provides for this functionality to be complete prior to the beginning of Phase B service.	B	Y	T	Y
IV.	b. Provide alert notifications that correspond to specific operational events.	C	C	Section F-1-IV-Functional Requirements, 1.4.1.2 Flight Alerting		A	Y	T	Y
IV.	c. Automatically alert Users when there is an expected imbalance between capacity and demand for both arrival and departure traffic. User shall have the ability to configure whether the alert is visual, aural or both.	PC	C	Section F-1-IV-Functional Requirements, 1.4.1.4 Capacity and Demand Forecasting and Alerting	The Aerobahn product roadmap provides for this functionality to be complete prior to the beginning of Phase B service.	B	Y	T	Y
IV.	d. Provide a 'chat' function or other approved means of facilitating instantaneous communication between Users.	C	C	Section F-1-IV-Functional Requirements, 1.4.1.6 Chat		A	Y	T	Y
IV.	e. Have a feature to provide instant replay of specified historical time periods, synchronizing both surface surveillance, chosen local radio frequencies, and the respective time frame of the taxi time allocation and chat functions. The System shall have the capability to save a copy of the recorded playback in a MPEG-2 format.	PC	C	Section F-1-IV-Functional Requirements, 1.4.1.8 Playback with Audio	The Aerobahn product roadmap provides for this functionality to be complete prior to the beginning of Phase B service.	B	Y	T	Y
IV.	f Contractor shall develop a performance measure, "Scorecard" to facilitate assessment of	PC	C	Section F-1-IV-Functional	The Aerobahn product roadmap	B	Y	T	Y

Section	Requirement	Phase A	Phase B	Proposal Cross Reference	Comments	Test Phase	Procedure Only	Verification Method	FAT Only
	overall airport operational performance and the performance of individual Users. This Scorecard shall assess accuracy and timeliness of shared data and performance including routine compliance measurement/analysis. The format and content of this Scorecard shall be proposed by the Contractor and approved by the Port Authority.			Requirements, 1.4.1.3 Airport Status and Summary Display	provides for this functionality to be complete prior to the beginning of Phase B service.				
IV.	g. Surface surveillance may be dependent on Federal Aviation Administration (FAA) system, e.g., ASDE-X, TFMS, ADS-B, or it may rely on an approved alternative(s) that provide(s) information comparable to data available through ASDE-X.	C	C	Section F-1-IV-Functional Requirements, 1.4.1.10 Surveillance		B		T	Y
IV.	h. If wholly independent of FAA systems, unless otherwise agreed to by the PANYNJ, the surveillance or alternatively approved infrastructure shall be refreshed and/or upgraded a minimum every two (2) years.	NA	NA	Section F-1-IV-Functional Requirements, 1.4.1.10 Surveillance	The Aerobahn SMS Service relies on the FAA-owned JFK ASDE-X and ASDE-X Gate systems. Therefore, this requirement is not applicable.	N/A			
IV.	i. Provide a secure, web-based environment available to authorized, geographically dispersed Users.	C	C	Section F-1-IV-Functional Requirements, 1.4.1.11 Web-Based Access		A	Y	T	
IV.	j. Forecast the projected airport throughput rates based on historical performance and current and forecasted conditions, including weather, flight schedule demand, traffic management initiatives and other operational constraints.	C	C	Section F-1-IV-Functional Requirements, 1.4.1.9 Operational Support		B	Y	T & D	Y
IV.	k. Estimate departure delay time during irregular operations such as dc-icing.	NC	C	Section F-1-IV-Functional Requirements, 1.4.1.3 Airport Status and	The Aerobahn product roadmap provides for this functionality to be	B	Y	T & D	Y

Section	Requirement	Phase A	Phase B	Proposal Cross Reference	Comments	Test Phase	Procedure Only	Verification Method	FAT Only
				Summary Display	complete prior to the beginning of Phase B service.				
IV.	l. The system shall have a feature that allows metering to individual runways and departure fixes to optimize aircraft sequencing to best meet the demands and priorities of FAA programs, as well as airfield and airspace constraints and opportunities	PC	C	Section F-1-IV-Functional Requirements, 1.4.1.5 Departure Management Capability - Final	The Aerobahn product roadmap provides for this functionality to be complete prior to the beginning of Phase B service.	B	Y	T & D	Y
IV.	m. Provide the capability to allow a User to match a "delay type time-stamp" for an Aircraft to log an operational event such as a reason for a delay. There shall be a list of 20 delay type time-stamps available in a drop-down style menu. These data elements will be stored, accessible and available to appropriate Users for reporting purposes.	PC	C	Section F-1-IV-Functional Requirements, 1.4.1.7 Manual Operational Event Tagging	The Aerobahn product roadmap provides for this functionality to be complete prior to the beginning of Phase B service.	B	Y	T	Y
IV.	n. Provide a status window graphically displaying delay length in time and/or number of aircraft for each runway. This display is to provide an accurate snapshot of the departure demand at the airport.	PC	C	Section F-1-IV-Functional Requirements, 1.4.1.3 Airport Status and Summary Display	The Aerobahn product roadmap provides for this functionality to be complete prior to the beginning of Phase B service.	B	Y	T	Y
IV.	o. Enable the Users to swap their own flights provided the change is within the agreed upon rationing principles set forth.	C	C	Section F-1-IV-Functional Requirements, 1.4.1.5 Departure Management Capability - Final		B	Y	T & D	Y
IV.	p. System must be capable of displaying predictive aircraft taxi times, to include, but not limited to:			Section F-1-IV-Functional Requirements, 1.4.1.1 Flight Data Display					
IV.	i. From runway touchdown to the ramp;	C	C	Section F-1-IV-		B	Y	T	Y

Section	Requirement	Phase A	Phase B	Proposal Cross Reference	Comments	Test Phase	Procedure Only	Verification Method	FAT Only
				Functional Requirements, 1.4.1.1 Flight Data Display					
IV.	ii. From the ramp to the gate;	C	C	Section F-1-IV-Functional Requirements, 1.4.1.1 Flight Data Display		B	Y	T	Y
IV.	iii. From the gate to the taxiway;	C	C	Section F-1-IV-Functional Requirements, 1.4.1.1 Flight Data Display		B	Y	T	Y
IV.	iv. From the taxiway to departure;	C	C	Section F-1-IV-Functional Requirements, 1.4.1.1 Flight Data Display		B	Y	T	Y
IV.	v. Display aircraft taxi times, to include, but not limited to;	C	C	Section F-1-IV-Functional Requirements, 1.4.1.1 Flight Data Display		N/A			
IV.	vi. From the gate to the taxiway	C	C	Section F-1-IV-Functional Requirements, 1.4.1.1 Flight Data Display		B	Y	T	Y
IV.	vii. From the taxiway to the metering location, hard stand dc-icing padsFrom the metering location, hard stand or dc-icing pads to departure	C	C	Section F-1-IV-Functional Requirements, 1.4.1.1 Flight Data Display		B	Y	T	Y
IV.	viii. From the gate to departure (For example, the system should provide estimated taxi times (from the gate to departure (wheels-up)) for aircraft ready to push back from the gate.	C	C	Section F-1-IV-Functional Requirements, 1.4.1.1 Flight Data Display		B	Y	T	Y
IV.	ix. Provide monitoring and reporting of aircraft that occupy or travel through a defined Region of Interest (ROI). Examples of ROIs include airport taxiways, runways, holding areas, parking areas, approach corridors, gates,	C	C	Section F-1-IV-Functional Requirements, 1.4.1.1 Flight Data Display		B	Y	T	Y

Section	Requirement	Phase A	Phase B	Proposal Cross Reference	Comments	Test Phase	Procedure Only	Verification Method	FAT Only
	concourses of gates, and other definable sections of movement and non-movement areas.								
IV.	2. Integration with External Systems								
IV.	The System shall integrate with external systems to receive and distribute key Data Elements in accordance with the Scope of Work. Flight Plan Data Elements, Additional Data Elements and potential sources are listed in Exhibit 2, Data Element Sheet. The Service shall, at a minimum, integrate with the external systems listed in Exhibit 6 or another Port Authority approved equivalent.	C	C	Section F-1-IV-Functional Requirements, 1.4.2 Integration with External Systems		A		T	Y
IV.	3. Function to Receive and/or Distribute Data Elements								
IV.	The Service shall receive and distribute the data elements listed in Exhibit 2, Data Element Sheet to perform functions in accordance with the Scope of Work. The data shall be derived from indicated general sources listed in the Data Element Sheet or approved equivalent:	PC	C	Section F-1-IV-Functional Requirements, 1.4.3 Function to Receive and/or Distribute Data Elements	Sensis will retrieve and distribute whatever data is available to the system. We will distribute whatever data Aerobahn produces as appropriate considering negotitated authorization. The Aerobahn product roadmap provides for this functionality to be co[illegible]plete prior to [illegible] beginning of [illegible]se B service.	N/A			
IV.	a. Adaptation Data — This data describes the layout of the airport. It shall include runways, taxiways, ramps, gates/stands among other	C	C	Section F-1-IV-Functional Requirements, 1.4.3.1		A		T	Y

Section	Requirement	Phase A	Phase B	Proposal Cross Reference	Comments	Test Phase	Procedure Only	Verification Method	FAT Only
	items.			Adaptation Data					
IV.	b. Surface Surveillance Data —Data received shall include real-time position information of aircraft and surface vehicles in both movement and non-movement areas. Sources include FAA and commercial systems.	C	C	Section F-1-IV-Functional Requirements, 1.4.3.2 Surface Surveillance Data		A		T	Y
IV.	c. Traffic Flow Management System (TFMS) Data — **Data received from TFMS shall include** flight plan information, takeoff time (DZ message), Traffic Management Initiative (TMI) data, etc. The data made available to TFMS shall include predicted taxi time, wheels off time, etc.	PC	C	Section F-1-IV-Functional Requirements, 1.4.3.3 Traffic Flow Management Data	Sensis will retrieve and distribute whatever data is available to the system. We will distribute whatever data Aerobahn produces as appropriate considering negotitated authorization. The Aerobahn product roadmap provides for this functionality to be complete prior to the beginning of Phase B service.	B	Y	T	Y
IV.	d. Traffic Management Advisor (TMA) Data — Data received from TMA shall include arrival time estimates at arrival fixes and runway thresholds, and identification of arrival runway assigned to the arriving aircraft if available.	NC	C	Section F-1-IV-Functional Requirements, 1.4.3.4 Traffic Management Advisor (TMA) Data	Sensis will retrieve and distribute whatever data is available to the system. We will distribute whatever data Aerobahn produces as appropriate considering negotitated	B	Y	T	Y

Section	Requirement	Phase A	Phase B	Proposal Cross Reference	Comments	Test Phase	Procedure Only	Verification Method	FAT Only
					authorization. The Aerobahn product roadmap provides for this functionality to be complete prior to the beginning of Phase B service.				
IV.	e. Weather Data — Data received shall include Integrated Terminal Weather System (ITWS) data, and Aviation Routine Weather Report (METAR), Corridor Integrated Weather System (CIWS), wind direction and velocity reports, Runway Visual Range (RVR), and Terminal Aerodrome Forecast (TAF) data and Route Availability Planning Tool (RAPT) or any other Port Authority approved equivalent.	PC	PC	Section F-1-IV-Functional Requirements, 1.4.3.5 Weather Data	Sensis will provide limited integration of ITWS, CIWS, and RAPT for the use in the Metering Coordination Center provided feeds from these systems are available.	B	Y	T	Y
IV.	f National Airspace System (NAS) Operator Supplied Data — The data received shall include estimated gate/stand time, boarding time, target off block time, flight prioritization, other readiness of flight indicators, etc.	PC	C	Section F-1-IV-Functional Requirements, 1.4.3.6 NAS Operator Supplied Data	Sensis will retrieve and distribute whatever data is available to the system. We will distribute whatever data Aerobahn produces as appropriate considering negotitated authorization. The Aerobahn product roadmap provides for this functionality to be complete prior to the beginning of	B	Y	T	Y

Section	Requirement	Phase A	Phase B	Proposal Cross Reference	Comments	Test Phase	Procedure Only	Verification Method	FAT Only
					Phase B service.				
IV.	g. Other data — This could include data from airport authority, such as Flight Information Display System (FIDS), etc.	C	C	Section F-1-IV-Functional Requirements, 1.4.3.6 NAS Operator Supplied Data		A		T	Y
IV.	4. Graphical User Displays								
IV.	The Contractor shall provide, at a minimum, graphical displays to enable the User to perform the functionality described below:	C	C	Section F-1-IV-Functional Requirements, 1.4.4 Graphical User Displays		A		T	Y
IV.	a. Combine and Process Flight Data								
IV.	This section lists below and describes the basic information that the System determines from the input data and then makes available to the User through information displays. Each individual component is not necessarily displayed directly to the User; rather the System combines this data into a set of informational displays presented on User terminals. The System shall process the data it collects, thereby generating both descriptive and predictive information about current and expected airport surface traffic situation and flows. This information shall include for each flight handled by the airport, the expected or predicted values for the quantities. These informational displays shall be updated frequently, in near real time, the frequency at which shall be approved by the Port Authority and will contain at a minimum the following information:	C	C	Section F-1-IV-Functional Requirements, 1.4.4.1 Combine and Process Flight Data		A		T	Y
IV.	i. Flight number	C	C	Section F-1-IV-Functional Requirements, 1.4.4.1 Combine and Process		A		T	Y

Section	Requirement	Phase A	Phase B	Proposal Cross Reference	Comments	Test Phase	Procedure Only	Verification Method	FAT Only
				Flight Data					
IV.	ii. Aircraft type	C	C	Section F-1-IV-Functional Requirements, 1.4.4.1 Combine and Process Flight Data		A		T	Y
IV.	iii. Heavy designator	C	C	Section F-1-IV-Functional Requirements, 1.4.4.1 Combine and Process Flight Data		A		T	Y
IV.	iv. Mode S	C	C	Section F-1-IV-Functional Requirements, 1.4.4.1 Combine and Process Flight Data		A		T	Y
IV.	v. Mode3A	C	C	Section F-1-IV-Functional Requirements, 1.4.4.1 Combine and Process Flight Data		A		T	Y
IV.	vi. Destination city for departing flights	C	C	Section F-1-IV-Functional Requirements, 1.4.4.1 Combine and Process Flight Data		A		T	Y
IV.	vii. Originating city for arriving flights	C	C	Section F-1-IV-Functional Requirements, 1.4.4.1 Combine and Process Flight Data		A		T	Y
IV.	viii. Estimated time of arrival	C	C	Section F-1-IV-Functional Requirements, 1.4.4.1 Combine and Process Flight Data		A		T	Y

Section	Requirement	Phase A	Phase B	Proposal Cross Reference	Comments	Test Phase	Procedure Only	Verification Method	FAT Only
IV.	ix. Estimated time of departure	C	C	Section F-1-IV-Functional Requirements, 1.4.4.1 Combine and Process Flight Data		A		T	Y
IV.	x. Predicted time of arrival	C	C	Section F-1-IV-Functional Requirements, 1.4.4.1 Combine and Process Flight Data		A		T	Y
IV.	xi. Predicted time of departure	C	C	Section F-1-IV-Functional Requirements, 1.4.4.1 Combine and Process Flight Data		A		T	Y
IV.	xii. Identification of arrival runway assigned to the arriving aircraft	PC	C	Section F-1-IV-Functional Requirements, 1.4.4.1 Combine and Process Flight Data	Sensis will retrieve and distribute whatever data is available to the system. We will distribute whatever data Aerobahn produces as appropriate considering negotitated authorization. The Aerobahn product roadmap provides for this functionality to be complete prior to the beginning of Phase B service.	B	Y	T	Y
IV.	xiii. Predicted arrival runway assigned to the arriving aircraft	C	C	Section F-1-IV-Functional		A		T	Y

Section	Requirement	Phase A	Phase B	Proposal Cross Reference	Comments	Test Phase	Procedure Only	Verification Method	FAT Only
				Requirements, 1.4.4.1 Combine and Process Flight Data					
IV.	xiv. Predicted and actual arrival times of inbound flights at the runway inbound threshold	C	C	Section F-1-IV-Functional Requirements, 1.4.4.1 Combine and Process Flight Data		A		T	Y
IV.	xv. Positions of arriving aircraft as it approaches the airport	C	C	Section F-1-IV-Functional Requirements, 1.4.4.1 Combine and Process Flight Data		A		T	Y
IV.	xvi. Positions of aircraft as it travels on the surface of the airport from the arrival runway threshold to the boarding gate/stand	C	C	Section F-1-IV-Functional Requirements, 1.4.4.1 Combine and Process Flight Data		A		T	Y
IV.	xvii. Identification of scheduled gate/stand assigned (as available)	C	C	Section F-1-IV-Functional Requirements, 1.4.4.1 Combine and Process Flight Data		A		T	Y
IV.	xviii. Predicted gate conflict and length of conflict	C	PC	Section F-1-IV-Functional Requirements, 1.4.4.1 Combine and Process Flight Data	Aerobahn can predict and alert the user to a gate conflict if a Dynamic Rule is configured to do so. The duration can be determined by examining the estimated off-block time of the flight occupying the gate in conflict.	A		T	Y

Section	Requirement	Phase A	Phase B	Proposal Cross Reference	Comments	Test Phase	Procedure Only	Verification Method	FAT Only
IV.	xix. Predicted and actual taxi time from the runway inbound threshold to the assigned gate/stand	C	C	Section F-1-IV-Functional Requirements, 1.4.4.1 Combine and Process Flight Data		A		T	Y
IV.	xx. Turn-around time	C	C	Section F-1-IV-Functional Requirements, 1.4.4.1 Combine and Process Flight Data		A	Y	T	Y
IV.	xxi. Identification of gate/stand predicted and assigned for departure	C	C	Section F-1-IV-Functional Requirements, 1.4.4.1 Combine and Process Flight Data		A		T	Y
IV.	xxii. Predicted and actual time to travel from arrival gate/stand to departure gate/stand	NC	NC	Section F-1-IV-Functional Requirements, 1.4.4.1 Combine and Process Flight Data	Tow and/or gate change schedules are not available from a single source or even from every airline individually.	N/A			
IV.	xxiii. Latest estimated, predicted and actual gate/stand pushback time	C	C	Section F-1-IV-Functional Requirements, 1.4.4.1 Combine and Process Flight Data		A		T	Y
IV.	xxiv. Predicted and actual identification of departure runway assigned to the aircraft	C	C	Section F-1-IV-Functional Requirements, 1.4.4.1 Combine and Process Flight Data		A		T	Y
IV.	xxv. Identification of aircraft that have pushed back and since returned to a gate/stand without departing.	C	C	Section F-1-IV-Functional Requirements, 1.4.4.1 Combine and Process Flight Data		A		T	Y

Section	Requirement	Phase A	Phase B	Proposal Cross Reference	Comments	Test Phase	Procedure Only	Verification Method	FAT Only
IV.	xxvi. Irregular operation times associated with departure events such as ground stops or de-icing	NC	C	Section F-1-IV-Functional Requirements, 1.4.4.1 Combine and Process Flight Data	The Aerobahn product roadmap provides for this functionality to be complete prior to the beginning of Phase B service.	B	Y	T	Y
IV.	xxvii. Predicted and actual taxi-time to the runway outbound threshold	C	C	Section F-1-IV-Functional Requirements, 1.4.4.1 Combine and Process Flight Data		A		T	Y
IV.	xxviii. Predicted and actual taxi time delays	C	C	Section F-1-IV-Functional Requirements, 1.4.4.1 Combine and Process Flight Data		A		T	Y
IV.	xxix. Predicted and actual wheels-off time	C	C	Section F-1-IV-Functional Requirements, 1.4.4.1 Combine and Process Flight Data		A		T	Y
IV.	xxx. Predicted and actual final runway-specific departure lineup order	C	C	Section F-1-IV-Functional Requirements, 1.4.4.1 Combine and Process Flight Data		A		T	Y
IV.	b. Base Map (Visual Overview Display) of the Airport								
IV.	The Contractor shall provide a Base Map, visual display, of the Airport that will show a top down view of, at a minimum, the following airport elements: runways, taxiways, ramps, gates/stands, possibly structures, and other physical structures as required to provide the Services described herein. The base map will	C	C	Section F-1-IV-Functional Requirements, 1.4.4.3.1 Base Map		A		T	Y

Section	Requirement	Phase A	Phase B	Proposal Cross Reference	Comments	Test Phase	Procedure Only	Verification Method	FAT Only
	provide a context for displaying situational information about surface traffic at the airport. A PDF of the current airport layout is provided as Exhibit 7.								
IV.	c. Organize Airport Adaptation Data to Support the Base Map								
IV.	One of the groups of data collected is data that describes the layout of the airport. This data shall be organized to support the drawing of a detailed visual overview of the airport. It is expected that this function of mapping the adaptation data to a visual overview will need be executed infrequently. Airport adaptation data shall be used to support a detailed visual overview of the airport layout.	C	C	Section F-1-IV-Functional Requirements, 1.4.4.3.1 Base Map	A	A		T	Y
IV.	The Port Authority shall provide information, adaptation data, which describes the physical details of the airport layout. The contractor shall update adaptation data to accurately reflect the physical details of the airport layout as provided by the Port Authority.	C	C	Section F-1-IV-Functional Requirements, 1.4.4.3.1 Base Map		A		T	Y
IV.	d. Characteristics of the Base Map At a minimum, the visual overview shall:								
IV.	i. Display the name and location of the airport.	C	C	Section F-1-IV-Functional Requirements, 1.4.4.3.1 Base Map		A		T	Y
IV.	ii. Show all of the runways, hold bars, taxiways, ramps, gates/stands, and other fixed elements at the airport.	C	C	Section F-1-IV-Functional Requirements, 1.4.4.3.1 Base Map		A		T	Y
IV.	iii. Display the runway configuration and the names of the active runways.	C	C	Section F-1-IV-Functional Requirements, 1.4.4.3.1 Base Map		A		T	Y
IV.	iv. The Service shall mark unavailable runways,	PC	C	Section F-1-IV-	For Phase A, these	A & B	Y	T	Y

Section	Requirement	Phase A	Phase B	Proposal Cross Reference	Comments	Test Phase	Procedure Only	Verification Method	FAT Only
	taxiways, etc. in a distinctive, color-coded or other approved manner. Such availability and closure information shall reflect real-time Notices to Airmen (NOTAM) and shall be obtained through the following website or another Port Authority approved source: https ://pilotweb.nas.faa.gov/PilotWeb/			Functional Requirements, 1.4.4.3.1 Base Map	regions can be marked manually using the Annotations tool. For Phase B, this will be automatic based on NOTAM updates, and the Region Closures Tool.				
IV.	v. Be updated when the physical details of the airport are changed.	C	C	Section F-1-IV-Functional Requirements, 1.4.4.3.1 Base Map		N/A			
IV.	vi. Be drawn to scale.	C	C	Section F-1-IV-Functional Requirements, 1.4.4.3.1 Base Map		A		T	Y
IV.	e. User Interface to the Base Map	C	C	Section F-1-IV-Functional Requirements, 1.4.4.3.2 Map Manipulation		A		T	Y
IV.	The interface is to the overview itself, not to the situational displays, superimposed on or around the overview. The User shall be given the capability to:	C	C	Section F-1-IV-Functional Requirements, 1.4.4.3.2 Map Manipulation		N/A			
IV.	i. Move the focus to any point on the overview	C	C	Section F-1-IV-Functional Requirements, 1.4.4.3.2 Map Manipulation		A		T	Y
IV.	ii. Scalable graphics enabling the user to seamlessly zoom in or out on whatever region is under focus, to the area the size of a gate.	C	C	Section F-1-IV-Functional Requirements,		A		T	Y

Section	Requirement	Phase A	Phase B	Proposal Cross Reference	Comments	Test Phase	Procedure Only	Verification Method	FAT Only
				1.4.4.3.2 Map Manipulation					
IV.	iii. Rotate the display, by any angle, to the user's preferred perspective	C	C	Section F-1-IV-Functional Requirements, 1.4.4.3.2 Map Manipulation		A		T	Y
IV.	iv. Create multiple instances of the Base Map in separate windows	C	C	Section F-1-IV-Functional Requirements, 1.4.4.3.2 Map Manipulation		A		T	Y
IV.	f. Situational Displays and Associated User Interfaces								
IV.	Situational displays provide information that is layered on top of the Base Map and provide information about surface data to the User. The System shall allow the user to control the format and the information to be presented.	C	C	Section F-1-IV-Functional Requirements, 1.4.4.3.3 Runway Configuration and Gate Occupancy, 1.4.4.4.1 Icons and Data Blocks		N/A			
IV.	The following items shall be displayed to the user by default; but the System shall allow the user to choose to either show or hide the display of each of these items.	C	C	Section F-1-IV-Functional Requirements, 1.4.4.3.3 Runway Configuration and Gate Occupancy, 1.4.4.4.1 Icons and Data Blocks		A		T	Y
IV.	i. An indication of the runway configuration and the names of the active runways shall be superimposed on the base map of the airport	C	C	Section F-1-IV-Functional Requirements, 1.4.4.3.3 Runway Configuration and Gate Occupancy		A	Y	T	Y

Section	Requirement	Phase A	Phase B	Proposal Cross Reference	Comments	Test Phase	Procedure Only	Verification Method	FAT Only
IV.	ii. An icon to represent each aircraft on the base map of the airport	C	C	Section F-1-IV-Functional Requirements, 1.4.4.4.1 Icons and Data Blocks		A		T	Y
IV.	iii. An icon to represent each non-aircraft vehicle on the base map of the airport	C	C	Section F-1-IV-Functional Requirements, 1.4.4.4.1 Icons and Data Blocks		A		T	Y
IV.	iv. An indication for each gate/stand as to whether it is occupied or vacant	C	C	Section F-1-IV-Functional Requirements, 1.4.4.3.3 Runway Configuration and Gate Occupancy		A		T	Y
IV.	g. Data Tag Associated With Each Aircraft Icon	C	C	Section F-1-IV-Functional Requirements, 1.4.4.4.1 Icons and Data Blocks		A		T	Y
IV.	Each aircraft icon displayed on the Base Map of the airport shall have a small block of text drawn with it that provides key data about the aircraft. This document refers to the attached textual data block to an aircraft as a "data tag."	C	C	Section F-1-IV-Functional Requirements, 1.4.4.4.1 Icons and Data Blocks		A		T	Y
IV.	i. The data tag shall include the aircraft's ACID (Aircraft Identification) and aircraft type.	C	C	Section F-1-IV-Functional Requirements, 1.4.4.4.1 Icons and Data Blocks		A		T	Y
IV.	ii. For aircraft on the surface, and not at a gate/stand, the data tag shall include the number of minutes the aircraft has been on the surface.	C	C	Section F-1-IV-Functional Requirements, 1.4.4.4.1 Icons and Data Blocks		A	Y	T	Y

Section	Requirement	Phase A	Phase B	Proposal Cross Reference	Comments	Test Phase	Procedure Only	Verification Method	FAT Only
IV.	• For departing aircraft this number of minutes shall be counted from leaving the gate/stand	C	C	Section F-1-IV-Functional Requirements, 1.4.4.4.1 Icons and Data Blocks		A	Y	T	Y
IV.	• For arriving aircraft this number of minutes shall be counted from wheels-on	C	C	Section F-1-IV-Functional Requirements, 1.4.4.4.1 Icons and Data Blocks		A	Y	T	Y
IV.	iii. Additionally, a departing aircraft shall have in its data tag: the departure fix, the destination airport, and the flight plan Field 10.	PC	C	Section F-1-IV-Functional Requirements, 1.4.4.4.1 Icons and Data Blocks	The Aerobahn product roadmap provides for this functionality to be complete prior to the beginning of Phase B service.	B	Y	T	Y
IV.	iv. An arriving aircraft shall have in its data tag the arrival fix and the origin airport	C	C	Section F-1-IV-Functional Requirements, 1.4.4.4.1 Icons and Data Blocks		A	Y	T	Y
IV.	v. While arriving aircraft remain airborne, their data tag shall have the aircraft altitude.	C	C	Section F-1-IV-Functional Requirements, 1.4.4.4.1 Icons and Data Blocks		B	Y	T	Y
IV.	vi. The user interface shall allow the user to turn on or off the display of tags for all flights.	C	C	Section F-1-IV-Functional Requirements, 1.4.4.4.1 Icons and Data Blocks		A		T	Y
IV.	vii. The user interface shall allow the user to perform an on or off toggle via mouse or touch-screen action.	C	C	Section F-1-IV-Functional Requirements, 1.4.4.4.1 Icons and		A		T	Y

Section	Requirement	Phase A	Phase B	Proposal Cross Reference	Comments	Test Phase	Procedure Only	Verification Method	FAT Only
				Data Blocks					
IV.	viii. The user interface shall allow the user to elect to hide the display of data tags for any specified aircraft. It shall also allow the user to show the tags only for aircraft that the user specifies.	C	C	Section F-1-IV-Functional Requirements, 1.4.4.4.1 Icons and Data Blocks		A		T	Y
IV.	ix. The user interface shall allow the user to hide the display of specific fields (such as the flight plan Field 10) of the data tags from all aircraft, from a selected list of aircraft, or for all but a selected list of aircraft.	NC	C	Section F-1-IV-Functional Requirements, 1.4.4.4.1 Icons and Data Blocks	The Aerobahn product roadmap provides for this functionality to be complete prior to the beginning of Phase B service.	B	Y	T	Y
IV.	x. The user interface shall allow any data tag to be dragged to a new position and connected to its icon by a line. (This is intended to allow the user to separate overlapping data tags, or move tags that obscure icons or other features the user wants to view.)	C	C	Section F-1-IV-Functional Requirements, 1.4.4.4.1 Icons and Data Blocks		A	Y	T	Y
IV.	h. Data Tags and Expanded Detail Window								
IV.	Each aircraft shall be rendered with an associated set of operational details contained in a data tag shown on the Base Map. The data tag shall serve as a concise reference to important aircraft and flight information so that Users have access critical operational data without losing focus of the airfield. The System shall provide the capability to the User to configure the data that is shown in both data tag views and the capability to quickly view or hide information. Each aircraft data tag can be individually toggled on or off through the aircraft's icon.	C	C	Section F-1-IV-Functional Requirements, 1.4.4.4.2 Icons and Data Blocks		A		T	Y
IV.	Furthermore, the Base Map view also shall allow Users to configure a completely separate list of data tag fields that will be shown when the User hovers the mouse over an aircraft icon.	C	C	Section F-1-IV-Functional Requirements, 1.4.4.4.2 Icons and		A		T	Y

Section	Requirement	Phase A	Phase B	Proposal Cross Reference	Comments	Test Phase	Procedure Only	Verification Method	FAT Only
	This "mouse over" feature shall allow Users to access an expanded set of data on a per aircraft icon basis without unduly cluttering the default display.			Data Blocks					
IV.	The visibility of the data tag will allow the user to see the information under a minimum of the following ways:			Section F-1-IV-Functional Requirements, 1.4.4.4.2 Icons and Data Blocks					Y
IV.	i. Air carrier	C	C	Section F-1-IV-Functional Requirements, 1.4.4.4.2 Icons and Data Blocks		A		T	Y
IV.	ii. Flight number	C	C	Section F-1-IV-Functional Requirements, 1.4.4.4.2 Icons and Data Blocks		A		T	Y
IV.	iii. Aircraft type	C	C	Section F-1-IV-Functional Requirements, 1.4.4.4.2 Icons and Data Blocks		A		T	Y
IV.	iv. Destination city for departing flights	C	C	Section F-1-IV-Functional Requirements, 1.4.4.4.2 Icons and Data Blocks		A		T	Y
IV.	v. Originating city for arriving flights	C	C	Section F-1-IV-Functional Requirements, 1.4.4.4.2 Icons and Data Blocks		A		T	Y
IV.	vi. Time elapsed during taxi	C	C	Section F-1-IV-Functional		A		T	Y

Section	Requirement	Phase A	Phase B	Proposal Cross Reference	Comments	Test Phase	Procedure Only	Verification Method	FAT Only
				Requirements, 1.4.4.4.2 Icons and Data Blocks					
IV.	vii. Scheduled departure runway for departing aircraft (based on departure fix or other reliable data)	C	C	Section F-1-IV-Functional Requirements, 1.4.4.4.2 Icons and Data Blocks		A		T	Y
IV.	viii. Estimated time of arrival	C	C	Section F-1-IV-Functional Requirements, 1.4.4.4.2 Icons and Data Blocks		A		T	Y
IV.	ix. Estimated time of departure	C	C	Section F-1-IV-Functional Requirements, 1.4.4.4.2 Icons and Data Blocks		A		T	Y
IV.	x. Scheduled arrival gate	C	C	Section F-1-IV-Functional Requirements, 1.4.4.4.2 Icons and Data Blocks		A		T	Y
IV.	xi. Configurable alert of predicted gate conflict when applicable	C	C	Section F-1-IV-Functional Requirements, 1.4.4.4.2 Icons and Data Blocks		A		T	Y
IV.	xii. All data tags shall be visible at once	C	C	Section F-1-IV-Functional Requirements, 1.4.4.4.2 Icons and Data Blocks		A		T	Y
IV.	In addition to the flight information contained in the data tag, Users shall also have the ability to quickly access detailed flight information for	C	C	Section F-1-IV-Functional Requirements,		A		T	Y

Section	Requirement	Phase A	Phase B	Proposal Cross Reference	Comments	Test Phase	Procedure Only	Verification Method	FAT Only
	any aircraft in the Base Map by simply clicking on it or mousing-over the aircraft icon.			1.4.4.4.2 Icons and Data Blocks					
IV.	When an aircraft or vehicle icon is selected from the situational display, detailed information such as the values of all optional data block fields, as well as the predictive assumptions, shall be viewable in a separate, Expanded Detail Window that can be added and arranged within data tag.	C	C	Section F-1-IV-Functional Requirements, 1.4.4.4.2 Icons and Data Blocks		A		T	Y
IV.	If the System is predicting a specific airport surface destination for an aircraft, such as a gate, and the destination changes, a User shall have the ability to manually change the destination and the System shall automatically recalculate the estimated taxi time to the new location.	C	C	Section F-1-IV-Functional Requirements, 1.4.4.4.2 Icons and Data Blocks		A	Y	T	Y
IV.	i. Additional Characteristics of the Base Map								
IV.	The Base Map shall provide the following characteristics and capabilities:								
IV.	i. The display of all of the items should be configurable to be displayed on one screen or if multiple screens should be used to hold the full set of items. These preferable setting should be savable as a default for each User.	C	C	Section F-1-IV-Functional Requirements, 1.4.4.2 Workspace		A	Y	T	Y
IV.	ii. Mark the name of the runway configuration, and the names of the active runways, on the Base Map of the Airport	C	C	Section F-1-IV-Functional Requirements, 1.4.4.3.4 Additional Characteristics of the Base Map		A		T	Y
IV.	iii. Draw an Icon, on the Base Map, to represent each aircraft near or on the airport surface.	C	C	Section F-1-IV-Functional Requirements, 1.4.4.4.3 Icon Types and Characteristics		A		T	Y
IV.	iv. For each flight (airborne and shortly to arrive on the surface, or airborne shortly after	C	C	Section F-1-IV-Functional		A		T	Y

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	departure), the Service shall draw an icon and properly position it on the Base Map.			Requirements, 1.4.4.4.3 Icon Types and Characteristics					
IV.	v. The user interface shall provide a method for searching and identifying an icon that represents a specified Aircraft Identification (ACID).	C	C	Section F-1-IV-Functional Requirements, 1.4.4.5 Search		A		T	Y
IV.	vi. The user interface shall provide a method for searching and identifying all the icons that fit into a specified class; the class shall be defined as an aircraft type, air carrier, first fix information or destination airport.	C	C	Section F-1-IV-Functional Requirements, 1.4.4.5 Search		A	Y	T	Y
IV.	vii. Allows customization through editing of all visual layers. Editing capabilities include the creation of new layers and textual and graphical objects within each layer. The User shall be provided the ability to configure the color of all layers and override the color for specific objects within a layer.	C	C	Section F-1-IV-Functional Requirements, 1.4.4.3.4 Additional Characteristics of the Base Map		A	Y	T	Y
IV.	viii. Selectable visual layers can be displayed including ramps, taxiways, runways and buildings	C	C	Section F-1-IV-Functional Requirements, 1.4.4.3.4 Additional Characteristics of the Base Map		A	Y	T	Y
IV.	ix. Through the Base Map, the user shall have the capability to open additional windows on screen(s) that displays additional content without obscuring the Base Map view. These	C	C	Section F-1-IV-Functional Requirements, 1.4.4.2 Workspace		A		T	Y
IV.	windows shall contain performance indicators, predictive/forecasted data, etc., all being displayed concurrently.					B	Y	T	Y
IV.	j. Icons								
IV.	i) Icon Types								
IV.	The System shall support, at a minimum, at least the distinct icon types to represent different					N/A			

Section	Requirement	Phase A	Phase B	Proposal Cross Reference	Comments	Test Phase	Procedure Only	Verification Method	FAT Only
	aircraft and vehicle types as listed below, and the icons selected for each aircraft type shall be configurable by the User:								
IV.	a) Small Aircraft	PC	C	Section F-1-IV-Functional Requirements, 1.4.4.4.3 Icon Types and Characteristics	For Phase A, icon differentiation for representing different aircraft types can be implemented using dynamic rules to change the icon color or decoration. The Aerobahn product roadmap provides for the unique icon types to be complete prior to the beginning of Phase B service.	B	Y	T	Y
IV.	b) Large Aircraft	PC	C	Section F-1-IV-Functional Requirements, 1.4.4.4.3 Icon Types and Characteristics	For Phase A, icon differentiation for representing different aircraft types can be implemented using dynamic rules to change the icon color or decoration. The Aerobahn product roadmap provides for the unique icon types to be complete prior to the beginning of Phase B service.	B	Y	T	Y
IV.	c) Heavy Aircraft	PC	C	Section F-1-IV-	For Phase A, icon	B	Y	T	Y

Section	Requirement	Phase A	Phase B	Proposal Cross Reference	Comments	Test Phase	Procedure Only	Verification Method	FAT Only
				Functional Requirements, 1.4.4.4.3 Icon Types and Characteristics	differentiation for representing different aircraft types can be implemented using dynamic rules to change the icon color or decoration. The Aerobahn product roadmap provides for the unique icon types to be complete prior to the beginning of Phase B service.				
IV.	d) Super-Heavy Aircraft	PC	C	Section F-1-IV-Functional Requirements, 1.4.4.4.3 Icon Types and Characteristics	For Phase A, icon differentiation for representing different aircraft types can be implemented using dynamic rules to change the icon color or decoration. The Aerobahn product roadmap provides for the unique icon types to be complete prior to the beginning of Phase B service.	B	Y	T	Y
IV.	e) Helicopter	PC	C	Section F-1-IV-Functional Requirements, 1.4.4.4.3 Icon Types and Characteristics	For Phase A, icon differentiation for representing different aircraft types can be	B	Y	T	Y

Section	Requirement	Phase A	Phase B	Proposal Cross Reference	Comments	Test Phase	Procedure Only	Verification Method	FAT Only
					implemented using dynamic rules to change the icon color or decoration. The Aerobahn product roadmap provides for the unique icon types to be complete prior to the beginning of Phase B service.				
IV.	f) Vehicles/Non-Aircraft	C	C	Section F-1-IV-Functional Requirements, 1.4.4.4.3 Icon Types and Characteristics		A		T	Y
IV.	a. Port Authority Snow Removal Equipment	C	C	Section F-1-IV-Functional Requirements, 1.4.4.4.3 Icon Types and Characteristics		B	Y	T	Y
IV.	b. Contractor Snow Removal Equipment	C	C	Section F-1-IV-Functional Requirements, 1.4.4.4.3 Icon Types and Characteristics		B	Y	T	Y
IV.	c. Super Tugs	C	C	Section F-1-IV-Functional Requirements, 1.4.4.4.3 Icon Types and Characteristics		B	Y	T	Y
IV.	d. Other	C	C	Section F-1-IV-Functional Requirements, 1.4.4.4.3 Icon Types and Characteristics		B	Y	T	Y

Section	Requirement	Phase A	Phase B	Proposal Cross Reference	Comments	Test Phase	Procedure Only	Verification Method	FAT Only
IV.	ii) Aircraft Icon Characteristics								
IV.	The System shall support the following characteristics for each aircraft icon:								
IV.	a) The aircraft shall indicate the plane orientation by having a recognizable nose and tall.	C	C	Section F-1-IV-Functional Requirements, 1.4.4.4.3 Icon Types and Characteristics		A		T	Y
IV.	b) Each icon's nose shall point in the direction of most recent motion of the aircraft.	C	C	Section F-1-IV-Functional Requirements, 1.4.4.4.3 Icon Types and Characteristics		A		T	Y
IV.	c) Each flight's icon shall be repositioned when the aircraft moves and changes its position.	C	C	Section F-1-IV-Functional Requirements, 1.4.4.4.3 Icon Types and Characteristics		A		T	Y
IV.	d) Each icon shall be configurable by the User to be color coded to indicate the flight's status:	C	C	Section F-1-IV-Functional Requirements, 1.4.4.4.3 Icon Types and Characteristics		A		T	Y
IV.	i) An aircraft currently airborne but about to land shall have its icon colored-coded to a configurable setting.	C	C	Section F-1-IV-Functional Requirements, 1.4.4.4.3 Icon Types and Characteristics		A		T	Y
IV.	ii) An aircraft landed but did not yet arrived at a gate/stand shall have its icon colored-coded to a configurable setting.	C	C	Section F-1-IV-Functional Requirements, 1.4.4.4.3 Icon Types and Characteristics		A		T	Y
IV.	iii) An aircraft parked shall have its icon colored-coded to a configurable setting.	C	C	Section F-1-IV-Functional Requirements,		A		T	Y

Section	Requirement	Phase A	Phase B	Proposal Cross Reference	Comments	Test Phase	Procedure Only	Verification Method	FAT Only
				1.4.4.4.3 Icon Types and Characteristics					
IV.	iv) An aircraft that is moving from an arrival gate/stand to a departure gate/stand shall have its icon colored-coded to a configurable setting.	PC	PC	Section F-1-IV-Functional Requirements, 1.4.4.4.3 Icon Types and Characteristics	Aerobahn will support a workflow allowing aircraft to be designated as being towed, which will allow them to be color coded via Dynamic Rules.	B	Y	T	Y
IV.	v) An aircraft that has left its gate/stand but has not yet departed shall have its icon colored-coded to a configurable setting.	C	C	Section F-1-IV-Functional Requirements, 1.4.4.4.3 Icon Types and Characteristics		A		T	Y
IV.	vi) An aircraft that has achieved wheels-off shall have its icon colored-coded to a configurable setting.	C	C	Section F-1-IV-Functional Requirements, 1.4.4.4.3 Icon Types and Characteristics		A		T	Y
IV.	vii) The information represented by the icon coloring shall also be displayed as a part of the aircraft's data tag.	C	C	Section F-1-IV-Functional Requirements, 1.4.4.4.3 Icon Types and Characteristics		A		T	Y
IV.	iii) Vehicles/Non-Aircraft Icons								
IV.	The System shall display an icon on the Base Map to indicate each non-aircraft vehicle at its current location on the Airport Operations Area. The System shall provide the following:	C	C	Section F-1-IV-Functional Requirements, 1.4.4.4.3 Icon Types and Characteristics		N/A			
IV.	a) The user shall be able to configure the non-aircraft icons.	C	C	Section F-1-IV-Functional Requirements, 1.4.4.4.3 Icon Types and Characteristics		A		T	Y

Section	Requirement	Phase A	Phase B	Proposal Cross Reference	Comments	Test Phase	Procedure Only	Verification Method	FAT Only
IV.	b) Reposition each vehicle's icon when the vehicle moves and changes its position on the movement and non-movement areas covered by surface surveillance.	C	C	Section F-1-IV-Functional Requirements, 1.4.4.4.3 Icon Types and Characteristics		A		T	Y
IV.	c) The user shall be able to select to show or hide the icons representing non-aircraft vehicles.	C	C	Section F-1-IV-Functional Requirements, 1.4.4.4.3 Icon Types and Characteristics		A		T	Y
IV.	k. Gates and Stands								
IV.	The System shall display every gate and stand position at the airport on the Base Map, and provide the following information:	C	C	Section F-1-IV-Functional Requirements, 1.4.4.3.5 Gate and Stands		A		T	Y
IV.	a) Indicate if Vacant or Occupied	C	C	Section F-1-IV-Functional Requirements, 1.4.4.3.5 Gate and Stands		A		T	Y
IV.	b) Active aircraft icons positioned on the surface graphical display will indicate scheduled gate/stand occupation for aircraft in the aircraft data tag.	C	C	Section F-1-IV-Functional Requirements, 1.4.4.3.5 Gate and Stands		A		T	Y
IV.	c) Indicate if an aircraft is scheduled to be serviced at the gate/stand. The method of illustrating that the gate/stand is scheduled for an aircraft is subject to Authority approval.	C	C	Section F-1-IV-Functional Requirements, 1.4.4.3.5 Gate and Stands		B	Y	T	Y
IV.	1. Timelines that Illustrate Pending Flight Arrivals and Departures								
IV.	Timelines of arriving and departing aircraft shall be drawn as part of the user interface and are intended to be distinct from the airport Base	C	C	Section F-1-IV-Functional Requirements, 1.4.4.6		A		T	Y

Section	Requirement	Phase A	Phase B	Proposal Cross Reference	Comments	Test Phase	Procedure Only	Verification Method	FAT Only
	Map. The System shall allow the User to hide any or all of the timelines and provide the following:			Timeline Display					
IV.	a) A timeline for each active arrival runway and departure runway.	C	C	Section F-1-IV-Functional Requirements, 1.4.4.6 Timeline Display		A		T	Y
IV.	b) A timeline for each active arrival fix and departure fix.	C	C	Section F-1-IV-Functional Requirements, 1.4.4.6 Timeline Display		B	Y	T	Y
IV.	c) Minute marks for each timeline.	C	C	Section F-1-IV-Functional Requirements, 1.4.4.6 Timeline Display		A		T	Y
IV.	d) Display Aircraft ACIDs (Aircraft Identification) at their runway ETA (Estimated Time of Arrival) (or ETD (Estimated Time of Departure)) minute mark on the timeline associated with its arrival (or departure) runway.	C	C	Section F-1-IV-Functional Requirements, 1.4.4.6 Timeline Display		A		T	Y
IV.	e) Display Aircraft ACIDs at their arrival fix ETA (or ETD) minute mark on the timelinc associated with its arrival (or departure) fix.	PC	C	Section F-1-IV-Functional Requirements, 1.4.4.6 Timeline Display	Aerobahn can display aircraft at arrival fix times which Sensis obtains via the ASDI feed. However, Sensis will require access to a source for departure fix times to use these times in the Operations Timeline.	B	Y	T	Y
IV.	m. Weather Display								
IV.	The Service shall be capable of receiving, processing, warehousing and displaying data								

Section	Requirement	Phase A	Phase B	Proposal Cross Reference	Comments	Test Phase	Procedure Only	Verification Method	FAT Only
	from, at a minimum, the following systems or other Port Authority approved equivalents:								
IV.	a) RAPT-Route Availability Planning Tool	NC	C	Section F-1-IV-Functional Requirements, 1.4.4.7 Weather Display	Sensis will provide limited integration of ITWS, CIWS, and RAPT for the use in the Metering Coordination Center provided feeds from these systems are available.	B	Y	T	Y
IV.	b) METAR - International standard code format for hourly surface weather observations	C	C	Section F-1-IV-Functional Requirements, 1.4.4.7 Weather Display		B	Y	T	Y
IV.	c) TAF — Terminal Aerodrome Forecast	C	C	Section F-1-IV-Functional Requirements, 1.4.4.7 Weather Display		B	Y	T	Y
IV.	d) RVR — Runway Visual Range	NC	C	Section F-1-IV-Functional Requirements, 1.4.4.7 Weather Display	The Aerobahn product roadmap provides for this functionality to be complete prior to the beginning of Phase B service.	B	Y	T	Y
IV.	Users shall have the capability to incorporate stored weather data from the above list or other Port Authority approved equivalents into reports and playback capability.	PC	C	Section F-1-IV-Functional Requirements, 1.4.4.7 Weather Display	The Aerobahn product roadmap provides for this functionality to be complete prior to the beginning of Phase B service.	B	Y	T	
IV.	n. Tabular Data Display	NC	C	Section F-1-IV-Functional	The Aerobahn product roadmap	B	Y	T	Y

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				Requirements, 1.4.4.8 Tabular Display Data	provides for this functionality to be complete prior to the beginning of Phase B service.				
IV.	The tabular display shall provide, at a minimum, the following information:	NC	C	Section F-1-IV-Functional Requirements, 1.4.4.8 Tabular Display Data		B	Y	T	Y
IV.	i. Name of the runway configuration	NC	C	Section F-1-IV-Functional Requirements, 1.4.4.8 Tabular Display Data	The Aerobahn product roadmap provides for this functionality to be complete prior to the beginning of Phase B service.	B	Y	T	Y
IV.	ii. Number of flights that have left gate/stand but not yet departed, and have been in this intermediate state for more than a configurable number of minutes	NC	C	Section F-1-IV-Functional Requirements, 1.4.4.8 Tabular Display Data	The Aerobahn product roadmap provides for this functionality to be complete prior to the beginning of Phase B service.	B	Y	T	Y
IV.	iii. Number of flights with reportable/configurable delay	NC	C	Section F-1-IV-Functional Requirements, 1.4.4.8 Tabular Display Data	The Aerobahn product roadmap provides for this functionality to be complete prior to the beginning of Phase B service.	B	Y	T	Y
IV.	iv. Average taxi time	NC	C	Section F-1-IV-Functional Requirements, 1.4.4.8 Tabular Display Data	The Aerobahn product roadmap provides for this functionality to be complete prior to the beginning of	B	Y	T	Y

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					Phase B service.				
IV.	v. Number of flights currently taxiing inbound	NC	C	Section F-1-IV-Functional Requirements, 1.4.4.8 Tabular Display Data	The Aerobahn product roadmap provides for this functionality to be complete prior to the beginning of Phase B service.	B	Y	T	Y
IV.	vi. Number of flights currently taxiing outbound	NC	C	Section F-1-IV-Functional Requirements, 1.4.4.8 Tabular Display Data	The Aerobahn product roadmap provides for this functionality to be complete prior to the beginning of Phase B service.	B	Y	T	Y
IV.	vii. Number of flights parked at gates/stands	NC	C	Section F-1-IV-Functional Requirements, 1.4.4.8 Tabular Display Data	The Aerobahn product roadmap provides for this functionality to be complete prior to the beginning of Phase B service.	B	Y	T	Y
IV.	viii. Numbers of gates/stands occupied and vacant	NC	C	Section F-1-IV-Functional Requirements, 1.4.4.8 Tabular Display Data	The Aerobahn product roadmap provides for this functionality to be complete prior to the beginning of Phase B service.	B	Y	T	Y
IV.	ix. Number and order of flights in final lineup order for runway departure	NC	C	Section F-1-IV-Functional Requirements, 1.4.4.8 Tabular Display Data	The Aerobahn product roadmap provides for this functionality to be complete prior to the beginning of Phase B service.	B	Y	T	Y

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IV.	x. To accurately indicate departure demand, indicate actual number of aircraft planning to depart within a configurable amount of time	NC	C	Section F-1-IV-Functional Requirements, 1.4.4.8 Tabular Display Data	The Aerobahn product roadmap provides for this functionality to be complete prior to the beginning of Phase B service.	B	Y	T	Y
IV.	o. Alerts to User								
IV.	The System shall provide notification to the User of off-nominal events via an alerting mechanism, which shall include, but not be limited to the following alert mechanisms;								
IV.	• An audible alarm which can be disabled by the user,	C	C	Section F-1-IV-Functional Requirements, 1.4.4.9 Alerts to User		A		T	Y
IV.	• A visual alarm that flashes on the screen and is color-coded based on the severity of the alarm. The color of the alarms shall be configurable by the User.	C	C	Section F-1-IV-Functional Requirements, 1.4.4.9 Alerts to User		B	Y	T	Y
IV.	• Issuance of an email to designated individuals and distribution lists. The System shall provide the capability allow the user to assign a different email address to receive each type of alarm.	C	C	Section F-1-IV-Functional Requirements, 1.4.4.9 Alerts to User		A		T	Y
IV.	The types of off-nominal events and the alarm features are described below:								
IV.	i. The user shall have the capability to select which alerts are displayed.	C	C	Section F-1-IV-Functional Requirements, 1.4.4.9 Alerts to User		A		T	Y
IV.	ii. The user shall set thresholds based on stated criteria for those alerts based on exceeding or falling below set criteria. The System shall provide the User the ability to monitor any data point in real time or in the system database and create an alarm that will notify the User when	C	C	Section F-1-IV-Functional Requirements, 1.4.4.9 Alerts to User		A		T	Y

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	the data point either exceeds or falls below a threshold value set by the user.								
IV.	iii. The alert shall be of a form that is a significant change from what is shown when there is no alert, so that the alerted data attracts attention to itself	C	C	Section F-1-IV-Functional Requirements, 1.4.4.9 Alerts to User		A		T	Y
IV.	iv. The alerted items shall include, at a minimum the following:								
IV.	• An aircraft enters a runway or taxiway that it is not planned to enter	NC	NC	Section F-1-IV-Functional Requirements, 1.4.4.9 Alerts to User	As indicated in PANYNJ Addendum 2, no coded taxi routes are provided.	B	Y	T	Y
IV.	• An aircraft enters a runway that it is not allowed to enter at this time	NC	C	Section F-1-IV-Functional Requirements, 1.4.4.9 Alerts to User	The Aerobahn product roadmap provides for this functionality to be complete prior to the beginning of Phase B service. Sensis assumes "not allowed at this time" indicates a region closure.	B	Y	T	Y
IV.	• An aircraft deviates from its predicted path on the airport surface by more than a certain distance. This distance shall be approved by the Port Authority	NC	NC	Section F-1-IV-Functional Requirements, 1.4.4.9 Alerts to User	While Aerobahn predicts a probable taxi route, it continuously updates based on the actual route the aircraft takes (similar to the way an automotive GPS device works). So this alert would not be feasible.	B	Y	T	Y

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					Dynamic Rules in the Phase B deployment will however, allow users to alert if the aircraft enters a runway other than the predicted or assigned runway.				
IV.	• The ACIDs of any flights that have spent a set amount of time on the surface and have not arrived at a gate/stand.	C	C	Section F-1-IV-Functional Requirements, 1.4.4.9 Alerts to User		A		T	Y
IV.	• An aircraft that has pushed back and has since returned to the gate/stand without departing.	C	C	Section F-1-IV-Functional Requirements, 1.4.4.9 Alerts to User		A		T	Y
IV.	• An aircraft has been assigned a metering location in the movement area, but is not taxiing to the assigned location.	NC	PC	Section F-1-IV-Functional Requirements, 1.4.4.9 Alerts to User	With some changes implemented for Phase B, Dynamic Rules will allow for a similar alert using the following criteria: The aircraft joins the departure queue for its assigned/predicted runway without having first entered the metering point region. In any case, the Phase B deployment of Aerobahn will monitor compliance	B	Y	T & A	Y

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					with use of metering locations after the fact.				
IV.	p. Configuration of Alerts to Users								
IV.	The Users shall be able to save specified configuration alerts under their respective User Preferences. The System shall provide the User the capability to configure the icons, data tags and other information presented on the Base Map to advise the User as to the status of a flight, including at a minimum the following:	C	C	Section F-1-IV-Functional Requirements, 1.4.4.9 Alerts to User		A		T	Y
IV.	• Manual color-coding of aircraft icons to indicate various statuses of the flights.	C	C	Section F-1-IV-Functional Requirements, 1.4.4.9 Alerts to User		A		T	Y
IV.	• To accurately indicate a snapshot of departure demand, provide graphical display of the number of aircraft planning to depart within a configurable amount of time	C	C	Section F-1-IV-Functional Requirements, 1.4.4.9 Alerts to User		A		T	Y
IV.	The Contractor shall propose alternative mechanisms to alert the operator. Implementation of the proposed alerts is subject to Port Authority approval.	C	C	Section F-1-IV-Functional Requirements, 1.4.4.9 Alerts to User		A		T	Y
IV.	5. Transmit Modeled OFF Times								
IV.	The System shall be capable of transmitting the OFF time estimates to the Traffic Flow Management System (TFMS) for each departing aircraft. The TFMS makes OFF time estimates on the basis of historical data, but has no mechanism to update those estimates to take account of recent and current surface traffic and flows and therefore the TFMS' estimates of OFF time are relatively static. By monitoring the surface traffic, the System calculates current, accurate estimates of OFF times and shall provide the OFF time estimates to the TFMS to	NC	C	Section F-1-IV-Functional Requirements, 1.4.5 Transmit Modeled OFF Times	The Aerobahn product roadmap provides for this functionality to be complete prior to the beginning of Phase B service.	B	Y	T	Y

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	supplement their data.								
IV.	**E. Reporting Requirements**								
IV.	The Contractor shall provide standard, requested and custom reports with the System in accordance with the requirements described herein. All reports, with the exception of the Summary Windows view, shall be provided in both implementation Phases A and B. Summary Window reporting requirements shall be available in conjunction with Phase B.	C	C	Section F-1-IV-Functional Requirements, 1.5 Reporting					
IV.	The System shall provide the capability to export report data in a format that can be imported into standard Microsoft 2007 Office suite of tools, including but not limited to the following formats:								
IV.	• Microsoft Word (*Docx)	C	C		User will be able to export as CSV which can be read by Excel and exported in any other of the specified formats.	A	Y	T	Y
IV.	• Microsoft Word 97- 2003 (*.Doc)	C	C			A	Y	T	Y
IV.	• XML	C	C			A	Y	T	Y
IV.	• Web pages (HTM, HTML, MHT and MHTML)	C	C			A	Y	T	Y
IV.	• Microsoft Excel (*.xls)	C	C			A	Y	T	Y
IV.	• CSV (MS-Dos), and	C	C			A	Y	T	Y
IV.	• Text (MS-Dos).	C	C			A	Y	T	Y
IV.	The System shall provide advanced data querying and reporting capabilities enabling Users to create textual and graphical reports from a database. Upon initial implementation, the System shall begin saving and storing 24 months of data, which shall be used to generate the Reports. Five *(5)* years of stored data shall	C	C	Section F-1-IV-Functional Requirements, 1.5 Reporting		A	Y	T	Y

Section	Requirement	Phase A	Phase B	Proposal Cross Reference	Comments	Test Phase	Procedure Only	Verification Method	FAT Only
	be available within two days of request. The System shall provide the flexibility to create, save, execute, and download comprehensive reports about the surface operation and utilization of airport resources. Users shall have the capability to obtain comprehensive statistics, including gate occupancy; the number of holdouts by fleet type, time of day, and concourse; average amount of time an inbound aircraft waits for a gate; taxiway occupancy; and runway occupancy. Similar information shall be obtainable about the Vehicles equipped with a tracking device.								
IV.	Reports shall be sortable by Airline, flight number, aircraft type, terminal or parking area, destination airport and location where the delay occurred (ramp, taxiway, metering location, etc.), originating airport and location where the hold out occurred (ramp, taxiway, metering location, etc.). The reports shall measure taxi times against official ACARS and 0001 (Out, Off, On and In) times when available.	PC	C	Section F-1-IV-Functional Requirements, 1.5 Reporting	The Aerobahn product roadmap provides for this functionality to be complete prior to the beginning of Phase B service.	B	Y	T	Y
IV.	In addition to the ability to generate reports "on demand," the System shall have a scheduling capability that enables Users to schedule the automatic generation of daily, weekly, monthly, quarterly, and yearly operational reports. The User who scheduled an report shall have the ability to configure the system to automatically receive the report via email once it is generated.	C	C	Section F-1-IV-Functional Requirements, 1.5 Reporting		A	Y	T	Y
IV.	1. General Reporting Requirements								
IV.	a. All reports shall be modified to reflect the configuration of the application furnished as part of this Contract. Headings should be standardized (Report Name, Airport, Date Report Run, Date Range of Report, Page	PC	C	Section F-1-IV-Functional Requirements, 1.5.1.1 Header Format	The Aerobahn product roadmap provides for this functionality to be complete prior to	B	Y	T	Y

Section	Requirement	Phase A	Phase B	Proposal Cross Reference	Comments	Test Phase	Procedure Only	Verification Method	FAT Only
	Numbers, Column Headings on every page, Totals, etc.) and appear in a consistent manner throughout all presentation formats.				the beginning of Phase B service.				
IV.	b. All reports shall be easily displayed and navigated on the User's access terminals, sent to a choice of any email address, network printer at the user's facility and saved to the User's desktop over the Authority's existing wide area network.	PC	PC	Section F-1-IV-Functional Requirements, 1.5.1.2 Display and Output	Aerobahn reports must be exported prior to printing or emailing.	B	Y	T	Y
IV.	c. Users shall have the ability to access and display Summary Windows to actively monitor the current status items. Summary Windows are described below in further detail.	PC	C	Section F-1-IV-Functional Requirements, 1.5.1.3 Summary Window	The Aerobahn product roadmap provides for this functionality to be complete prior to the beginning of Phase B service.	N/A			Y
IV.	d. Access to detailed operational statistics is limited to the "owner" of the aircraft and the Port Authority. For example, members of one organization are not permitted to view taxi times of other organizations.	PC	PC	Section F-1-IV-Functional Requirements, 1.5.1.4 Access Rights	The Aerobahn permissioning system allows for masking of airline proprietary data such as schedules and estimated times. However, any data or statistics created by Aerobahn itself is deemed accessible by the entire user community. Sensis is proposing maintaining the current data restriction levels that are in place today on the	N/A			

Section	Requirement	Phase A	Phase B	Proposal Cross Reference	Comments	Test Phase	Procedure Only	Verification Method	FAT Only
					Aerobahn JFK system.				
IV.	e. When a user selects any time field listed in a Report, the System shall launch into a playback of the event in a separate window on the Base Map. The playback feature shall synchronize a selected local frequency to enable the user to hear radio transmissions. The frequencies shall include those listed in the current Airport/Facility Directory, under John F Kennedy Intl JFK Communications.	PC	C	Section F-1-IV-Functional Requirements, 1.5.1.5 Playback	The Aerobahn product roadmap provides for this functionality to be complete prior to the beginning of Phase B service.	B	Y	T	Y
IV.	2. Standard Reports								
IV.	The Contractor shall include the standard reports that are normally included in the System and Services that it provides. The standards reports shall be provided as part of this Contract and shall include the ability to query and sort through the event log.	C	C	Section F-1-IV-Functional Requirements, 1.5.2 Standard Reports		A		T	Y
IV.	a.) Region of Interest Report (i.e. departure or deicing queue)- Provides a list of all aircraft that are ~~currently~~ within a selected, configurable ROI along with the time of entry, time of exit, and total occupancy time.	C	C	Section F-1-IV-Functional Requirements, 1.5.2 Standard Reports		A		T	Y
IV.	b.) Arrival and Departure Summary- This summary shall provide a breakdown of the total number of departures and arrivals over a configurable time period for the airport in total, by runway and by individual Airline.	C	C	Section F-1-IV-Functional Requirements, 1.5.2 Standard Reports		A		T	Y
IV.	c.) Movement Area Taxi Time- This report shall target taxi details for individual flights upon entry into the movement area to wheels-up or from wheels-down to exit from the movement area. Breakdown of minimum information includes: flight call sign, aircraft registration number, runway, wheels down date and time, at gate date and time, total taxi time, gate and	C	C	Section F-1-IV-Functional Requirements, 1.5.2 Standard Reports		B	Y	T	Y

Section	Requirement	Phase A	Phase B	Proposal Cross Reference	Comments	Test Phase	Procedure Only	Verification Method	FAT Only
	terminal assigned, gate and terminal used, time the aircraft transitioncd from the movement area into the non-movement area, direction (inbound or outbound), Mode 3A and Mode S information, model of aircraft, movement area time, origin and destination airports, ramp/non-movement area time, runway occupancy time, taxiway used to enter/exit the ramp area, ship number, flight origination date, scheduled and actual out, off, on, in times, actual taxi in and out times and the marketing carrier.								
IV.	d.) Total Taxi Time- This report shall target taxi details for individual flights from movement off the gate or stand to wheels-up or from wheels down to arrival at gate or stand. Breakdown of minimum information includes: flight call sign, aircraft registration number, runway, wheels down date and time, at gate date and time, total taxi time, gate and terminal assigned, gate and terminal used, time the aircraft moved off the gate or stand, transitioned from the movement area into the non-movement area, direction (inbound or outbound), Mode 3A and Mode S information, model of aircraft, movement area time, origin and destination airports, ramp/non-movement area time, runway occupancy time, taxiway used to enter/exit the ramp area, ship number, flight origination date, scheduled and actual out, off, on, in times, actual taxi in and out times and the marketing carrier.	C	C	Section F-1-IV-Functional Requirements, 1.5.2 Standard Reports		B	Y	T	Y
IV.	e.) Wheels Up/ Wheels Down — This report shall highlight for wheels up and wheels down times for individual flights. Minimum information includes: flight call sign, aircraft registration number, runway, wheels down date and time, direction (inbound or outbound),	C	C	Section F-1-IV-Functional Requirements, 1.5.2 Standard Reports		A		T	Y

Section	Requirement	Phase A	Phase B	Proposal Cross Reference	Comments	Test Phase	Procedure Only	Verification Method	FAT Only
	Mode 3A and Mode S information, model of aircraft, ship number, flight origination date, scheduled and actual out, off, on, in times, actual taxi in and out times, scheduled and actual gate, and the marketing carrier.								
IV.	f) Planned Taxi Time vs. Allocated Taxi Time — This report shall measure the difference in time between the when an aircraft can be ready to call for taxi versus the taxi time assigned to the aircraft due to departure constraints. This information shall be sortable on a flight-by-flight basis, by first fix, by airline, by terminal or by total airport average over configurable amounts of time selected by the User.	C	C	Section F-1-IV-Functional Requirements, 1.5.2 Standard Reports		B	Y	T	Y
IV.	g.) Allocated Taxi Time vs. Wheels Up Time - This report shall indicate the difference in time between the Allocated Taxi Time assigned to an aircraft and the actual time that the aircraft's wheels leave the airport surface. This information shall be sortable on a flight-by-flight basis, by first fix, by airline, by terminal or by total airport average over configurable amounts of time periods selected by the User.	NC	C	Section F-1-IV-Functional Requirements, 1.5.2 Standard Reports	The Aerobahn product roadmap provides for this functionality to be complete prior to the beginning of Phase B service.	B	Y	T	Y
IV.	h.) Gate Utilization								
IV.	Amount of time between the vacating of departing aircraft from gate and the arrival time of the next AC at the same gate, including their associated time stamps, flight and gate information.	C	C	Section F-1-IV-Functional Requirements, 1.5.2 Standard Reports		A	Y	T	Y
IV.	i.) Departure Delay								
IV.	Amount of time between the vacating of departing aircraft from gate and wheels up VS. the scheduled time. This report should highlight the flights that had a wheels up indication more than 45 minutes past the scheduled departure time, including their associated time stamps,	NC	C	Section F-1-IV-Functional Requirements, 1.5.2 Standard Reports	The Aerobahn product roadmap provides for this functionality to be complete prior to the beginning of	B	Y	T	

Section	Requirement	Phase A	Phase B	Proposal Cross Reference	Comments	Test Phase	Procedure Only	Verification Method	FAT Only
	flight and gate information.				Phase B service.				
IV.	j.) Arrival Delay								
IV.	Scheduled arrival time (block in) VS. actual arrival time (block in), highlighting flights that arrive (block in) more than 15 minutes past the scheduled arrival (block in) time, including their associated "wheels-on" indication, time stamps, flight and gate information.	NC	C	Section F-1-IV-Functional Requirements, 1.5.2 Standard Reports	The Aerobahn product roadmap provides for this functionality to be complete prior to the beginning of Phase B service.	B	Y	T	
IV.	k.) Runway Utilization								
IV.	Runway utilization by hour, day, month and/or year.	C	C	Section F-1-IV-Functional Requirements, 1.5.2 Standard Reports		A	Y	T	Y
IV.	1.) Metering Area Usage								
IV.	Metering location usage including flight information, time stamps in and out of region to highlight length of stay in region, and a count of how many aircraft metered in such locations, by hour and by total, for more than two minutes.	C	C	Section F-1-IV-Functional Requirements, 1.5.2 Standard Reports		B	Y	T	
IV.	3. Database Query Reports								
IV.	In addition to the established predefined reports, the System shall feature an advanced database query reporting capability that generates reports based on customizable User-defined criteria. This shall be a free-form query capability where Users will be able to generate reports identifying the operational situations and conditions that they would want to be aware of in real-time. For example, a Database Query Report could be run to identify stranded aircraft on the airfield, flights that required secondary deicing, unmet arrivals that had to wait at the gate, or flights that utilized a specific departure fix.	C	C	Section F-1-IV-Functional Requirements, 1.5.3 Database Query Reports		A	Y	T	Y
IV.	Database Query Reports shall be executed by defining the query criteria within the same GUI	C	C	Section F-1-IV-Functional		A	Y	T	Y

Section	Requirement	Phase A	Phase B	Proposal Cross Reference	Comments	Test Phase	Procedure Only	Verification Method	FAT Only
	that is employed by the configurable alerts in the Base Map. Already defined criteria shall be automatically shared between the Base Map and Database Query Reports so that reports can easily be run to review past alert situations. After the selection criteria are defined, report execution shall return the list of all matching aircraft, vehicles, or flights depending on the report subject. The details shown for each element shall be completely customizable so that Users can expeditiously access the information they need.			Requirements, 1.5.3 Database Query Reports					
IV.	The Contractor shall provide additional, custom reports, beyond those reports specified herein when requested by the Port Authority throughout the term of the contract period. Once the Port Authority identifies the content of the reports, the Contractor shall submit a report proposal that contains a scope of work, detailed labor breakdown, schedule and a cost proposal for approval by the Port Authority's Project Manager. The labor cost to provide custom reports shall not be included in the cost to provide the basic System and Services, but shall be compensated in accordance with the provisions stated in Section X.F. Supplemental Work			Section F-1-IV-Functional Requirements, 1.5.3 Database Query Reports		N/A			
IV.	4. Summary Windows								
IV.	Summary Windows shall provide Users the capability to display dynamic, real-time and forecasted status operation that is critical to their specific job function and needs. The System shall enable Users to choose trend indicators to illustrate whether the chosen values are increasing or decreasing and shall be capable of configuring the columns they want to see as well	PC	C	Section F-1-IV-Functional Requirements, 1.5.4 Summary Windows	The Aerobahn product roadmap provides for this functionality to be complete prior to the beginning of Phase B service.	B	Y	T	Y

Section	Requirement	Phase A	Phase B	Proposal Cross Reference	Comments	Test Phase	Procedure Only	Verification Method	FAT Only
	as the length of time that should be used to aggregate statistical trends (i.e. 30 minutes or greater, in multiples of 30).								
IV.	a. Region of Interest Summary								
IV.	Region of Interest (i.e. Departure Queue, Deicing Queue) Summary shall enable Users to monitor aircraft that occupy a defined Region of Interest (ROI). ROIs include Airport taxiways, runways, holding areas, parking areas, approach corridors, gates, concourses of gates, and other definable area in the movement and non-movement areas. This Summary Window shall provide a list of all aircraft that are currently within each ROI along with the time of entry, time of exit, and total occupancy time. Users shall have the ability to select the region they are interested in, along with the specific information to be displayed for each aircraft or vehicle in the region. The Summary shall also optionally display a sliding queue depth graph depicting the number of occupying aircraft.	C	C	Section F-1-IV-Functional Requirements, 1.5.4 Summary Windows		A		T	Y
IV.	b. Surface Delay Summary								
IV.	The Surface Delay Summary shall identify all established regions of interest and the corresponding delay. The delay shall be a calculated moving average of all delays recently incurred in each region respectively. Users shall have the ability to configure the table to show only regions with a delay above a certain threshold or to color code regions in the table with delays above a threshold.	C	C	Section F-1-IV-Functional Requirements, 1.5.4 Summary Windows		A		T	Y
IV.	c. Airport Demand Summary								
IV.	The Base Map Airport Demand Summary shall display archived, predicted, and summarized arrival and departure rates at JFK. The Service shall calculate and forecast the total number of	PC	C	Section F-1-IV-Functional Requirements, 1.5.4 Summary Windows	The Aerobahn product roadmap provides for this functionality to be	B	Y	T	Y

Section	Requirement	Phase A	Phase B	Proposal Cross Reference	Comments	Test Phase	Procedure Only	Verification Method	FAT Only
	arrivals and departures that have occurred, or will occur, in fixed size time intervals. For each time interval, the predicted or actual (depending on whether the interval is in the past or the future) rate is plotted alongside the scheduled rate to visually illustrate how JFK's traffic is progressing in relation to scheduled operations:				complete prior to the beginning of Phase B service.				
IV.	d. Runway Configuration Summary								
IV.	The Runway Configuration Summary shall graphically depict the current airport configuration. It shall be displayed as a simplified airport map with large colored arrows placed at the ends of the runways to indicate the current runway configuration. The colors shall be configurable and indicate if the runway is supporting arrivals, departures, or both. As the traffic patterns change, the arrows shall dynamically update to reflect the changes.	C	C	Section F-1-IV-Functional Requirements, 1.5.4 Summary Windows		A	Y	T	Y
IV.	e. Arrival and Departure Sequencing Summary								
IV.	The System shall predict the expected sequence of operations for the entire airport or an individual runway. Using predictive methods, the Arrival and Departure Sequencing Summary shall display ETA and ETD information using a condensed graphical timeline or other Port Authority Approved method. Users shall have the ability to add any number of predicted sequence charts to and arrange on a User's Base Map workspace.	C	C	Section F-1-IV-Functional Requirements, 1.5.4 Summary Windows		B	Y	T	Y
IV.	f. Taxi Time Summary								
IV.	Taxi Time Summary shall display all active aircraft taxi times along with estimated total taxi time for the entire airport or a specific runway. In addition, the minimum time, maximum time, average time, and trend for the airport and each runway shall be shown.	C	C	Section F-1-IV-Functional Requirements, 1.5.4 Summary Windows		A		T	Y

Section	Requirement	Phase A	Phase B	Proposal Cross Reference	Comments	Test Phase	Procedure Only	Verification Method	FAT Only
IV.	g. Active Flight Summary								
IV.	The Active Flights Summary displays all active flights along with the corresponding ETA or ETD, and a colored shape indicating flight progress. The thresholds used to determine status shall be configurable as shall the color and shape.	C	C	Section F-1-IV-Functional Requirements, 1.5.4 Summary Windows		A		T	Y
V.	**General System Design Requirements**								
V.	**A. Overview of Application**								
V.	For both phases of implementation, the System shall provide the following:								
V.	• Secure access and protection of Port Authority data against intrusions and internal misuse of data	C	C	Section F-1-V General System Design Requirements, 1.1 Overview of Application		A & B		R	Y
V.	• Continuous operations in the event of a catastrophic failure	C	C	Section F-1-V General System Design Requirements, 1.1 Overview of Application		A & B		R	Y
V.	• Consistent user interface	C	C	Section F-1-V General System Design Requirements, 1.1 Overview of Application		A & B		R	Y
V.	• Interface with external systems through an open systems architecture	C	C	Section F-1-V General System Design Requirements, 1.1 Overview of Application		A & B		R	Y
V.	The Contractor shall build the System to comply with the most current version of the Port Authority's Audit Department's Control Guidelines included in Exhibit ~~S~~ 5 and satisfy the checklists therein.	C	C	Section F-1-V General System Design Requirements, 1.1 Overview of Application		A & B		R	Y

Section	Requirement	Phase A	Phase B	Proposal Cross Reference	Comments	Test Phase	Procedure Only	Verification Method	FAT Only
V.	**B. Security Requirements**								
V.	1. Data Security								
V.	The System shall provide secured access and protection of Port Authority data against intrusions and internal misuse of that data. The techniques used to secure access and protect the data shall include, but not be limited to the following:			Section F-1-V General System Design Requirements, 1.2.1 Data Security		N/A			
V.	• Transparent Data Encryption	NC	NC	Section F-1-V General System Design Requirements, 1.2.1 Data Security	The Aerobahn SMS System does not encrypt data stored on the system. Instead, Sensis employs rigid physical security and system access controls to protect the data from exploitation or tampering.	N/A			
V.	• Compartmentalized system authorization	C	C	Section F-1-V General System Design Requirements, 1.2.1 Data Security		A & B		R	Y
V.	• Secure transmission of data	C	C	Section F-1-V General System Design Requirements, 1.2.1 Data Security		A & B		R	Y
V.	• Secure encryption of data	PC	PC	Section F-1-V General System Design Requirements, 1.2.1 Data Security	The Aerobahn SMS System encrypts data using VPN tunnels whenever that data is transmitted over a publicly accessible network. Sensis	A & B		R	Y

Section	Requirement	Phase A	Phase B	Proposal Cross Reference	Comments	Test Phase	Procedure Only	Verification Method	FAT Only
					relies on physical security and access controls to protect the data when it is sent over dedicated customer or internal Sensis networks.				
V.	• Strong, best practices password policy	C	C	Section F-1-V General System Design Requirements, 1.2.1 Data Security		B	Y	T	Y
V.	• Record all User activities	PC	PC	Section F-1-V General System Design Requirements, 1.2.1 Data Security	Aerobahn currently tracks major user activities as outlined in Section V.1.8 of the Proposal.	B	Y	T	Y
V.	2. Physical Security								
V.	The Contractor shall provide secured access and protection of the System against unauthorized physical contact to ensure that System operations are never compromised. Only authorized personnel shall be permitted access to the System to perform their designated assignments. The Contractor shall control, monitor and document access to the System and all System components. Protect the System and the building(s) where the System components are located from theft, vandalism, natural disaster, manmade catastrophes, and accidental damage and provide an appropriate environment that is conducive for proper System operation in accordance with the requirements stated herein.	C	C	Section F-1-V General System Design Requirements, 1.2.2 Physical Security		A & B		R	Y
V.	3. Security Submittal								
V.	The Contractor shall submit a description of all security features, policies and practices for	C	C	Section F-1-V General System Design		A		R	Y

Section	Requirement	Phase A	Phase B	Proposal Cross Reference	Comments	Test Phase	Procedure Only	Verification Method	FAT Only
	Authority approval.			Requirements, 1.2.3 Security Submittal					
V.	**C. System Architecture**								
V.	1. Redundancy								
V.	The System shall be redundant and configured to provide for continuous operation in the event of the failure of any single System component. The redundant operation shall include, but not be limited to, all central computer system, software, network and Internet components that are used to fulfill the requirements of the Contract.	C	C	Section F-1-V General System Design Requirements, 1.3 System Architecture		A		A	Y
V.	2. Fault Tolerance								
V.	A fault tolerant computing solution shall be provided so that the system will continue to run upon detection of any type of failure. Once implemented, the hardware and application shall continue to operate if one server, the software or any single system component fails.	C	C	Section F-1-V General System Design Requirements, 1.3 System Architecture		A		A	Y
V.	Any failures occurring in the primary application server (or database server if used), shall cause the system to automatically switchover, without operator intervention, from their primary central components to the secondary/redundant components upon detection of a hardware or software failure in any primary component without any loss of data or user control. The System shall instantaneously switchover the software processing to maintain continuous System operation. The operation of the System shall be transparent to the operator during and after the switchover. The system shall display an alert to the operators of the failover on all of the User Workstations to notify them of the condition. Once the primary server or component is repaired to full operation, all	PC	PC	Section F-1-V General System Design Requirements, 1.3 System Architecture	Sufficient redundancy is employed in the virtual environment, that in the event of a normal (non-disastrous) failure, there will be no loss of service. Aerobahn servers, in the event of a disaster recovery situation, will switch over in less than an hour resulting in a minimal loss of	A		A	Y

Section	Requirement	Phase A	Phase B	Proposal Cross Reference	Comments	Test Phase	Procedure Only	Verification Method	FAT Only
	data shall be recovered on the primary server without any loss of data during the outage. Restoration of the primary server(s) into the fault tolerant configuration shall be performed without any loss of data.				data.				
V.	3. Diversely Located Secondary/Redundant System								
V.	The secondary/redundant components of the system shall be diversely located, both physically and logically, in an alternate computer site that is subject to Port Authority approval, to ensure continuity of operations in event a catastrophic event adversely affects the site where the primary components are located.	C	C	Section F-1-V General System Design Requirements, 1.3 System Architecture		A	Y	A	
V.	4. Web-Enabled								
V.	Authorized Users shall access the application through a secure, web-enabled interface on normal desktop or laptop computers using standard Internet Browsers in their native operating systems, including, but not limited to, the following:	PC	PC	Section F-1-V General System Design Requirements, 1.3 System Architecture	Aerobahn runs in any modern browser that supports Java applets. This does not necessarily include all browsers on all platforms.	N/A			
V.	• Internet Explorer, version 7 (and later)			Section F-1-V General System Design Requirements, 1.3 System Architecture		A		T	Y
V.	• FireFox 3 (and later)			Section F-1-V General System Design Requirements, 1.3 System Architecture		A		T	Y
V.	• Safari 4 (and later)			Section F-1-V General System Design Requirements, 1.3 System Architecture		?			Y
V.	• Chrome (all versions)			Section F-1-V General		?			Y

Section	Requirement	Phase A	Phase B	Proposal Cross Reference	Comments	Test Phase	Procedure Only	Verification Method	FAT Only
				System Design Requirements, 1.3 System Architecture					
V.	• Opera 9 (and later)			Section F-1-V General System Design Requirements, 1.3 System Architecture		?			Y
V.	**D. Database Requirements**								
V.	1. Data Ownership	C	C						
V.	The Contractor shall propose ownership rights of the data collected by and used for System operation. The Contractor shall include a detailed description of which data will be owned by the Port Authority and its appropriate Users and which data will remain in ownership of the Contractor. The Contractor shall take all appropriate actions and measures to protect the data from unauthorized access and submit its approach for Authority approval. Within 30 days of the end of the contract period including any extension periods, a copy of the data collected throughout the entire time period of the contract shall be provided in a digital format to be approved by the Port Authority.	C	C	Section F-1-V General System Design Requirements, 1.4.1 Data Ownership		A	Y	R	Y
V.	2. Data Integrity	C	C						
V.	The integrity of the data used in the System, including frequency of exchange of the identified data, accuracy, timeliness and standardization of shared data, shall be proposed by the Contractor and is subject to Port Authority approval.	C	C	Section F-1-V General System Design Requirements, 1.4.2 Data Integrity		A	Y	R	Y
V.	3. Database Setup	C	C						
V.	The Contractor shall provide a fully functional system that includes the configuration, data entry and fine-tuning of a database and configuration of the system to meet the	C	C	Section F-1-V General System Design Requirements, 1.4.3 Database Setup		A	Y	T	Y

Section	Requirement	Phase A	Phase B	Proposal Cross Reference	Comments	Test Phase	Procedure Only	Verification Method	FAT Only
	requirements of the contract.								
V.	4. Database Replication	C	C						
V.	The System database(s) shall be replicated onto the backup application server, (and/or backup database server if a separate server is used), which is located in a different data center for diversity in order to maintain System operation in the event that the primary application server (or primary database server if used) fails without loss of data or user control. The replication process shall be performed in real-time, replicate each transaction and validate that the replicated data is accurate and complete.	C	C	Section F-1-V General System Design Requirements, 1.4.4 Database Replication		A	Y	T	Y
V.	5. Data Storage, Archive and Restore	C	C						
V.	The System shall provide online storage of data for a minimum of two (2) years of data without any degradation in System performance. For each month beyond the current two (2) years of storage, the system shall automatically archive the data for long-term storage to disk, and R/W-DVD if requested by the user, and deleted from the online database storage. The System shall provide authorized Users with the capability to retrieve the archived data for reports, analysis and playback for a minimum period of five *(5)* years and removed from normal access once the User indicates they completed use of the archived data.	C	C	Section F-1-V General System Design Requirements, 1.4.5 Data Storage, Archive and Restore		A		T	Y
V.	6. Database Backups	C	C						
V.	The Contractor shall backup all servers that are used as part of the application. The backup shall contain all data, application and system files and be performed as follows:	C	C	Section F-1-V General System Design Requirements, 1.4.6 Database Backups		A		T	Y
V.	• A full backup of each server shall be performed on a weekly basis.	C	C	Section F-1-V General System Design Requirements, 1.4.6		A		T	Y

Section	Requirement	Phase A	Phase B	Proposal Cross Reference	Comments	Test Phase	Procedure Only	Verification Method	FAT Only
				Database Backups					
V.	• An incremental backup of each server shall be performed on a daily basis and backup all files that have changed since the last backup.	C	C	Section F-1-V General System Design Requirements, 1.4.6 Database Backups		A		T	Y
V.	7. Testing the Restore Procedure	C	C						
V.	The Contractor shall verify that system backups can be used to successfully restore the backed up data. It is recommended that the test restore be performed on a single non-critical directory only, not the entire server. When incremental or differential backups are routinely used, the test restore procedure should incorporate the following:	C	C	Section F-1-V General System Design Requirements, 1.4.7 Testing the Restore Procedure		A	Y	T	
V.	• Immediately prior to performing the test restore procedure, do a special full backup on the directory being tested.	C	C	Section F-1-V General System Design Requirements, 1.4.7 Testing the Restore Procedure		A	Y	T	
V.	• Testing a full restore shall oniy be performed on a non-production server.	C	C	Section F-1-V General System Design Requirements, 1.4.7 Testing the Restore Procedure		A	Y	T	
V.	• Testing shall be performed, at a minimum, at least annually.	C	C	Section F-1-V General System Design Requirements, 1.4.7 Testing the Restore Procedure		A		T	Y
V.	• Test results shall be documented.	C	C	Section F-1-V General System Design Requirements, 1.4.7 Testing the Restore Procedure		A	Y	T	
V.	8. Data Analysis	C	C						
V.	The Contractor shall provide the User with the	C	C	Section F-1-V General		A		T	Y

Section	Requirement	Phase A	Phase B	Proposal Cross Reference	Comments	Test Phase	# Procedure Only	Verification Method	FAT Only
	capability to analyze the data recorded by the System. The Contractor shall propose, for Authority approval, the methods of analysis.			System Design Requirements, 1.4.8 Data Analysis					
V.	9. Data Playback								
V.	The System shall provide the capability to playback recorded data in sync with recorded radio transmissions.	PC	C	Section F-1-V General System Design Requirements, 1.4.9 Data Playback	The Aerobahn product roadmap provides for this functionality to be complete prior to the beginning of Phase B service.	A		T	Y
V.	10. Data Extraction	C	C						
V.	The System shall provide authorized Users with the capability to extract all Port Authority data in an appropriate hierarchical XML format that matches the business model of the application. The Contractor shall propose an XML structure, for Authority approval, based on the design of the application.	C	C	Section F-1-V General System Design Requirements, 1.4.10 Data Extraction		B	Y	T	Y
V.	**E. Screen Display and User Control**								
V.	The System shall provide critical information on all screens to provide a context for users of the application (i.e. state Facility for which data being reported). Report headings shall be standardized, and shall appear in a consistent manner throughout all presentation formats of the application on both the real-time Screen or in archived Reports.	PC	C	Section F-1-V General System Design Requirements, 1.5 Screen Display and User Control	The Aerobahn product roadmap provides for this functionality to be complete prior to the beginning of Phase B service.	B	Y	T	Y
V.	The System shall support a minimum of four (4) active windows operating concurrently and update the data in each window in accordance with the approved data refresh rate. The System shall also support the use of multiple monitors connected to the system unit of each workstation.	C	C	Section F-1-V General System Design Requirements, 1.5 Screen Display and User Control		A	Y	T	Y
V.	**F. Access Privileges**	C	C						

Section	Requirement	Phase A	Phase B	Proposal Cross Reference	Comments	Test Phase	Procedure Only	Verification Method	FAT Only
V.	Security shall be role-based and the application software shall support a minimum of eight (8) levels of application access security, including one (1) for system administration, totaling nine (9) access security levels, and be capable of storing a user passwords, associated access levels and access permissions/restrictions for the number of users specified in Attachment C, Section 5, M., System Sizing. The access level shall determine which functions the User can implement, as indicated below. The System shall allow each User's profile to be configured to allow Read-Only, Read & Write, or No Access permissions/restrictions to, at a minimum, the following resources:	C	C	Section F-1-V General System Design Requirements, 1.6.1 User Access Permission		A	Y	T	Y
V.	• airport terminal data	C	C	Section F-1-V General System Design Requirements, 1.6.1 User Access Permission		A	Y	T	Y
V.	• ramp area data	C	C	Section F-1-V General System Design Requirements, 1.6.1 User Access Permission		A	Y	T	Y
V.	• airline data, and	C	C	Section F-1-V General System Design Requirements, 1.6.1 User Access Permission		A	Y	T	Y
V.	• special system capabilities, such as the display of real time flight tracking for 15 PANYNJ Users	C	C	Section F-1-V General System Design Requirements, 1.6.1 User Access Permission		B	Y	T	Y
V.	User access permissions/restrictions to	C	C	Section F-1-V General		A	Y	T	Y

Section	Requirement	Phase A	Phase B	Proposal Cross Reference	Comments	Test Phase	Procedure Only	Verification Method	FAT Only
	application functions and resources shall be configured by the Contractor and approved by the Port Authority's Project Manager.			System Design Requirements, 1.6.1 User Access Permission					
V.	The application software shall provide the capability to allow the Application Administrator to examine, modify and print the list of user access permissions/restrictions and functions associated with each access level and each of the above resources the User can access. This capability shall enable the Application Administrator to change the user access privileges assigned to each access level, and change the permissions/restrictions each User "may"/"may not" access online to the above resources, without requiring a compilation or regeneration of the application software.	PC	PC	Section F-1-V General System Design Requirements, 1.6.2 Viewing and Modifying Access Permissions	Any application administrator can view and modify access permissions on groups and users at the administrator's level and below. Currently there is no built-in print functionality.	B	Y	T	Y
V.	1. Application Access Levels	C	C						
V.	The default user privileges associated with each access level arc defined as follows:	C	C	Section F-1-V General System Design Requirements, 1.7 Application Access Levels		N/A			
V.	a. Level One — Monitor-Only Airline Data	C	C	Section F-1-V General System Design Requirements, 1.7 Application Access Levels		A	Y	T	Y
V.	This level will provide users with read-only access to monitor all airline data and obtain all reports for the airlines they are authorized to have access to. Users with level one access shall not be able to modify any data.	C	C	Section F-1-V General System Design Requirements, 1.7 Application Access Levels		A	Y	T	Y
V.	b. Level Two — Monitor-Only Terminal Data	C	C	Section F-1-V General System Design Requirements, 1.7					

Section	Requirement	Phase A	Phase B	Proposal Cross Reference	Comments	Test Phase	Procedure Only	Verification Method	FAT Only
				Application Access Levels					
V.	This level will provide users with read-only access to monitor all terminal and ramp area data and obtain all reports that are related to the airport terminal they are authorized to have access to. Users with level two access shall not be able to modify any data.	C	C	Section F-1-V General System Design Requirements, 1.7 Application Access Levels		A	Y	T	Y
V.	c. Level Three — Monitor-Only Airport Data	C	C	Section F-1-V General System Design Requirements, 1.7 Application Access Levels					
V.	This level will provide users with read-only access to monitor all airport data and obtain all reports that are related to all airlines and terminals at the airport. Users with level three access shall not be able to modify any data.	C	C	Section F-1-V General System Design Requirements, 1.7 Application Access Levels		A	Y	T	Y
V.	d. Level Four — Modify Airline Operational Data:	C	C	Section F-1-V General System Design Requirements, 1.7 Application Access Levels					
V.	This level will provide authorized users with the ability to modify the operational data for the airlines they are authorized to access but not change any configuration data. Level four users shall have access to all level one functionality.	C	C	Section F-1-V General System Design Requirements, 1.7 Application Access Levels		A	Y	T	Y
V.	e. Level Five — Modify Terminal Operational Data	C	C	Section F-1-V General System Design Requirements, 1.7 Application Access Levels					
V.	This level will provide authorized users with the ability to modify the operational data for the terminals ramps they are authorized to access	C	C	Section F-1-V General System Design Requirements, 1.7		A	Y	T	Y

Section	Requirement	Phase A	Phase B	Proposal Cross Reference	Comments	Test Phase	Procedure Only	Verification Method	FAT Only
	but not change any configuration data. Level five users shall have access to all level two functionality.			Application Access Levels					
V.	f. Level Six — Modify Airport Operational Data	C	C	Section F-1-V General System Design Requirements, 1.7 Application Access Levels					
V.	This level will provide authorized users with the ability to modify the operational data related to all airlines and terminals at the airport but not change any configuration data. Level six users shall have access to all level three functionality.	C	C	Section F-1-V General System Design Requirements, 1.7 Application Access Levels		A	Y	T	Y
V.	g. Level Seven — Flight Tracking Data	C	C	Section F-1-V General System Design Requirements, 1.7 Application Access Levels					
V.	This level will provide authorized users with the ability to configure and access the flight tracking software that is provided as part of the Contract. Unlike most other users, once a Level Seven user logs into the System and invokes the flight tracking display, the System shall continually display the flight tracking software, even across staff shift changes, to ensure the continuity of the flight tracking display.	C	C	Section F-1-V General System Design Requirements, 1.7 Application Access Levels		A	Y	T	Y
V.	h. Level Eight — Application Administrator	C	C	Section F-1-V General System Design Requirements, 1.7 Application Access Levels					
V.	This level will provide authorized users with the ability to administer and maintain the application. Its use is limited to changes that affect the application software, its setup and	C	C	Section F-1-V General System Design Requirements, 1.7 Application Access		A		T	Y

Section	Requirement	Phase A	Phase B	Proposal Cross Reference	Comments	Test Phase	Procedure Only	Verification Method	FAT Only
	configuration, but not change any operational data. Level eight users shall have the ability to maintain a list of authorized users and their passwords, access to all Level three functions and to do the following:			Levels					
V.	i. Make operational adjustments to system thresholds and parameters.	C	C	Section F-1-V General System Design Requirements, 1.7 Application Access Levels		A		T	Y
V.	ii. Examine, modify, print database entries and perform all database maintenance functions.	C	C	Section F-1-V General System Design Requirements, 1.7 Application Access Levels		A		T	Y
V.	iii. Backup and restore the system configuration, libraries, database.	C	C	Section F-1-V General System Design Requirements, 1.7 Application Access Levels		A		T	Y
V.	iv. Maintain user and password controls and application access permissions.	C	C	Section F-1-V General System Design Requirements, 1.7 Application Access Levels		A		T	Y
V.	v. Assign User access permissions to terminals, ramp areas and air carriers.	C	C	Section F-1-V General System Design Requirements, 1.7 Application Access Levels		A		T	Y
V.	vi. Access and maintain the event log	C	C	Section F-1-V General System Design Requirements, 1.7 Application Access Levels		A		T	Y
V.	**G. Event Logging**								

Section	Requirement	Phase A	Phase B	Proposal Cross Reference	Comments	Test Phase	Procedure Only	Verification Method	FAT Only
V.	The System shall record all system activity and maintain the activity log for subsequent reporting. The System shall record all events and changes made by the users. Each record shall contain, at a minimum, the User name, time, date and location from which the event/activity occurred, and include the event or activity performed. The record shall include, but not be limited to the following information:	PC	PC	Section F-1-V General System Design Requirements, 1.8 Event Logging	Aerobahn currently tracks major user activities as outlined in Section V.1.8 of the Proposal.	A	Y	T	Y
V.	• Log in and log out activity by each user,	C	C	Section F-1-V General System Design Requirements, 1.8 Event Logging		A	Y	T	Y
V.	• All events and changes made by the users to operational data,	C	C	Section F-1-V General System Design Requirements, 1.8 Event Logging	All manual data entry/modification by users will be logged.	A	Y	T	Y
V.	• All changes made to the setup or configuration.	C	C	Section F-1-V General System Design Requirements, 1.8 Event Logging		A	Y	T	Y
V.	Description for each change shall include the values of the data both before and after the changes were applied.	C	C	Section F-1-V General System Design Requirements, 1.8 Event Logging		A	Y	T	Y
V.	**H. State of Common Usage**								
V.	Furnished hardware, equipment, software, database and communications protocols shall be in a "state of common usage," or industry-standard, and shall be an open architecture. Computer software shall consist of all system, application, and utility software required to meet the requirements of this Contract. All off-the-shelf software shall be industry standard. The Contractor shall submit the latest commercially available release/version of all hardware and	PC	PC	Section F-1-V General System Design Requirements, 1.9 State of Common Usage	Sensis monitors the current state of the industry and uses the most up-to-date versions of hardware and software within cost and security constraints.	A	Y	T	Y

Section	Requirement	Phase A	Phase B	Proposal Cross Reference	Comments	Test Phase	Procedure Only	Verification Method	FAT Only
	software products in general use prior to System acceptance and comply with the industry's best practices.								
V.	**I. Graphical User Interface**								
V.	A user-friendly graphical user interface (GUI) shall be furnished that is ergonomically designed to facilitate user operation in an intuitive manner and to minimize operator actions for information retrieval and system operation. The user shall be able to invoke any action or command with no more than three (3) mouse clicks and any additional required data. The user interface shall be designed with streamlined business display screens to facilitate easy data entry and general viewing. Navigation tools/menus/keys shall be prominently displayed and provide consistent, easy movement within and between screens.	PC	PC	Section F-1-V General System Design Requirements, 1.10 Graphical User Interface	Most features, including workspace and tool configuration, report creation, and manual data entry items can indeed be accessed in three mouse-clicks or less. Features requiring more than three clicks are typically used for in-depth configuration and then only rarely.	A	Y	T	Y
V.	All control and reporting features shall have a logical hierarchical arrangement to engage the user through such features as pull-down menus, interactive graphics, dialog boxes, touch screens or other user-friendly means. The user interface shall prompt the operator with instructions or for additional information when user entry is required. The user interface shall not require the operator to memorize command sequences to perform operator controls. Context sensitive help or another form of on-line documentation for all functions and operations shall be provided.	C	C	Section F-1-V General System Design Requirements, 1.10 Graphical User Interface		A	Y	T	Y
V.	All screen layouts shall be submitted for approval by the Port Authority's Project Manager. The Contractor may request in writing	PC	PC	Section F-1-V General System Design Requirements, 1.10	Aerobahn is an existing tool already in use at JFK.	A	Y	R	Y

Section	Requirement	Phase A	Phase B	Proposal Cross Reference	Comments	Test Phase	Procedure Only	Verification Method	FAT Only
	for the Authority to provide any drawings or graphics of the project area that are required for use in developing the system graphics.			Graphical User Interface	Sensis welcomes any suggestions to the interface to improve its usability as we have been taking such comments for over 8 years from our various customers. Concept screens illustrating functionality new for the Aerobahn SMS Service contract are included in this proposal.				
V.	**J. Start Up**				To the extent possible Sensis will engage the Port Authority for feedback in the creation of new menus and functions that are relevant to the Port Authority operation.				
V.	The System shall automatically execute all site-specific configuration parameters required to start up and enter the operational mode of the application software upon system initialization.	C	C	Section F-1-V General System Design Requirements, 1.11 Start Up		A		T	Y
V.	**K. Orderly Shutdown**								
V.	The System shall be capable of being shutdown in an orderly fashion and in a manner that causes no anomalies in other subsystem components or software applications and no loss of data. Other	PC	PC	Section F-1-V General System Design Requirements, 1.12 Orderly Shutdown	The system does not notify connected users that a shutdown is	A	Y	T	Y

Section	Requirement	Phase A	Phase B	Proposal Cross Reference	Comments	Test Phase	Procedure Only	Verification Method	FAT Only
	subsystem components shall not report multiple errors nor be unavailable for shutdown. Just prior to shutdown, the System shall automatically notify connected Workstations that system shutdown is imminent.				imminent. However, customer support will have sent an email days before the action notifying users it will happen. Note that if a user is logged in and running Aerobahn at the time of shutdown, and the Aerobahn server is restarted before the user closes the client application, it will generally reconnect to the server automatically.				
V.	Only authorized users, i.e. Application and System Administrators shall have the capability of shutting down the System.	C	C	Section F-1-V General System Design Requirements, 1.12 Orderly Shutdown		A		T	Y
V.	**L. Change Management**	C	C						
V.	The application must be secured and all revision changes shall require prior Port Authority approval. All changes shall be tracked and implemented in accordance with the Authority's approved change management procedure.	C	C	Section F-1-V General System Design Requirements, 1.13 Change Management		B		A	Y
V.	**M. System Sizing**	C	C						
V.	The System shall be capable of supporting, at a minimum, the following:	C	C	Section F-1-V General System Design Requirements, 1.14 System Sizing					
V.	• 1 airport location, supporting, at a minimum,	C	C	Section F-1-V General		A	Y	T	Y

Section	Requirement	Phase A	Phase B	Proposal Cross Reference	Comments	Test Phase	Procedure Only	Verification Method	FAT Only
	11 airline terminals			System Design Requirements, 1.14 System Sizing					
V.	• 400 concurrent Users on separate, independent Workstations.	C	C	Section F-1-V General System Design Requirements, 1.14 System Sizing		B	Y	T	Y
V.	• 3200 Registered Users	C	C	Section F-1-V General System Design Requirements, 1.14 System Sizing		B	Y	T	Y
V.	• Licenses to use the flight tracking software at 15 PANYNJ workstation locations, concurrently.	C	C	Section F-1-V General System Design Requirements, 1.14 System Sizing		B	Y	T	Y
VI.	General System Performance Requirements					B	Y	T	Y
VI.	**A. General System Performance Requirements:**								
VI.	For both phases of implementation, the System shall consist of readily available, proven hardware and software elements, which arc fully consistent with the System's design and operation as specified. It shall have the throughput, capacity, and availability, as specified herein, to provide the required functionality. It shall meet the performance requirements identified herein and under the maximum loading when all Users, as specified in Section V. M. System Sizing, are connected and interacting with the System and all System devices are engaged and performing their specified functions, with no loss of data or user control.	C	C	Section F-1-VI-General System Performance Requirements, 1.1 General System Performance Requirements		A & B	Y	T	
VI.	At a minimum, the System shall:	C	C	Section F-1-VI-General System Performance					

Section	Requirement	Phase A	Phase B	Proposal Cross Reference	Comments	Test Phase	Procedure Only	Verification Method	FAT Only
				Requirements, 1.1 General System Performance Requirements					
VI.	1. Update User Workstation displays within 10 seconds of User action/request if Workstation is connected to the Internet through a broadband Internet connection, except for reports or database queries.	C	C	Section F-1-VI-General System Performance Requirements, 1.1 General System Performance Requirements		B	Y	T	
VI.	2. Use a maximum of 50 % of internal random access memory and disk storage in the servers and Workstations.	C	C	Section F-1-VI-General System Performance Requirements, 1.1 General System Performance Requirements		B	Y	T	
VI.	3. Use a maximum of 50 % loading on individual processors under worst case loading when all devices are engaged and all System elements arc in operation.	C	C	Section F-1-VI-General System Performance Requirements, 1.1 General System Performance Requirements		B	Y	T	
VI.	4. Provide the capability for the number of Users, specified in Section V. M. System Sizing, at different Workstations to access the same application concurrently without any degradation of system performance.	C	C	Section F-1-VI-General System Performance Requirements, 1.1 General System Performance Requirements		B	Y	T	
VI.	**B. System Availability**	C	C						
VI.	The System shall be a redundant, fault tolerant architecture with an availability of 99.99%. The application software furnished and installed by	C	C	Section F-1-VI-General System Performance		A & B	Y	A & I	

Section	Requirement	Phase A	Phase B	Proposal Cross Reference	Comments	Test Phase	Procedure Only	Verification Method	FAT Only
	the Contractor shall be designed and built so that the applications software always operates properly on an active server and meet the availability requirement of 99.99%.			Requirements, 1.2 System Availability					
VI.	During periods of outages, disruption and maintenance, periodic updates shall be emailed to approved Users highlighting the impact to the service. The updates shall include, at a minimum, the following information:	C	C	Section F-1-VI-General System Performance Requirements, 1.2 System Availability		A		I	Y
VI.	1. Work to be performed	C	C	Section F-1-VI-General System Performance Requirements, 1.2 System Availability		A		I	Y
VI.	2. Date and Time of Maintenance Activity	C	C	Section F-1-VI-General System Performance Requirements, 1.2 System Availability		A		I	Y
VI.	3. Anticipated impact on System performance	C	C	Section F-1-VI-General System Performance Requirements, 1.2 System Availability		A		I	Y
VI.	4. Notification about how the Contractor plans to capture information about the specific activity	C	C	Section F-1-VI-General System Performance Requirements, 1.2 System Availability		A		I	Y
VI.	5. Timeframe describing the forecasted outage, disruption or maintenance completion time	C	C	Section F-1-VI-General System Performance Requirements, 1.2 System Availability		A		I	Y
VI.	6. A follow-up message indicating completion of the event and System restoration.	C	C	Section F-1-VI-General System		A		I	Y

Section	Requirement	Phase A	Phase B	Proposal Cross Reference	Comments	Test Phase	Procedure Only	Verification Method	FAT Only
				Performance Requirements, 1.2 System Availability					
VI.	7. A phone number and email address where the User can call or write with questions regarding the activity.	C	C	Section F-1-VI-General System Performance Requirements, 1.2 System Availability		A		I	Y
VII.	Users and Training	C	C	F-1-VII-Users and Training, 1.1 Aerobahn Training Methodology					
VII.	A. Types and Quantity	C	C	F-1-VII-Users and Training, 1.1 Aerobahn Training Methodology					
VII.	The Authority currently has operational, supervisory and administrative staff that will use the application. Training shall be provided for up to SO staff in all Port Authority facilities and up to 300 representatives of the various air carriers who will be using this system staff in accordance with the requirements of this section. The Contractor shall provide training for training of Users both who work at Port Authority facilities and training, using a separate methodology, for Users who do not physically work at Port Authority facilities.	C	C	F-1-VII-Users and Training, 1.1 Aerobahn Training Methodology					
VII.	B. Training	C	C	F-1-VII-Users and Training, 1.1 Aerobahn Training Methodology					
VII.	The Contractor shall provide operation and administrative training for the entire System to designated Authority personnel and representatives of the airline industry at several	C	C	F-1-VII-Users and Training, 1.1 Aerobahn Training Methodology					

Section	Requirement	Phase A	Phase B	Proposal Cross Reference	Comments	Test Phase	Procedure Only	Verification Method	FAT Only
	Authority facilities to be determined by the Port Authority's Project Manager, through the means of practical demonstrations, seminars and other related technical teaching procedures. Training shall also be provided to airline staff working for the air carriers in locations off Port Authority facilities. The training program shall be implemented with formal classroom training and/or other forms of presentation as recommended by the Contractor. The curriculum shall be designed so that each group of trainees shall be trained in the full repertoire of system commands that they may have to use in the course of performing their designated functions. Students shall be provided with complete sets of training materials during the training sessions, which they shall retain for use on the job at the completion of training. Training shall be conducted on-site at the designated Airport facilities, and off-site for air carrier representatives who do not work at Port Authority facilities, in accordance with the approved training plan and methodology. Separate training classes shall be provided for each phase of implementation.								
VII.	Upon completion of each training program, the Contractor shall prepare and submit to the Port Authority's Project Manager a training report that shall summarize the results of the training program, including a list of attendees and individual test results, course evaluation forms, and recommendations for follow-up training or modifications to the curriculum.	C	C	F-1-VII-Users and Training, 1.2.1 Training Reports					
VII.	1. Training Schedule	C	C	F-1-VII-Users and Training, 1.2 Aerobahn Training					

Section	Requirement	Phase A	Phase B	Proposal Cross Reference	Comments	Test Phase	Procedure Only	Verification Method	FAT Only
				Courses					
VII.	The Contractor shall conduct two complete set of training sessions to coincide with each phase of the project implementation. Each set of training sessions shall educate the Users on the features and functions that are placed into production with each of the two project implementation phases.	C	C	F-1-VII-Users and Training, 1.2 Aerobahn Training Courses					
VII.	For each implementation phase, the Contractor shall conduct two (2) independent sets of training sessions for appropriate users at each Airport at the scheduled times and locations designated by the Port Authority's Project Manager and consistent with the approved training plan. Additional training courses shall be provided to the air carrier representatives in accordance with the approved training methodology.	C	C	F-1-VII-Users and Training, 1.1 Aerobahn Training Methodology					
VII.	2. Training Coach	C	C	F-1-VII-Users and Training, 1.3 On-Site Training Coach					
VII.	Contractor shall provide an on-site coach to work at each of the 9 terminal facilities to work directly with the terminal operators and coach them in the use of the system. Coaching shall be conducted concurrently at each terminal facility for a minimum of three days and provide coverage for each of the two (2) operational shifts. The time and dates for coaching the terminal operations staff shall be coordinated with each terminal manager and be conducted subsequent to implementation of the System at each terminal.	C	C	F-1-VII-Users and Training, 1.3 On-Site Training Coach					
VII.	C. **Training Time Constraints**	C	C	F-1-VII-Users and Training, 1.1.2 Training Time					

Section	Requirement	Phase A	Phase B	Proposal Cross Reference	Comments	Test Phase	Procedure Only	Verification Method	FAT Only
				Constraints					
VII.	The Contractor shall complete all training on-site prior to the commencement of the 14-Day Operational Test.	C	C	F-1-VII-Users and Training, 1.1.2 Training Time Constraints					
VIII.	**Acceptance and Testing**	C	C	F-1-VIII-Acceptance and Testing, 1. Acceptance and Testing					
VIII.	**A. System Inspection & Tests**	C	C	F-1-VIII-Acceptance and Testing, 1. Acceptance and Testing					
VIII.	After the Contractor completes the development, internal testing and configuration of its application to meet the contract requirements, the System shall be formally tested in its entirety at a location approved by the Port Authority for each phase of the project implementation. Therefore, the Contractor shall conduct two complete sets of System Inspection and Test of the System to coincide with each phase of the project implementation.	C	C	F-1-VIII-Acceptance and Testing, 1.3.3.5 AT Execution					
VIII.	Since the System will be operational and in a production environment subsequent to the initial implementation, the Contractor shall propose a methodology, for Port Authority approval, for testing the features and functions implemented for the second phase of the project without disrupting the operation of the on-line production System.	C	C	F-1-VIII-Acceptance and Testing, 1.3.3.5 AT Execution					
VIII.	The Contractor shall notify the Port Authority's Project Manager that it is ready to schedule a System Inspection and Test of the System. The Port Authority's Project Manager has the right to include not more than two additional Port	C	C	F-1-VIII-Acceptance and Testing, 1.3.3.4 Test Readiness Review					

Section	Requirement	Phase A	Phase B	Proposal Cross Reference	Comments	Test Phase	Procedure Only	Verification Method	FAT Only
	Authority professionals, who have been deemed the technical and operational experts to assist in witnessing the System Inspection and Tests.								
VIII.	1. A pre-acceptance test shall be conducted by the Contractor in advance of the formal acceptance test, using the Inspection and Test procedures approved by the Port Authority's Project Manager to demonstrate that the system is ready for the formal acceptance test that will be witnessed by the Port Authority's Project Manager.	C	C	F-1-VIII-Acceptance and Testing, 1.3.3.2 Dry Runs and Formalization of Acceptance Test Procedures					
VIII.	2. Testing shall be performed by the Contractor and witnessed by the Port Authority's Project Manager using test procedures submitted by the Contractor and approved by the Port Authority.	C	C	F-1-VIII-Acceptance and Testing, 1.3.3.5 AT Execution					
VIII.	3. Testing shall be conducted with all devices and components integrated as a System with use of simulation expressly limited to perform stress and performance testing. Testing shall demonstrate proper System operation in the fully integrated environment to validate the intended function and performance of all field devices and infrastructure components function in accordance with the Contract requirements and operate as a fully integrated system.	C	C	F-1-VIII-Acceptance and Testing, 1.3.3 Acceptance Test					
VIII.	4. Each item of the System shall be tested in its entirety with the use of simulated inputs and simulated outputs, additional processors, or control equipment, shall only be used in the event that conditions cannot be replicated or to demonstrate requirements for future capabilities or expansion.	C	C						
VIII.	5. The success (pass) or failure of each test and any detailed test results will be recorded by the Port Authority's Project Manager's designated representative.	C	C	F-1-VIII-Acceptance and Testing, 1.3.3.5 AT Execution	Sensis will document all test results and maintain the official copy.				

Section	Requirement	Phase A	Phase B	Proposal Cross Reference	Comments	Test Phase	Procedure Only	Verification Method	FAT Only
VIII.	6. All hardware, software, network, equipment, external connectivity, licenses and labor required for the test shall be furnished by the Contractor.	C	C	F-1-VIII-Acceptance and Testing, 1.3.3.5 AT Execution					
VIII.	7. The Inspection and Tests shall be conducted in their entirety in order to demonstrate that every feature and function of the hardware, software, firmware and network components of the System is fully integrated and is in conformance with the Contract documents. Testing shall demonstrate end-to-end connectivity and full functionality of all System components. Testing shall include a stress test to demonstrate that the System meets the performance requirements when processing all devices in the final system configuration. Simulated inputs may be used to demonstrate that the full processing load can be achieved.	C	C	F-1-VIII-Acceptance and Testing, 1.3.3.1 Requirements and Performance Test					
VIII.	8. The Contractor shall demonstrate that the automatic failover from the primary server(s) to the secondary (backup) server(s) and the complete restoration of the primary server(s) subsequent to the failover operates successfully.	C	C	F-1-VIII-Acceptance and Testing, 1.3.3.1 Requirements and Performance Test					
VIII.	9. The Contractor shall demonstrate that Users can access all features of and control the System from a minimum of sixteen (16) User Workstations simultaneously, at least 8 of which shall be remotely connected to the System through an Internet connection.	C	C	F-1-VIII-Acceptance and Testing, 1.3.3.1 Requirements and Performance Test					
VIII.	10. In the event of a test failure, the Contractor shall make all repairs or modifications required for passing the test. The failed test shall be repeated until the results are satisfactory to the Port Authority's Project Manager. Any subsequent planned tests that, in the opinion of the Port Authority's Project Manager, are	C	C	F-1-VIII-Acceptance and Testing, 1.3.3.8 AT Acceptance	Sensis and the Port will agree to requirements and test procedures prior to the commencement of test. All				

Section	Requirement	Phase A	Phase B	Proposal Cross Reference	Comments	Test Phase	Procedure Only	Verification Method	FAT Only
	dependent on the satisfactory passing of the failed test shall not be performed until the failed test is repeated and has satisfactorily passed. To demonstrate a satisfactory resolution of a failed test, the Port Authority's Project Manager may require that the Contractor perform additional tests. These additional tests shall be made at the expense of the Contractor.				assessments will be done according to these agreed-to criteria.				
VIII.	11. If, in the opinion of the Port Authority's Project Manager, there are an excessive number of failed tests, the System Inspection and Test shall be halted and the Contractor shall repeat all or part of the Inspection and Test, at the discretion of the Port Authority's Project Manager, at a later date.	C	C	F-1-VIII-Acceptance and Testing, 1.3.3.8 AT Acceptance					
VIII.	12. Should it be necessary for the Port Authority's Project Manager to attend more than one System Inspection and Testing session due to Contractor delays, product failure, failure to pass approved testing procedures, inability to complete the test in the scheduled time period or failure to implement approved testing procedures, the Contractor shall bear all costs incurred by the Port Authority for each additional test session where up to two (2) Port Authority representatives may attend. Such costs for Port Authority representatives for each additional Inspection and Test session will be deducted from the Contractor's compensation.	C	C	F-1-VIII-Acceptance and Testing, 1.3.3.8 AT Acceptance					
VIII.	13. Prior to the conclusion of the test, submit to the Port Authority's Project Manager an internationally recognized certification conforming to SAS-70 Level 2, or approved equivalent, that the security policies and practices employed in the System configuration, setup and operation provide the protections	C	C	F-1-VIII-Acceptance and Testing, 1.3.3.6 Security Policies		N/A			

Section	Requirement	Phase A	Phase B	Proposal Cross Reference	Comments	Test Phase	Procedure Only	Verification Method	FAT Only
	stated in Attachment C, Section V, B (Data Security) and C (System Architecture).								
VIII.	14. At the conclusion of the test, submit to the Port Authority's Project Manager an acceptance test report for the purpose of verifying and validating the accuracy and integrity of the System as installed. The Port Authority's Project Manager will review the report and respond; indicating approval or noting changes required either in the performance of the Work or in the report. The Contractor shall make all changes and perform such necessary Work as the Port Authority's Project Manager may direct prior to the start of the 14-Day Operational Test.	C	C	F-1-VIII-Acceptance and Testing, 1.3.3.8 AT Acceptance					
VIII.	**15. Neither the witnessing of a test by the Port Authority's Project Manager, or the waiving of a** right to witness a test shall relieve the Contractor of the responsibility of furnishing the System that is in compliance with the Contract requirements. The witnessing of any tests by the Port Authority's Project Manager's designated representative, or the approval for shipment of System shall not be deemed as acceptance of the System, the associated control, electronics and communications equipment.	C	C	F-1-VIII-Acceptance and Testing, 1.3.3.8 AT Acceptance					
VIII.	**B. 14-Day Operational Test**	C	C	F-1-VIII-Acceptance and Testing, 1.4 Operational Test					
VIII.	Upon notification from the Port Authority's Project Manager of approval of the System Inspection and Test Report and the Contractor's certification that the System is ready for operational testing, an Operational Test phase shall commence for each phase of the project. The Port Authority operating staff with the advice and assistance of the Contractor shall	C	C	F-1-VIII-Acceptance and Testing, 1.4 Operational Test					

Section	Requirement	Phase A	Phase B	Proposal Cross Reference	Comments	Test Phase	Procedure Only	Verification Method	FAT Only
	perform the Operational Test during a 14 consecutive day period. During this period, Port Authority staff and Users will operate the System using the latest version of all applicable manuals, printed guides and procedures. Therefore, the Contractor shall conduct two complete sets of 14-day Operational Tests of the System to coincide with each phase of the project implementation.								
VIII.	**1. Failures during Operational Test**	C	C	F-1-VIII-Acceptance and Testing, 1.4 Operational Test					
VIII.	If there is a major system or component failure during the 14 day Operational Test, the Contractor shall correct any malfunctions as they occur. After the Contractor corrects a malfunction, the 14-day test shall restart, at day one, and shall continue until the System and all associated control,electronics, and communications equipment have operated without interruption or malfunction for 14 days, and the results are satisfactory, with the written approval of the Port Authority's Project Manager.	C	C	F-1-VIII-Acceptance and Testing, 1.4 Operational Test					
VIII.	**2. Performance Period**	C	C	F-1-VIII-Acceptance and Testing, 1.4 Operational Test					
VIII.	The Performance Period for operational testing shall begin on the date operational testing commences. It shall end when the System has met the 14 consecutive days of operation in conformance with the Contract requirements at the required availability level stated herein.	C	C	F-1-VIII-Acceptance and Testing, 1.4 Operational Test					
VIII.	**C. Submittal Requirements for Testing**	C	C	F-1-VIII-Acceptance and Testing, 1.2.1.2 Acceptance Test					

Section	Requirement	Phase A	Phase B	Proposal Cross Reference	Comments	Test Phase	Procedure Only	Verification Method	FAT Only
				Procedures					
VIII.	1. An Acceptance Test Plan shall be submitted to the Port Authority's Project Manager for approval not less than 21 days prior to the proposed start of the System Inspection and Test and shall include, at a minimum, the following details:	C	C	F-1-VIII-Acceptance and Testing, 1.2.1.2 Acceptance Test Procedures					
VIII.	a. A summary statement of the purpose and goal of each portion of the test plan.	C	C	F-1-VIII-Acceptance and Testing, 1.2.1.2 Acceptance Test Procedures					
VIII.	b. The method of testing. A description of the overall test environment including block diagrams showing the total test environment, relevant equipment interconnection and test equipment hookup.	C	C	F-1-VIII-Acceptance and Testing, 1.2.1.2 Acceptance Test Procedures					
VIII.	c. Hardware and software used for the test.	C	C	F-1-VIII-Acceptance and Testing, 1.2.1.2 Acceptance Test Procedures					
VIII.	d. Detailed test procedures that demonstrate that every feature and function to be provided in the furnished hardware and software conforms to the requirements of the Contract.	C	C	F-1-VIII-Acceptance and Testing, 1.2.1.2 Acceptance Test Procedures					
VIII.	2. Identify the:	C	C	F-1-VIII-Acceptance and Testing, 1.2.1.2 Acceptance Test Procedures					
VIII.	a. Steps for each test to be performed	C	C	F-1-VIII-Acceptance and Testing, 1.2.1.2 Acceptance Test Procedures					
VIII.	b. Test purpose	C	C	F-1-VIII-Acceptance and Testing, 1.2.1.2 Acceptance Test Procedures					

Section	Requirement	Phase A	Phase B	Proposal Cross Reference	Comments	Test Phase	Procedure Only	Verification Method	FAT Only
VIII.	c. Conditions which exist at the start of each test procedure	C	C	F-1-VIII-Acceptance and Testing, 1.2.1.2 Acceptance Test Procedures					
VIII.	d. Conditions/results expected at the conclusion of each test procedure	C	C	F-1-VIII-Acceptance and Testing, 1.2.1.2 Acceptance Test Procedures					
VIII.	e. The specification requirement that will be demonstrated by the test procedure.	C	C	F-1-VIII-Acceptance and Testing, 1.2.1.2 Acceptance Test Procedures					
VIII.	3. Include space for recording the following:	C	C	F-1-VIII-Acceptance and Testing, 1.2.1.2 Acceptance Test Procedures					
VIII.	a. the actual test results	C	C	F-1-VIII-Acceptance and Testing, 1.2.1.2 Acceptance Test Procedures					
VIII.	b. check boxes for the test outcome (pass or fail)	C	C	F-1-VIII-Acceptance and Testing, 1.2.1.2 Acceptance Test Procedures					
VIII.	c. dated signatures of both the person performing the test and the Authority's authorized (witness) representative, and	C	C	F-1-VIII-Acceptance and Testing, 1.2.1.2 Acceptance Test Procedures					
VIII.	d. Comments of the test witness (es).	C	C	F-1-VIII-Acceptance and Testing, 1.2.1.3 Acceptance Test Report	Comments are typically recorded in the test log.				
VIII.	4. Describe the documents to be provided to the Port Authority's Project Manager to validate the test results (reports, database listings, statistical analyses, message displays, etc.).	C	C	F-1-VIII-Acceptance and Testing, 1.3.2 Prodcut Acceptance Test, 1.3.3.8 AT					

Section	Requirement	Phase A	Phase B	Proposal Cross Reference	Comments	Test Phase	Procedure Only	Verification Method	FAT Only
				Acceptance					
VIII.	S. A request to conduct the test shall be submitted to the Port Authority's Project Manager for approval, not less than 21 calendar days prior to the proposed start of the test. The request shall include the estimated length of time required to complete the testing and shall include an agenda that identifies when each of the tests are scheduled to be conducted. The Contractor shall also submit draft copies of all user manuals to enable test participants to become familiar with the System's operation.	C	C	F-1-VIII-Acceptance and Testing, 1.3.3.4 Test Readiness Review					
VIII.	6. Certification that the System passed pre-acceptance tests using the approved test procedure and a copy of the pre-acceptance test report indicating the results shall be submitted to the Port Authority's Project Manager for approval, not less than ten (10) calendar days prior to the scheduled start of the System Inspection and Test.	C	C	F-1-VIII-Acceptance and Testing, 1.3.3.3 Pre-Acceptance Test					
VIII.	7. A test report shall be submitted to the Port Authority's Project Manager after the completion of the test. The report shall include two (2) copies of the signed test document, including all annotations and notes from the actual tests and all failed test reports. The test report shall also state the test results and indicate the nature of any failure(s), the reasons for the failure(s), what corrective actions were taken and on which units the corrections were made, and a list of any outstanding items.	C	C	F-1-VIII-Acceptance and Testing, 1.3.3.8 AT Acceptance					
IX.	**Submittal and Documentation Requirements**	C	C	F-1-IX - Submittal and Documentation Requirements					
IX.	Unless specifically stated otherwise, the Contractor shall submit to the Port Authority's	C	C	F-1-IX - Submittal and Documentation					

Section	Requirement	Phase A	Phase B	Proposal Cross Reference	Comments	Test Phase	Procedure Only	Verification Method	FAT Only
	Project			Requirements					
IX.	Manager project management, design, testing, operational documentation and plan submittals, and	C	C	F-1-IX - Submittal and Documentation Requirements					
IX.	System As-Built drawings as follows:	C	C	F-1-IX - Submittal and Documentation Requirements					
IX.	**A. General Submittal Requirements**	C	C	F-1-IX - Submittal and Documentation Requirements					
IX.	**1. Submittal Review**	C	C	F-1-IX - Submittal and Documentation Requirements					
IX.	Allow the Port Authority's Project Manager a minimum often (10) workdays to review each Contractor submittal and re-submittal. The Contractor is responsible for maintaining the approved schedule even if multiple review cycles are required for each submittal.	C	C	F-1-IX - Submittal and Documentation Requirements					
IX.	**2. Submittal Format**	C	C	F-1-IX - Submittal and Documentation Requirements					
IX.	a. The Contractor shall submit all narrative text or tabular list-based submittals as follows:	C	C	F-1-IX - Submittal and Documentation Requirements					
IX.	b. Bind all 8.5" x 11" documentation, except standard spiral bound materials, in logical groupings in 3-ring loose-leaf binders. Each bound grouping of documentation shall be permanently and appropriately labeled. No documentation shall be smaller than 8.5" x 11". Document pages shall be numbered sequentially. Revised documentation shall be identified with a version number and revision date on the cover and each page.	C	C	F-1-IX - Submittal and Documentation Requirements					
IX.	c. Six sets of hardcopy documents	C	C	F-1-IX - Submittal and					

Section	Requirement	Phase A	Phase B	Proposal Cross Reference	Comments	Test Phase	Procedure Only	Verification Method	FAT Only
				Documentation Requirements					
IX.	d. One set in a machine-readable format that shall be viewable and easily modifiable with the Microsoft Office 2007 suite of tools.	C	C	F-1-IX - Submittal and Documentation Requirements					
IX.	**B. Submittal Schedule**	C	C	F-1-IX - Submittal and Documentation Requirements					
IX.	**1. Project Plan and Schedule**	C	C	F-1-IX - Submittal and Documentation Requirements					
IX.	Within five (5) days after award the Contractor shall submit a Project Plan and Schedule to the Port Authority's Project Manager. Elements of the Plan shall include, but are not limited to: installation plan drawings and product installation literature for all primary components of the System; a schedule and plan for the installation of all devices, communications conduit and cable, and computer hardware, development of custom software features and the loading of all software (with emphasis on what precautions shall be taken to minimize disruption of current operations); plans for the loading of the initial database; training; and, responsibilities for application administration during installation.	C	C	F-1-IX - Submittal and Documentation Requirements					
IX.	The Project Schedule shall include Gantt charts and PERT charts with the critical path identified (using CPM) showing when tasks occur, when resources are required, and what task dependencies exist. The Project Schedule shall be of sufficient detail and clarity so that all work can be reviewed and the Port Authority Project Manager can monitor progress. The charts shall indicate a logical sequence of work and identify	C	C	F-1-IX - Submittal and Documentation Requirements					

Section	Requirement	Phase A	Phase B	Proposal Cross Reference	Comments	Test Phase	Procedure Only	Verification Method	FAT Only
	all dependencies, personnel resources, material, equipment, and work areas required for completion of the work. The Project Schedule shall be submitted both electronically and hard copy.								
IX.	The degree of detail shall be sufficient to identify at a minimum:	C	C	F-1-IX - Submittal and Documentation Requirements					
IX.	a. All activities, tasks and stages of construction, milestones and deliverables as specified both within the Contractor's system development and installation methodology and those specifically identified herein.	C	C	F-1-IX - Submittal and Documentation Requirements					
IX.	b. All the activities and tasks associated with the development, installation, integration, configuration and preparation of the System and all subsystem components, submittals, testing and training.	C	C	F-1-IX - Submittal and Documentation Requirements					
IX.	c. Project activities with associated tasks and sub-tasks.	C	C	F-1-IX - Submittal and Documentation Requirements					
IX.	d. Interfaces and dependencies with preceding, concurrent, and succeeding work effort.	C	C	F-1-IX - Submittal and Documentation Requirements					
IX.	e. Resources needed and assignments down to the task level for staff, material, and equipment.	C	C	F-1-IX - Submittal and Documentation Requirements					
IX.	It shall be noted that the development, installation, integration and testing of all Technology Components shall be coordinated with the Port Authority Technology Services Department through the Port Authority Project Manager.	C	C	F-1-IX - Submittal and Documentation Requirements					
IX.	**2. Progress Schedule - Preparation, Updating & Reporting**	C	C	F-1-IX - Submittal and Documentation Requirements					

Section	Requirement	Phase A	Phase B	Proposal Cross References	Comments	Test Phase	Procedure Only	Verification Method	FAT Only
IX.	The Contractor shall prepare and submit updated progress schedules to the Contract Manager every other week, with a complete outline of all tasks and activities required for the execution of this project.	C	C	F-1-IX - Submittal and Documentation Requirements					
IX.	The Contractor shall also schedule and conduct regular status meetings on strategic, tactical and operational issues via telephone conference calls or at an Authority-selected site no less frequently than on a weekly basis with the Authority, and other service providers as necessary for resolution of agenda items. At the sole discretion of the Authority, the frequency of meetings may be adjusted. The purpose of these meetings shall be, (but not limited) to:	C	C	F-1-IX - Submittal and Documentation Requirements					
IX.	• tracking the status of the work activities;	C	C	F-1-IX - Submittal and Documentation Requirements					
IX.	• reporting on the operational status of the services, infrastructure and communications links and availability of connectivity between the Authority and the Contractor, as well as connectivity between end-users and the managed environment via the Internet and Mobile devices	C	C	F-1-IX - Submittal and Documentation Requirements					
IX.	• reviewing and reporting on any operational issues including service tickets;	C	C	F-1-IX - Submittal and Documentation Requirements					
IX.	• reviewing the Contractor's performance to the contracted service level metrics;	C	C	F-1-IX - Submittal and Documentation Requirements					
IX.	• reviewing Contractor's invoices for services provided;	C	C	F-1-IX - Submittal and Documentation Requirements					
IX.	• reporting or communicating on all availability of services and the environment directly	C	C	F-1-IX - Submittal and Documentation					

Section	Requirement	Phase A	Phase B	Proposal Cross Reference	Comments	Test Phase	Procedure Only	Verification Method	FAT Only
	impacting the Authority's services, and			Requirements					
IX.	• resolving disputes.	C	C	F-1-IX - Submittal and Documentation Requirements					
IX.	The Contractor shall produce and deliver to the Authority, at least 48 hours prior to each status meeting, an agenda that includes a status report listing strategic, tactical, and operational items and issues and the status of each. The report shall at a minimum provide a complete statement of the system's status through performance measure reporting, and indicate progress made on operational, project or task issues or activities during the reporting period. Also included should be progress made on work to correct deficiencies, the status of activities to be undertaken in the next reporting period, activities/tasks behind schedule and identification of problems/concerns related to the services, statistics on problems encountered/resolved in the reporting period and year-to-date, as well as statistics on the Service Levels (SLA) standards and ad hoc reports as required by the Authority. Service Level Agreements are described in detail throughout Section X., Maintenance of the System.	C	C	F-1-IX - Submittal and Documentation Requirements					
IX.	3. System Diagrams	C	C	F-1-IX - Submittal and Documentation Requirements					
IX.	Within twenty-one (21) days after Contract Award, the Contractor shall submit to the Port Authority's Project Manager for review and approval the following detailed system design documentation:	C	C	F-1-IX - Submittal and Documentation Requirements					
IX.	a. System Block Diagram illustrating the interrelationship between all system	C	C	F-1-IX - Submittal and Documentation					

Section	Requirement	Phase A	Phase B	Proposal Cross Reference	Comments	Test Phase	Procedure Only	Verification Method	FAT Only
	components.			Requirements					
IX.	b. Connectivity Diagrams to illustrate the connections among all system components including, but not limited to, the primary and backup application and database servers, Workstations, communications network and any proposed external connections. The connectivity diagram shall identify the use of all ports and communications protocols.	C	C	F-1-IX - Submittal and Documentation Requirements					
IX.	c. Schematic diagrams to show the proposed locations of the equipment that are to be furnished and installed.	C	C	F-1-IX - Submittal and Documentation Requirements					
IX.	**4. Security Practices and Policies**	C	C	F-1-IX - Submittal and Documentation Requirements					
IX.	Within ten (10) days after Contract Award a description of all system security features, practices and policies that are designed into the System to protect, control and monitor access to the System and its components (e.g., hardware, software and data) to achieve the security requirements as described herein.	C	C	F-1-IX - Submittal and Documentation Requirements					
IX.	5. System Documentation	C	C	F-1-IX - Submittal and Documentation Requirements					
IX.	Within ten (10) days after Contract Award, the Contractor shall submit to the Port Authority's Project Manager for review and approval a detailed description of the products to be furnished for installation as part of this Contract. System documentation shall include comprehensive and detailed technical descriptions of the System hardware, software, and communications architecture that include, at a minimum, the following information:	C	C	F-1-IX - Submittal and Documentation Requirements					
IX.	a. Executive Summary:	C	C	F-1-IX - Submittal and					

Section	Requirement	Phase A	Phase B	Proposal Cross Reference	Comments	Test Phase	Procedure Only	Verification Method	FAT Only
				Documentation Requirements					
IX.	This document is a summary of documentation material provided in this deliverable, an overview of the System describing all major components, and special features of the System that address performance, expansion, system security, ease of use, and maintainability.	C	C	F-1-IX - Submittal and Documentation Requirements					
IX.	b. Design Overview:	C	C	F-1-IX - Submittal and Documentation Requirements					
IX.	A description of the overall design. This shall include the advantages and disadvantages of the design, (e.g., modularity, flexibility, expandability), and an explanation of why the design is the best implementation to meet the Authority's requirements.	C	C	F-1-IX - Submittal and Documentation Requirements					
IX.	c. Functional Description:	C	C	F-1-IX - Submittal and Documentation Requirements					
IX.	This document is a detailed description of the overall system that provides a functional description of the maj or components and describes their operation.	C	C	F-1-IX - Submittal and Documentation Requirements					
IX.	d. System Architecture:	C	C	F-1-IX - Submittal and Documentation Requirements					
IX.	This document is a system-level graphic representation of logical components and their interconnections. This shall include identification of the interfaces between each application and each computer and the interfaces to all other external and future systems. The diagram shall include all communications ports and protocols that will be used as part of the system operation.	C	C	F-1-IX - Submittal and Documentation Requirements					

Section	Requirement	Phase A	Phase B	Proposal Cross Reference	Comments	Test Phase	Procedure Only	Verification Method	FAT Only
IX.	e. Failure Handling and Recovery:	C	C	F-1-IX - Submittal and Documentation Requirements					
IX.	This document is a failure/switchover/recovery matrix showing the types of failures, the process of reporting these failures and indicate whether the reporting mechanism is automatic or semiautomatic. This shall include descriptions of system diagnostics to detect and isolate failures and a detailed explanation of the fault tolerant solution.	C	C	F-1-IX - Submittal and Documentation Requirements					
IX.	**1'. Narratives:**	C	C	F-1-IX - Submittal and Documentation Requirements					
IX.	The narratives shall describe all user functions to enable the System to operate as specified. The narratives also shall pay special emphasis to the requirements for operation and system administration, with an explanation including graphic descriptions that illustrate the proposed user interface, and shall describe the following:	C	C	F-1-IX - Submittal and Documentation Requirements					
IX.	**a. Operating features**	C	C	F-1-IX - Submittal and Documentation Requirements					
IX.	i. Report formats	C	C	F-1-IX - Submittal and Documentation Requirements					
IX.	ii. Screen Layouts illustrating all user interface screens, graphical maps, pop-up windows, pull-down menus, etc.	C	C	F-1-IX - Submittal and Documentation Requirements					
IX.	iii. Matrix that defines the access restrictions to all applications, by user and Workstation location.	C	C	F-1-IX - Submittal and Documentation Requirements					
IX.	iv. Data Loading Analysis:	C	C	F-1-IX - Submittal and Documentation Requirements					

Section	Requirement	Phase A	Phase B	Proposal Cross Reference	Comments	Test Phase	Procedure Only	Verification Method	FAT Only
IX.	A description that identifies the type, the amount, and the frequency of data transmission which originated from physical devices and logical processes, and traces the data flow through all communications paths from the origin of the data to its destination, including all intermediate processes or equipment. The analysis includes an estimate of the bandwidth required to support the aggregated data that is likely to traverse each of the communications paths in the system.	C	C	F-1-IX - Submittal and Documentation Requirements					
IX.	v. Requirements Matrix:	C	C	F-1-IX - Submittal and Documentation Requirements					
IX.	A chart that identifies the design requirements and approved design changes, and indicates the logical processes and physical system/subsystem components where the System's requirements will be implemented. As the design evolves, submit updated requirements matrix. Said chart, based on the approved requirements list, shall identify the location in the design submittals where all the design requirements and approved design changes will be implemented by the proposed logical processes and physical system/subsystem components.	C	C	F-1-IX - Submittal and Documentation Requirements					
IX.	vi. Any other material, documentation or drawings, which the Contractor deems, appropriate.	NA	NA	F-1-IX - Submittal and Documentation Requirements	The requirement is assumed to be applicable only if Sensis determines to send additional documentation.				
IX.	**6. System Hardware Documentation**			F-1-IX - Submittal and Documentation Requirements					
IX.	Within twenty-one (21) days after Contract			F-1-IX - Submittal and					

Section	Requirement	Phase A	Phase B	Proposal Cross Reference	Comments	Test Phase	Procedure Only	Verification Method	FAT Only
	Award, the Contractor shall submit to the Port			Documentation Requirements					
IX.	Authority's Project Manager for review and approval a detailed description of the system hardware.			F-1-IX - Submittal and Documentation Requirements					
IX.	Hardware documentation shall include:	PC	PC	F-1-IX - Submittal and Documentation Requirements	Aerobahn is a hosted service utilizing virtualization. The system architecture is addressed in Section V. Sensis will provide documentation on the hardware used in the Metering Coordination Center.				
IX.	a. Hardware Specifications	C	C	F-1-IX - Submittal and Documentation Requirements	Sensis provides all necessary client hardware specifications. These specifications will include minimum CPU, RAM, all supported configurations, and network connectivity.				
IX.	Complete specifications for each hardware component of the System.	C	C	F-1-IX - Submittal and Documentation Requirements	Sensis provides on-site staff with appropriate client hardware to meet client specifications.				
IX.	b. Component Drawings	C	C	F-1-IX - Submittal and					

Section	Requirement	Phase A	Phase B	Proposal Cross Reference	Comments	Test Phase	Procedure Only	Verification Method	FAT Only
				Documentation Requirements					
IX.	Drawings that clearly and completely indicate the function of each System hardware component. The drawings shall indicate termination points of devices, and interconnections required for System operation, interconnection between modules and devices, spacing of components, and location, mounting and positioning details.	C	C	F-1-IX - Submittal and Documentation Requirements					
IX.	c. Computer Hardware Requirements	C	C	F-1-IX - Submittal and Documentation Requirements					
IX.	Provide detailed requirements of the computer hardware that is required by the applications software to satisfy the functional and performance requirements of the Contract. The requirements shall state all computer hardware considerations, and include, at a minimum the computer architecture, processor speed, memory, secondary storage and peripheral considerations. Subsequent to submission of Contractor's computer hardware requirements, the Contractor shall meet with TSD to review the Contractor's requirements, formulate system architecture, and finalize the computer architecture that will be used to run the application software.	C	C	F-1-IX - Submittal and Documentation Requirements					
IX.	d. Commercial Off-the-Shelf Products	C	C	F-1-IX - Submittal and Documentation Requirements					
IX.	The Contractor shall furnish a complete list of Commercial Off-the-Shelf (COTS) products furnished as part of the Contract. Include the name, manufacturer, part number and material specifications as applicable.	C	C	F-1-IX - Submittal and Documentation Requirements					

Section	Requirement	Phase A	Phase B	Proposal Cross Reference	Comments	Test Phase	Procedure Only	Verification Method	FAT Only
IX.	**7. Manuals**	C	C	F-1-IX - Submittal and Documentation Requirements					
IX.	Within twenty-one (21) calendar days prior to the start of the System Inspection and Test, prepare and submit, for approval, six (6) sets of complete, separate manuals for Airport Operations' Staff and contract administrators that will use the System for Authority review and approval. A site-specific manual shall also be provided to document the specific site-related configuration and operations / maintenance. Additionally, all Manuals shall be available electronically for local and geographically disbursed Users.	C	C	F-1-IX - Submittal and Documentation Requirements					
IX.	All manuals shall be specifically written for this installation. Pages from the original equipment manufacturers standard operations and maintenance manuals can be referenced in the manuals written for this Contract, provided all of the referenced items are included in the manuals.	C	C	F-1-IX - Submittal and Documentation Requirements					
IX.	**a. Operations Manuals**	C	C	F-1-IX - Submittal and Documentation Requirements					
IX.	A set of Operations Manuals shall be provided that clearly describes all User operations. The manuals shall explain all the features and functions of the System for day-to-day operations and how to use the system to manage more complex situations. A separate Quick Reference Guide for problems and/or exception conditions shall be included to enable the User to quickly resolve common operating problems, and address common configuration and replay techniques. The Quick Reference Guide shall be available in multiple locations; one source shall	C	C	F-1-IX - Submittal and Documentation Requirements	The Sensis online Help system includes a feature to build a customized Quick Reference Guid.				

Section	Requirement	Phase A	Phase B	Proposal Cross Reference	Comments	Test Phase	Procedure Only	Verification Method	FAT Only
	be within the electronic and hard copy Operations Manual and the other as a stand-alone electronic and hard copy version of the document.								
IX.	The Operations Manual(s) shall contain detailed description of system operations and procedures on how to perform all user functions, including but not limited to the following: Monitor equipment operation, Control all equipment (if applicable), Invocation and explanation of the System reports, Filter and sort the event log, Implement any special system features, and Error and alarm handling procedures, including recovery from all equipment failures.	C	C	F-1-IX - Submittal and Documentation Requirements					
IX.	The Operations Manual shall be written for beginner computer users who are not famjliar with detailed computer operations and terms. It shall contain step-by-step procedures with examples containing pictures of the computer screens, explanation of the user interfaces and graphics to illustrate the overall concepts. The manual shall be for instructional, study and refresher use.	C	C	F-1-IX - Submittal and Documentation Requirements					
IX.	**b. Application Administration Manual**	PC	PC	F-1-IX - Submittal and Documentation Requirements					
IX.	The Application Administration Manual shall include, but not be limited to all sections covering administration of the application, configuration functions, including but not limited to the following items:	PC	PC	F-1-IX - Submittal and Documentation Requirements	Sensis will provide a standard System Administration Manual containing all the information necessary to configure user permissions, and other system-level settings. The				

Section	Requirement	Phase A	Phase B	Proposal Cross Reference	Comments	Test Phase	Procedure Only	Verification Method	FAT Only
					Aerobahn SMS System is hosted and operated by Sensis. Therefore, the specific requirements listed below need not be included in this manual.				
IX.	i. Detailed instructions and procedures for the installation and configuration of the software.	NA	NA	F-1-IX - Submittal and Documentation Requirements					
IX.	ii. Detailed description and procedures for configuration of user access privileges and access levels to use of all application functions;	C	C	F-1-IX - Submittal and Documentation Requirements					
IX.	iii. Detailed description and procedures for the configuration and management of the application and its databases;	NA	NA	F-1-IX - Submittal and Documentation Requirements					
IX.	iv. Detailed description and procedures for installing, backing up and restoring the application software and include system generation procedures if software development tools are furnished as part of the Contract;	NA	NA	F-1-IX - Submittal and Documentation Requirements					
IX.	v. Detailed description and procedures for event logs maintenance activities including downloading, sorting, printing and clearing.	NA	NA	F-1-IX - Submittal and Documentation Requirements					
IX.	vi. Detailed description and procedures conducting system health check to ensure the operational health and vitality of the system.	NA	NA	F-1-IX - Submittal and Documentation Requirements					
IX.	vii. A detailed procedure that describes all of the steps to manually switch over operation from the primary application and database servers to the backup application and database servers and to switch back to the primary application and database servers once the operation of the primary application and database servers are	NA	NA	F-1-IX - Submittal and Documentation Requirements					

Section	Requirement	Phase A	Phase B	Proposal Cross Reference	Comments	Test Phase	Procedure Only	Verification Method	FAT Only
	restored.								
IX.	**c. System Administrator's Manual**	NA	NA	F-1-IX - Submittal and Documentation Requirements					
IX.	A System Administrator's Manual shall be provided which contains graphical depictions, written detailed descriptions and procedures of all functions that the Contractor will perform for the proper monitoring, maintenance and administration of the System, including but not limited to, the following topics, each described in a separate section of the document:	NA	NA	F-1-IX - Submittal and Documentation Requirements	The Aerobahn SMS System is hosted and operated by Sensis. Therefore, there the Port Authority will not need this type of manual.				
IX.	• steps to manually switch over operation from the primary application Server to the secondary application server and to switch back to the primary application server once the operation of the primary application server is restored	NA	NA	F-1-IX - Submittal and Documentation Requirements					
IX.	• archiving data and restoring archived data to the database	NA	NA	F-1-IX - Submittal and Documentation Requirements					
IX.	• backing-up and restoring the database	NA	NA	F-1-IX - Submittal and Documentation Requirements					
IX.	• changing the database to add or delete tables and or fields; installation and configuration of the software	NA	NA	F-1-IX - Submittal and Documentation Requirements					
IX.	• backing up and restoring the application software	NA	NA	F-1-IX - Submittal and Documentation Requirements					
IX.	• generating the system software from the source code	NA	NA	F-1-IX - Submittal and Documentation Requirements					
IX.	• performance analysis	NA	NA	F-1-IX - Submittal and Documentation Requirements					
IX.	• scheduled maintenance	NA	NA	F-1-IX - Submittal and					

Section	Requirement	Phase A	Phase B	Proposal Cross Reference	Comments	Test Phase	Procedure Only	Verification Method	FAT Only
				Documentation Requirements					
IX.	• audit and control	NA	NA	F-1-IX - Submittal and Documentation Requirements					
IX.	• report production	NA	NA	F-1-IX - Submittal and Documentation Requirements					
IX.	• contingency plan	NA	NA	F-1-IX - Submittal and Documentation Requirements					
IX.	• configuration control	NA	NA	F-1-IX - Submittal and Documentation Requirements					
IX.	• system diagnostics	NA	NA	F-1-IX - Submittal and Documentation Requirements					
IX.	• database integrity checks	NA	NA	F-1-IX - Submittal and Documentation Requirements					
IX.	A separate, removable section of the System Administration Manual shall contain information on the proper administration and control of the security features built into the System. Some of the information to be contained in this section includes: maintenance of user identifiers, password control, and security policy review.	NA	NA	F-1-IX - Submittal and Documentation Requirements					
IX.	**8. Disaster Recovery Plan**	C	C	F-1-IX - Submittal and Documentation Requirements					
IX.	Prior to the completion and acceptance of the System Inspection and Tests for each project phase, Phase A and B, the Contractor shall obtain and submit, for the Port Authority's Project Manager's approval, a disaster recovery	C	C	F-1-IX - Submittal and Documentation Requirements					

Section	Requirement	Phase A	Phase B	Proposal Cross Reference	Comments	Test Phase	Procedure Only	Verification Method	FAT Only
	plan to recover all System components and data operating as part of this Contract, to ensure continuity of operations in case a catastrophic event eliminates one or more of the locations where the System is housed. See Exhibit 3 for Disaster Recover requirements.								
IX.	9. Audit Report	C	C	F-1-IX - Submittal and Documentation Requirements					
IX.	Prior to the completion and acceptance of the System Inspection and Test, the Contractor shall obtain and submit, for the Port Authority's Project Manager's approval, an internationally recognized certification (such as SAS-70 Level 2 or an approved equivalent) of the security policies and practices employed in its System operation which demonstrate that the following protections are provided:	C	C	F-1-IX - Submittal and Documentation Requirements					
IX.	• Physical access to the production environment, stored data, and documentation is restricted to prevent unauthorized destruction, modification, disclosure, or use	C	C	F-1-IX - Submittal and Documentation Requirements					
IX.	• Logical access to the production environment, data files, and sensitive system transactions, is restricted to authorized users only	C	C	F-1-IX - Submittal and Documentation Requirements					
IX.	• The production environment is protected against environmental hazards and related damage	C	C	F-1-IX - Submittal and Documentation Requirements					
IX.	• Regularly scheduled processes that are required to maintain continuity of operations in the event of a catastrophic loss of data, facilities, or to minimize the impact of threats to data, facilities or equipment, are performed as scheduled.	C	C	F-1-IX - Submittal and Documentation Requirements					
IX.	• System hardening measures have been adequately applied to protect the System against	C	C	F-1-IX - Submittal and Documentation					

Section	Requirement	Phase A	Phase B	Proposal Cross Reference	Comments	Test Phase	Procedure Only	Verification Method	FAT Only
	risks to which it is exposed			Requirements					
IX.	• Logging of IT security events is enabled for the System, security logs are reviewed in a timely manner, and appropriate actions are taken by Contractor IT staff in response to System security events.	C	C	F-1-IX - Submittal and Documentation Requirements					
IX.	**10. Training**	C	C	F-1-VII - Users and Training					
IX.	**a. Training Plan**	C	C	F-1-VII - Users and Training					
IX.	Submit to the Port Authority's Project Manager for approval, not less than twenty-one (21) days prior to the intended start date for training, nine (9) hard copies and an electronic copy of the Training Plan that includes, but is not limited to the following for each training class:	C	C	F-1-VII - Users and Training					
IX.	1. Detailed description of the course curriculum;	C	C	F-1-VII - Users and Training					
IX.	2. Draft copies of the course material including but not limited to manuals, study guides, workbooks, technical reference material, etc.;	C	C	F-1-VII - Users and Training					
IX.	3. Technique that will be used to provide training to airline staff working for the air carriers in locations off Port Authority facilities.	C	C	F-1-VII - Users and Training					
IX.	4. Comprehensive schedule for the delivery of all training classes. The schedule shall include the dates, times and exact locations for the training courses. The training courses shall be held at one or more Authority facilities, in those locations designated by the Port Authority's Project Manager. The dates and times shall be coordinated with and approved by the Port Authority's Project Manager and Training shall also be provided to airline staff working for the air carriers in locations off Port Authority facilities.	C	C	F-1-VII - Users and Training					

Section	Requirement	Phase A	Phase B	Proposal Cross Reference	Comments	Test Phase	Procedure Only	Verification Method	FAT Only
IX.	5. Post-training and/or on-the-job technical reference guides.	C	C	F-1-VII - Users and Training					
IX.	**b. After completion of all Training Courses, submit the following:**	C	C	F-1-VII - Users and Training					
IX.	1. One unbound, reproducible master set of all manuals and a copy of each manual in a digital format that may be edited using Microsoft Word 2007. These master sets shall include a written non-disclosure and copyright waiver allowing the Authority to make unlimited copies, for its own use, of any copyrighted material within, royalty free, for a period of 99 years.	C	C	F-1-VII - Users and Training					
IX.	2. Six (6) bound sets of operations manuals.	C	C	F-1-VII - Users and Training					
IX.	3. Six (6) bound sets of Applications Administration and System Administration	C	C	F-1-VII - Users and Training					
IX.	**11. Change Management**	C	C	F-1-IX - Submittal and Documentation Requirements					
IX.	Prior to the start of the 14-Day Operational Test, submit the form that will be provided by the	C	C	F-1-IX - Submittal and Documentation Requirements					
IX.	Contractor and the procedures that will be performed before attempting to effect a change to any	C	C	F-1-IX - Submittal and Documentation Requirements					
IX.	part of the system, whether hardware, software, database or network.	C	C	F-1-IX - Submittal and Documentation Requirements					
IX.	**12. Database Documentation**	C	C	F-1-IX - Submittal and Documentation Requirements					
IX.	Prior to the start of the 14-Day Operational Test, the Contractor shall submit to the Port Authority's Project Manager for review and approval a detailed description of the database. Database documentation shall include:	C	C	F-1-IX - Submittal and Documentation Requirements					

Section	Requirement	Phase A	Phase B	Proposal Cross Reference	Comments	Test Phase	Procedure Only	Verification Method	FAT Only
IX.	**a. Database Schema**	C	C	F-1-IX - Submittal and Documentation Requirements					
IX.	Database schema is a description of the overall organization of the files and tables to be used in the System. This description shall include an identification of all data files, tables, and fields, and the relationships between fields and tables and demonstrate compliance with the data requirements specified herein. This description shall also include, but not be limited to full details regarding any third party database products including version, release, functional characteristics, operational requirements and any other relevant characteristics of the product.	C	C	F-1-IX - Submittal and Documentation Requirements					
IX.	**b. Data Dictionary**	C	C	F-1-IX - Submittal and Documentation Requirements					
IX.	A listing of all System data elements, including the size, definition, validation rules and other information pertaining to the data elements. If a commercially available data dictionary is to be used, also submit complete and current information about the product.	C	C	F-1-IX - Submittal and Documentation Requirements					
IX.	**c. Data Storage Analysis**	C	C	F-1-IX - Submittal and Documentation Requirements					
IX.	The techniques employed to ensure that the System can meet the storage requirements for on-line and historical data and expansion capabilities. The analysis shall include identification of all files (e.g., system, message, report files), databases, and their retention cycles and indicate the accessibility to the data, i.e. whether the information will be available for on-line retrieval or archived in off-line storage.	C	C	F-1-IX - Submittal and Documentation Requirements					

Section	Requirement	Phase A	Phase B	Proposal Cross Reference	Comments	Test Phase	Procedure Only	Verification Method	FAT Only
IX.	**d. Data Flow Diagram**	C	C	F-1-IX - Submittal and Documentation Requirements					
IX.	A graphical depiction of the logical processes that comprise the System and an illustration that depicts the data flow as the data moves between these processes. This description shall identify all of the System's functional processes and show the flow from the data's inception to its long-term storage. The documentation shall include data flow diagrams and other necessary documentation to understand how the data is handled and stored.	C	C	F-1-IX - Submittal and Documentation Requirements					
IX.	**e. Entity-Relationship Diagram**	C	C	F-1-IX - Submittal and Documentation Requirements					
IX.	A graphical illustration of the interactions between the various entities for which data is collected in the System that depicts the relationships between the entities and their associated data. This description shall identify all significant System entities (person, object, place, events, etc.) and show the nature of all significant interactions from the data's inception to storage.	C	C	F-1-IX - Submittal and Documentation Requirements					
IX.	**13. Final Versions of the Documentation**	C	C	F-1-IX - Submittal and Documentation Requirements					
IX.	Prior to certification by the Authority that the Contractor has completed all work as specified in the Detailed Project Plan (except for maintenance), the Contractor shall submit all design documentation, manuals, and/or drawings, which have been revised to reflect the as-built conditions. System Documentation shall be provided in both a bound copy and an	C	C	F-1-IX - Submittal and Documentation Requirements					

Section	Requirement	Phase A	Phase B	Proposal Cross Reference	Comments	Test Phase	Procedure Only	Verification Method	FAT Only
	electronic version in a machine-readable form, which is viewable with the Microsoft Office 2007 suite of tools and Auto-Cad (if used). System documentation submittal(s) shall include but not be limited to versions of the System Drawings and System Documentation that have been updated to reflect the as-built conditions.								
X.	**Maintenance of the System**	C	C	F-1-X - Maintenance of the System	Some of the maintenance requirements, as defined herein, are not applicable in a Service environment where a contractor is not providing equipment on site. Sensis will meet service level requirements, however, many individual hardware maintenance activities will occur at the data center and will be transparent to Aerobahn users. For these types of situations, no reporting will be provided.				
X.	**A. Maintenance Requirements:**	C	C	F-1-X - Maintenance of the System					
X.	Upon certification by the Authority that the System has satisfactorily completed the 14-Day	C	C	F-1-X - Maintenance of the System					

Section	Requirement	Phase A	Phase B	Proposal Cross Reference	Comments	Test Phase	Procedure Only	Verification Method	FAT Only
	Operational Acceptance Test for Phase B and that the Contractor has completed all work as specified in the Detailed Project Plan (except for warranty and maintenance), the Contractor shall then provide the maintenance required for the System to perform in accordance with, but not limited to, the following requirements:								
X.	**1. Maintenance Period**	C	C	F-1-X - Maintenance of the System					
X.	The maintenance & support tasks identified in this section must be performed:	C	C	F-1-X - Maintenance of the System					
X.	• Under the warranty period for the system which extends Twelve (12) months from the successful completion of the 14-Day Operational Test for each phase of the project.	C	C	F-1-X - Maintenance of the System					
X.	• Under the maintenance provisions which start one (1) day after the one (1) year warranty period.	C	C	F-1-X - Maintenance of the System					
X.	2. Maintenance and support tasks	C	C	F-1-X - Maintenance of the System					
X.	Maintenance and support tasks include all expenses (parts, labor, tools, equipment, software, travel, signage, shipping costs, etc.), without additional cost to the Authority, required to perform (but not limited to) the following:	C	C	F-1-X - Maintenance of the System					
X.	• Host, operate and maintain the System in a secure and protected environment in order to meet the functional, performance and availability requirements as defined herein;	C	C	F-1-X - Maintenance of the System					
X.	• On-call remedial and scheduled preventive maintenance in order to meet the availability requirements stated herein;	C	C	F-1-X - Maintenance of the System					
X.	• Correct defects in the furnished applications software;	C	C	F-1-X - Maintenance of the System					
X.	• Validate and correct (when necessary) the	C	C	F-1-X - Maintenance					

Section	Requirement	Phase A	Phase B	Proposal Cross Reference	Comments	Test Phase	Procedure Only	Verification Method	FAT Only
	applications software furnished by the Contractor to ensure that it performs in accordance with the specifications of the Contract within ten (10) days after Microsoft and other software providers release patches and updates to the operating system, database and other third-party software that is furnished or used in the System;			of the System					
X.	• User support to administer the application;	C	C	F-1-X - Maintenance of the System					
X.	• System Administration (See Exhibit 4 for the System Administration requirements);	C	C	F-1-X - Maintenance of the System					
X.	• On-Call Help Desk Support by telephone during twenty-four (24) hours per day, seven (7) days per week is required.	C	C	F-1-X - Maintenance of the System					
X.	Note: Help Desk Support is intended to User questions on the use of the application and is	C	C	F-1-X - Maintenance of the System					
X.	independent of any notifications made to report errors or remedial maintenance issues with the System or application.	C	C	F-1-X - Maintenance of the System					
X.	• Update and Test disaster recovery plan on an annual basis.	C	C	F-1-X - Maintenance of the System					
X.	**3. Operational Availability**	C	C	F-1-X - Maintenance of the System					
X.	The Operational Availability of the System and Services shall meet the percentages stipulated below each calendar month for the term of this Contract:	C	C	F-1-X - Maintenance of the System					
X.	System Hardware and Software: 99.99%	C	C	F-1-X - Maintenance of the System					
X.	Applications software: 99.99%	C	C	F-1-X - Maintenance of the System					
X.	User Services provided through the Worldwide Web: 99.99%	C	C	F-1-X - Maintenance of the System					
X.	As used in this numbered Clause (and in this clause only) "Operational Availability" means	C	C	F-1-X - Maintenance of the System					

Section	Requirement	Phase A	Phase B	Proposal Cross Reference	Comments	Test Phase	Procedure Only	Verification Method	FAT Only
	the time during any twenty-four (24) hour period the System and communications network is Available to Users for Surface Management System operations. "Available" means that during any twenty-four (24) hour period, the furnished and installed software applications and any Contractor furnished equipment perform according to the manufacturer's specifications.								
X.	In the event that Operational Availability fails to meet the percentage stipulated herein, and is not responded to or repaired within the Service Level Agreement time requirements, damage amounts for unavailability for operation are as specified herein.	C	C	F-1-X - Maintenance of the System					
X.	**4. Maintenance Work**	C	C	F-1-X - Maintenance of the System					
X.	The Contractor shall perform complete scheduled preventive maintenance and on-call remedial maintenance so that the System meets the Operational Availability and may be operated twentyfour (24) hours a day, seven (7) days a week. The maintenance program shall be performed with all reasonable care to keep the System in a proper, safe, and efficient operating condition capable of correct operation and reporting. The Contractor shall furnish all labor, travel, materials, supplies, parts, equipment, warning signs, other safety devices, and all other things necessary or proper for, or incidental to, such maintenance.	C	C	F-1-X - Maintenance of the System					
X.	The Contractor, at its option, shall repair or replace System components maintaining all original specified performance requirements, within the time(s) stipulated in Attachment C, Scope of Work Section X.C titled "Time to Repair" herein, for any part, component,	C	C	F-1-X - Maintenance of the System					

Section	Requirement	Phase A	Phase B	Proposal Cross Reference	Comments	Test Phase	Procedure Only	Verification Method	FAT Only
	equipment item, software or firmware of the System that become unsuitable for continued use. Replacement parts or components shall be identical to the original, or equal, as approved by the Contract Manager.								
X.	The maintenance performed by the Contractor shall include, but not be limited to, scheduled preventive maintenance, on-call remedial maintenance, error correction, software and firmware diagnostics and corrections, validation that the applications software continues to work (in accordance with the Contract requirements) with manufacturer-released patches to third-party software and engineering updates of the System as described below. The Contractor shall submit to the Port Authority's Project Manager for review a schedule of preventive maintenance activities and a description of preventive maintenance procedures no less than 14 days prior to the Warranty Start Date and each anniversary thereof The Port Authority's Project Manager will review the submission, and make comments, within ten (10) working days.	C	C	F-1-X - Maintenance of the System					
X.	In order to make replacements and repairs as expeditiously as possible, the Contractor shall stock, keep and maintain a sufficient supply of parts and materials, tools or other equipment as may be necessary to make such replacements and repairs.	C	C	F-1-X - Maintenance of the System					
X.	In order to meet the service level agreements stipulated in Attachment C, Scope of Work Section X.C, Time to Repair, in this contract, the Contractor shall maintain an adequate number of qualified staff to provide the required technical support.	C	C	F-1-X - Maintenance of the System					
X.	5. Maintenance Description	C	C	F-1-X - Maintenance					

Section	Requirement	Phase A	Phase B	Proposal Cross Reference	Comments	Test Phase	Procedure Only	Verification Method	FAT Only
				of the System					
X.	All maintenance shall be performed in accordance with the equipment and component manufacturers' recommendations. The results from all inspections, tests, diagnostics, equipment repairs and corrective actions shall be reported to the Contract Manager on Authority approved forms.	C	C	F-1-X - Maintenance of the System					
X.	The maintenance performed by the Contractor shall include, but not be limited to scheduled preventive maintenance, on-call remedial maintenance, error correction, and software and firmware diagnostics and corrections of the System as described herein.	C	C	F-1-X - Maintenance of the System					
X.	**a. Scheduled preventive maintenance**	C	C	F-1-X - Maintenance of the System					
X.	Scheduled preventive maintenance shall consist of all actions necessary to inspect, test, diagnose, repair equipment failures, correct System malfunctions and restore System operation to perform in accordance with the manufacturer's stated specification, performance and tolerances. Scheduled preventive maintenance shall include, but not be limited to adjustment, repairs, the replacement of field installable parts that are approaching unserviceable status, all actions necessary to prevent System failures and extend the System's useful life, verify adequate empty disk space available for program usage (i.e., temporary files, logs, etc.,), verify log files are saved to removable media and log files are purged on a regular basis, review reports on communications throughput and errors and perform communications diagnostics on each communications channel to identify equipment or cabling problems.	C	C	F-1-X - Maintenance of the System					

Section	Requirement	Phase A	Phase B	Proposal Cross Reference	Comments	Test Phase	Procedure Only	Verification Method	FAT Only
X.	**b. On-call remedial maintenance**	C	C	F-1-X - Maintenance of the System					
X.	On-call remedial maintenance shall consist of all unscheduled actions necessary to obtain the Operational Availability, diagnose and correct all System malfunctions and failures and restore the equipment in accordance with the manufacturer's stated specification, performance and tolerances and the System to perform in accordance with the Contract requirements. The Contractor shall provide a specified telephone number and FAX number and email address at no additional cost to the Authority, which shall be staffed 24 hours a day, 7 days a week, to enable the Users to report errors and malfunctions to the System.	C	C	F-1-X - Maintenance of the System	Sensis has found Fax to be an unreliable mechanism for reporting service problems.				
X.	Within twenty-four (24) hours of each reported on-call remedial maintenance problem, the Contractor shall provide written documentation of the reported problem and all actions performed related to the maintenance call in a computer-readable format to the Contract Manager.	C	C	F-1-X - Maintenance of the System					
X.	**6. Loss of Service**	C	C	F-1-X - Maintenance of the System					
X.	The Users will notify the Contractor via the 24-hour telephone or fax number or email, described above, when the System does not perform in accordance with the Contract requirements due to a loss of service. The Contractor shall dispatch Trained Personnel and complete performance of such error correction to diagnose, debug, repair, replace and correct all malfunctions or restore lost services required for the System to perform in accordance with the Contract requirements within the time(s)	C	C	F-1-X - Maintenance of the System					

Section	Requirement	Phase A	Phase B	Proposal Cross Reference	Comments	Test Phase	Procedure Only	Verification Method	FAT Only
	stipulated in Section X.C. 1., "Time to Repair" herein.								
X.	**7. Error Correction**	C	C	F-1-X - Maintenance of the System					
X.	The Users will notify the Contractor via the 24-hour telephone, fax number or email, described above, when the System does not perform in accordance with the Specifications stipulated in the Contract due to error in the applications software (including firmware) or any modifications thereto. Hardcopy documentation of the error condition will be mailed, faxed or emailed to the Contractor. The Contractor shall correct any such error in the System as identified by the Authority or through the Contractor's investigation of the reported error(s). Errors shall include, but not be limited to, flaws in operations and errors due to flaws in the design and coding of the System.	C	C	F-1-X - Maintenance of the System					
X.	The Contractor shall dispatch his/her personnel and complete performance of such error correction to diagnose, debug, repair, replace and correct all malfunctions required for the System to perform in accordance with the Contract requirements within the time(s) stipulated in this Maintenance Section X.C.3, "Time to Repair" herein. The Contractor shall provide documentation in machine-readable format, if any, relating to the error correction. The Contractor in an off-line test environment shall test the corrected software. The Contractor shall then prepare a test report and submit it to the Authority for review and approval before the corrected software is installed into the System. Such corrections to the software shall be provided at no additional cost to the Authority.	C	C	F-1-X - Maintenance of the System					

Section	Requirement	Phase A	Phase B	Proposal Cross Reference	Comments	Test Phase	Procedure Only	Verification Method	FAT Only
X.	The Contractor shall repair all software malfunctions maintaining all original specified performance requirements, within the time(s) stipulated in Attachment C, Section X.C.3, "Time to Repair," herein.	C	C	F-1-X - Maintenance of the System					
X.	**B. Time to Respond**	C	C	F-1-X - Maintenance of the System					
X.	In response to a call for maintenance by the Users, the Contractor shall contact the Contract Manager within fifteen (15) minutes of the initial notification by the Authority to the Contractor's designated telephone or Fax number, or email address for remedial maintenance, in order to document the need for service.	PC	PC	F-1-X - Maintenance of the System	Sensis can comply with this requirement, however, Sensis typically works with each customer to develop a detailed communications response plan that defines the types of requests that require notification and the timeframes for each type. Sensis would like to discuss this requirement's wording and a specific communications plan for the Port.				
X.	**C. Time to Repair**	C	C	F-1-X - Maintenance of the System					
X.	**1. On-Call Remedial Maintenance**	C	C	F-1-X - Maintenance of the System					
X.	The Contractor's personnel shall return to full operation the System and all failed System components, services or operations in response to on-call remedial maintenance within the time	C	C	F-1-X - Maintenance of the System					

Section	Requirement	Phase A	Phase B	Proposal Cross Reference	Comments	Test Phase	Procedure Only	Verification Method	FAT Only
	period stipulated below after notification to the Contractor.								
X.	• The "Repair Time" includes the fifteen (15) response time.	C	C	F-1-X - Maintenance of the System					
X.	• The Contractor shall respond, repair and return to full operation the System and all failed System components and services in response to on-call remedial maintenance within sixty 60) minutes.	C	C	F-1-X - Maintenance of the System	Sensis assumes that this is limited to software defects, as defined in the assumptions section of the cost proposal.				
X.	**2. Validate and Correct Applications Software with Patches and Updates to Third Party Software**	C	C	F-1-X - Maintenance of the System					
X.	The Contractor shall complete performance of such testing, validation and correction to ensure that the software furnished by the Contractor performs in accordance with the Contract requirements with the released patches and updates within ten (10) business days from the date that Microsoft and other software providers used in the System release patches and updates to fix software defects or security vulnerabilities to the operating system, database and other third-party software that are furnished or used in the System.	C	C	F-1-X - Maintenance of the System					
X.	**3. Error Correction**	C	C	F-1-X - Maintenance of the System					
X.	The Contractor shall dispatch Trained Personnel and complete performance of such error correction to diagnose, debug, test, repair, replace and correct all malfunctions required for the System to perform in accordance with the Specifications stipulated in the Contract within ten (10) business days from the date of notification of System malfunction.	C	C	F-1-X - Maintenance of the System					
X.	**D. Failure to Meet Service Level Agreements**	C	C	F-1-X - Maintenance					

Section	Requirement	Phase A	Phase B	Proposal Cross Reference	Comments	Test Phase	Procedure Only	Verification Method	FAT Only
				of the System					
X.	**1. Failure to Repair**	C	C	F-1-X - Maintenance of the System					
X.	The Contractor's obligations for the performance and completion of on-call remedial maintenance within the time or times provided above and for achieving the Operational Availability stipulated in Section X.A.3 above are of the essence of the maintenance portion of this Contract. The Contractor guarantees that it can and will obtain the Operational Availability at or above the percentages hereinbefore stipulated and will complete the on-call remedial maintenance within the time(s) hereinbefore stipulated. Inasmuch as the damage and loss to the Authority for failure to repair within the time(s) hereinbefore stipulated will be incapable or very difficult of accurate estimation, the damages to the Authority shall be liquidated in accordance with Attachment B, Part 1, Section 17 entitled, "Non-Performance of Contractor's Duties - Liquidated Damages."	C	C	F-1-X - Maintenance of the System					
X.	**2. Failure to Correct Error**	C	C	F-1-X - Maintenance of the System					
X.	The Contractor's obligations for the performance and completion of error correction in order to ensure that the System performs in accordance with the Contract requirements within the time provided for in the above are of the essence of the maintenance portion this Contract. The Contractor guarantees that it can and will obtain the Operational Availability at or above the percentages hereinbefore stipulated and will complete the error correction(s) within the time(s) hereinbefore stipulated. Inasmuch as the damage and loss to the Authority for failure	C	C	F-1-X - Maintenance of the System					

Section	Requirement	Phase A	Phase B	Proposal Cross Reference	Comments	Test Phase	Procedure Only	Verification Method	FAT Only
	to correct errors within the time(s) hereinbefore stipulated will be incapable or very difficult of accurate estimation, the damages to the Authority shall be liquidated in accordance with Attachment B, Part 1, Section 17 entitled, "Non-Performance of Contractor's Duties - Liquidated Damages," Section E.								
X.	**3. Failure to Validate and Correct Applications Software with Third-Party Software Patches and Updates**	C	C	F-1-X - Maintenance of the System					
X.	The Contractor's obligations for the performance and completion of testing, validation and error correction in order to ensure that the applications software performs in accordance with the Contract requirements with patches and updates to third-party software within the time provided for in the above are the essence of the maintenance portion this Contract. The Contractor guarantees that it can and will obtain the Operational Availability at or above the percentages herein-before stipulated and will validate and correct the applications software to work as described hereinbefore with the updates and patches to third-party software within the time(s) hereinbefore stipulated. Inasmuch as the damage and loss to the Authority for failure to validate and correct the applications software within the time(s) hereinbefore stipulated will be incapable or very difficult of accurate estimation, the damages to the Authority shall be liquidated in accordance with Attachment B, Part 1, Section 17 entitled, "Non-Performance of Contractor's Duties - Liquidated Damages," Section F.	C	C	F-1-X - Maintenance of the System					
X.	**E. Upgrades and Enhancements**	C	C	F-1-X - Maintenance of the System					

Section	Requirement	Phase A	Phase B	Proposal Cross Reference	Comments	Test Phase	Procedure Only	Verification Method	FAT Only
X.	The Contractor shall notify the Port Authority's Project Manager whenever upgrades and/or enhancements to operating system, the software provided under the Contract or third party software become available and provide a proposal for the proposed enhancement and upgrade. The proposal shall describe the work to be performed, contain a detailed estimate of the labor involved by labor category, a lump sum price and a proposed schedule for the work. The Contractor shall also provide the Port Authority's Project Manager with an analysis of the potential effects of such upgrades/enhancements on the System. This analysis shall include, at a minimum, the following:	C	C	F-1-X - Maintenance of the System					
X.	• Compatibility of the application software with the new operating system or third-party software	C	C	F-1-X - Maintenance of the System					
X.	• Potential increases or decreases in operating System performance	C	C	F-1-X - Maintenance of the System					
X.	• The availability of product support for the current (older) version of the operating system or third party software	C	C	F-1-X - Maintenance of the System					
X.	• The testing required ensuring that the upgrade will perform as expected	C	C	F-1-X - Maintenance of the System					
X.	• The cost of the software upgrade, including testing and any other tasks which may be associated with the upgrade	C	C	F-1-X - Maintenance of the System					
X.	The Port Authority's Project Manager will then determine whether to install the upgrade. If the Port Authority's Project Manager selects the upgrade, the Contractor shall perform the recommended testing, prepare the test report, and perform the upgrade on the System.	C	C	F-1-X - Maintenance of the System					
X.	**F. Supplemental Work**	C	C	F-2 - Cost Proposal					
X.	The Port Authority's Project Manager will	C	C	F-2 - Cost Proposal					

Section	Requirement	Phase A	Phase B	Proposal Cross Reference	Comments	Test Phase	Procedure Only	Verification Method	FAT Only
	notify the Contractor whenever Supplemental Work is requested. In response to the request, the Contract Manager shall submit a proposal that describes the work to be performed, contain a detailed estimate of the labor involved by labor category, a lump sum price and a proposed schedule for the work. The Contractor shall also provide the Port Authority's Project Manager with an analysis of the potential effects of the requested supplemental work on the System.								
X.	Supplemental work includes but not limited to the following categories:	C	C	F-2 - Cost Proposal					
X.	• Refresher training classes as part of the on-going maintenance contract	C	C	F-2 - Cost Proposal					
X.	• Design, development and implementation of custom reports	C	C	F-2 - Cost Proposal					
X.	• Staffing to support irregular operations.	C	C	F-2 - Cost Proposal					
X.	This Supplemental Work ordered and approved by the Port Authority's Project Manager shall be paid as per Attachment D, Cost Proposal Tables, Compensation for Supplemental Costs, as accepted by the Port Authority.	C	C	F-2 - Cost Proposal					
X.	In response to the Authority's Directive, the Contract Manager shall submit a written proposal that describes the work to be performed, contain a detailed breakdown of the labor involved by labor category, and state a firm lump sum price and a proposed schedule for the Work. The Work expended to prepare proposals is not a reimbursable expense. Labor costs to perform the work shall reflect the unit cost for labor itemized in the Attachment D Cost Proposal Tables for Unit Costs for Supplemental Work. Prior to performance of any supplemental work, the Port Authority's Project Manager shall approve any such Work in writing prior to	C	C	F-2 - Cost Proposal					

Section	Requirement	Phase A	Phase B	Proposal Cross Reference	Comments	Test Phase	Procedure Only	Verification Method	FAT Only
	execution.								
X.	**G. Hours of Scheduled Maintenance**	C	C						
X.	Scheduled preventive maintenance of System components shall be conducted between the hours of midnight and 0500 EST.	C	C						
X.	**H. System Administration**	C	C						
X.	The Contractor shall perform all system and application administration functions in accordance with the requirement stated in Exhibit 4.	C	C						
X.	**I. Training**	C	C	F-1-VII-Users and Training, 1.4 Refresher Training					
X.	The Contractor shall provide supplemental on-site refresher training twice a year, when requested by the Port Authority, using the training material already provided, for approximately 100 hours each 6 months. Refresher training shall also be provided to Users working in the airline industry in accordance with the approved training plan for off-site users. Payment for refresher training shall be separated from the overall maintenance costs (see Attachment D, Cost proposal Form);	C	C	F-1-VII-Users and Training, 1.4 Refresher Training					
X.	**J. Disaster Recovery Plan**	C	C	F-1-X - Maintenance of the System					
X.	The Contractor shall create, review and test the disaster recovery plan in accordance with the requirements stated in Exhibit 3. In the event a catastrophic event causes damage to the System or a portion of the System's components, the Contractor shall restore the System and its operation in accordance with the approved Disaster Recovery Plan.	C	C	F-1-X - Maintenance of the System					

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1. Pricing Tables

The Port authority has requested several new features and capabilities to the Aerobahn Surface Management system that will allow users to derive greater value and efficiency. When evaluated on a per licenses basis (assuming 400 licenses), the associated new features have been added with a resulting 34% reduction in the monthly per license price.

The table below provides a summary of Features and Capabilities compared with those currently in place at JFK. When fully integrated, the Port Authority and other stakeholders at JFK will have access to the most sophisticated and powerful surface management system in the world

Description	Today	Future	Comments
Licenses	75	**400**	Increase of 325 licenses
Departure management	Manual Process	**Integrated**	Professional Staffing- Aerobahn Trained
Sensis DMAN Engine	Not adapted to JFK	**Integrated**	Additional Taxi time reduction, increased runway utilization
Aerobahn Predictive Engine	Not adapted to JFK	**Integrated**	Provides Taxi Time, and Demand and Capacity Predictions
Metering Hours	8 hours per day	**14 hours per day**	Additional 6 hours per day of staffing
Dedicated On Site Manager	Not in Place	**Sensis Manager**	Incremental Person over staffing
ATC Radio Integration	Does not exist	**Included**	Integrated with playback
Weather Integration	Does not exist	**Included**	Improved access to information
Emissions Tracking	Does not exist	**Included**	Available Dynamically
Conformance Monitoring	Does not exist	**Custom Functionality**	Only available with Sensis
Custom Reports	Robust capability	**Expanded and integrated with Departure Metering**	Leverages Sensis data superiority
Service level	No SLA	**0.9999**	Creation of supporting infrastructure
Aerobahn at LGA	Does not exist	**10 seats**	Movement Area only
Aerobahn at EWR	Private System	**10 seats**	8 additional seat for Port only
Cost per License per month	**$960**	**$625**	**Lower Unit price/ higher value**

The aforementioned table is for illustrative purposes only and does not represent an offer to sell individual licenses on a monthly basis.

1.1 Table 1 – Phase A Services Payment Schedule

Phase A: Services Payment Schedule				
Commencement of Contract to on or before February 15, 2012, payment for all services to Implement Phase A				
	Project Timeframe	**Fractional Payment**	**Payment**	**Deliverables**
Project plan and Schedule Submittal	10/24/2011	5.00%	$ 59,970.00	Deliverables as described in SOW
Systems Diagrams, Security Practices and Policies, and Systems Documentation Submittals	11/15/2011	5.00%	$ 59,970.00	Deliverables as described in SOW
Acceptance Test Plan Submittal	10/21/2011	5.00%	$ 59,970.00	Deliverables as described in SOW
System Hardware Documentation and Manual Submittal	11/15/2011	5.00%	$ 59,970.00	Deliverables as described in SOW
Training Plan, Change Management and Database Documentation Submittals	10/7/2011	5.00%	$ 59,970.00	Deliverables as described in SOW
User Training	12/22/2011	25.00%	$ 299,850.00	Deliverables as described in SOW
Successful Completion of System Acceptance Test	1/27/2012	25.00%	$ 299,850.00	Deliverables as described in SOW
Successful Completion of 14 Day Operation Test	2/10/2012	25.00%	$ 299,850.00	Deliverables as described in SOW
Total Cost to Implement Phase A		**100.00%**	**$ 1,199,400.00**	

1.2 Table 2 –Phase B Services Payment Schedule

Phase B: Services Payment Schedule				
Commencement of Contract to on or before August 1, 2012, payment for all services to Implement Phase B				
	Project Timeframe	**Fractional Payment**	**Payment**	**Deliverables**
Project plan and Schedule Submittal	10/24/2011	5.00%	$ 44,600.00	Deliverables as described in SOW
Systems Diagrams, Security Practices and Policies, and Systems Documentation Submittals	4/25/2012	5.00%	$ 44,600.00	Deliverables as described in SOW
Acceptance Test Plan Submittal	4/27/2012	5.00%	$ 44,600.00	Deliverables as described in SOW
System Hardware Documentation and Manual Submittal	4/25/2012	5.00%	$ 44,600.00	Deliverables as described in SOW
Training Plan, Change Management and Database Documentation Submittals	4/25/2012	5.00%	$ 44,600.00	Deliverables as described in SOW
User Training	5/25/2012	25.00%	$ 223,000.00	Deliverables as described in SOW
Successful Completion of System Acceptance Test	7/25/2012	25.00%	$ 223,000.00	Deliverables as described in SOW
Successful Completion of 30 Day Operation Test	8/8/2012	25.00%	$ 223,000.00	Deliverables as described in SOW
Total Cost to Implement Phase B		**100.00%**	**$ 892,000.00**	

1.3 Table 3 – Phase A Monthly Fee to Host, Operate, Administer and Maintain System For Interim Period

MONTHLY FEE TO HOST, OPERATE, ADMINISTER AND MAINTAIN SYSTEM FOR INTERIM PERIOD			
Monthly Operation Commencing from Base Date of Operational Usage (Est. February 15, 2012)* Through the Commencement of Phase B (Est. July 31, 2012 at 11:59 P.M.)			
Total Lump Sum Cost Per Month*	Estimate Number of Months	Total Estimated Cost for Period	
$ 250,000.00	5.5	$ 1,375,000.00	
*Monthly charge shall be all inclusive and utilize fully loaded cost of staff to operate, administer and maintain the system in the JFK Operations Center within the calendar month; as well as fully loaded ocst of labor, equipment and miscellaneous costs to host the Application in the Primary and Backup Data Centers.			

1.4 Table 4 – Phase B Monthly Fee to Host, Operate, Administer and Maintain System For Interim Period

MONTHLY FEE TO HOST, OPERATE, ADMINISTER AND MAINTAIN SYSTEM FOR INTERIM PERIOD			
Monthly Operation Commencing from Phase B (Est. August 1, 2012 at 12:00 A.M.)* Through Contract End Date			
Total Lump Sum Cost Per Month*	Estimate Number of Months	Total Estimated Cost for Period	
$ 250,000.00	28	$ 7,000,000.00	
*Monthly charge shall be all inclusive and utilize fully loaded cost of staff to operate, administer and maintain the system in the JFK Operations Center within the calendar month; and also fully loaded cost of labor, equipment and miscellaneous costs to host the Application in the Primary and Backup Data Centers.			

1.5 Table 5 – Supplemental Work

SUPPLEMENTAL WORK EFFECTIVE DECEMBER 1, 2012 AT 12:00 A.M. THROUGH CONTRACT END DATE			
	A. Proposed Maximum Hourly Rate	B. Estimated number of hours for the first year of the base period	C. Total Estimated Cost (A x B = C)
Contract Manager (Information Technology)	$225.36	150	$33,804.10
Software Engineer (Analyst/Programmer)	$183.53	300	$55,059.40
Report Writer	$225.36	300	$67,608.20
Trainer	$183.53	300	$55,059.40
System Operator during Irregular Operations	$108.00	450	$48,600.00
TABLE ESTIMATED TOTAL			**$260,131.10**

1.6 Table 6 – Estimated Total Costs

ESTIMATED BASE CONTRACT TOTAL		
TABLE 1:	Total Cost to Implement Phase A	$ 1,199,400.00
TABLE 2:	Total Cost to Implement Phase B	$ 892,000.00
TABLE 3:	Total Estimated Cost for First Operation Usage (Estimated to be 2/15/12-7/31/12 - 5.5 Months)	$ 1,375,000.00
TABLE 4:	Total Estimated Cost for Second Operation Usage (Estimated to be 8/1/12-11/31/14 - 28 Months)	$ 7,000,000.00
TABLE 5:	Estimated Cost for Supplemental Work	$ 260,131.10
	TOTAL ESTIMATED CONTRACT COST	**$ 10,726,531.10**

See option pricing descriptions in Section 2.

PRICED OPTIONS	
Gate System Rack redundancy	$80,000
Additional Airfield Surveillance	$528,300
Enhanced Live ATC Coverage	$50,000 / $7,000 per year
TOTAL ESTIMATED CONTRACT COST (INCL OPTIONS)	$10,726,531.10

1.7 Table 7 - Assumptions

Sensis can meet the required implementation end dates, however, the schedule defined in the RFP would require work to begin prior to contract award to meet certain deliverables, such as test procedures and plans. As this is not possible, Sensis would like to discuss dates for in-process deliverables once the contract has been awarded and an effective date determined.
All software provided under this contract is considered COTS. No software development will be performed specific to this contract.
Sensis will have the opportunity to discuss the contract items identified in F-8 - Acceptance of General Contract Provisions.doc
Award of the SMS contract to Sensis will not inhibit the ability of Sensis to sell Aerobahn to other entities at JFK.
Gate surveillance data is available and the existing Sensis/FAA MOU or another vehicle will be in place prior to work commencing to make the gate surveillance data available.
Surveillance and other external data feeds are not included in availability calculations.
All requirements of the Port in Proposal Section F-3 1.5 Requirements of Authority are met.
SOW 5.1 and 5.2 - IDS5 is currently used at JFK and SMS operators will have access to it, or an equivalent source for airport/flight information.
SOW 5.1 and 5.2 - Operators are not expected to handle Arrivals except in the Daily report.
Licensed users under this contract will use Aerobahn solely for the Port's business purposes at JFK.
The Port and subsequent Aerobahn users shall not reverse engineer, reproduce, disclose, or create derivative works using Aerobahn.
A system "defect" is defined as a design or production problem that prevents the provided system from meeting its functional performance requirements. A problem is not considered a "defect" if it is induced by external sources that are not within the control of the Contractor.
This assumption list is not to be considered all inclusive. Other assumptions are made within individual proposal sections.

2. Options

2.1 Option Pricing Table

PRICED OPTIONS	
Rack redundancy	$80,000
Additional Surveillance	$528,300
Enhanced Live ATC Coverage	$50,000 / $7,000 per year
TOTAL ESTIMATED CONTRACT COST (INCL OPTIONS)	$ 10,726,531.10

2.2 Option Assumptions

- All prices in the options section are contingent upon award of the JFK SMS to Sensis. No optional pricing is valid outside the scope of this RFP and options cannot be selected without award of the primary contract to Sensis.
- Option pricing is valid through December 31, 2011.

2.3 Redundant Processing Equipment for JFK Gate Surveillance

The Redundant Processing Equipment enhancement option for the JFK Gate Surveillance will upgrade the existing JFK Gate system Racks from a single string of processing and network equipment servers to a fully redundant string of processing and network equipment servers. This upgrade improves the fault tolerance of the JFK Ramp system, making the server room surveillance processing and network equipment fully redundant with automatic failover for the servers and network equipment. This upgrade includes the following items:

- A set of equipment to provide a fully redundant, fault tolerant, processing capability to the Gate Surveillance Processing Racks in the Equipment room
  - 1 GPS Time Server
  - 1 Multilateration Target Processing Server
  - 1 Multi-Sensor Data Processing Server
  - 1 Network Routing and Switching Device
  - 1 Power Conditioning Unit
  - 1 Rack Mounted Display to interface with all Servers

  - 1 Set of Installation hardware and cables
- Engineering services for system installation, drawing updates, and site work.

The JFK SMS tender contains requirements for a system that is fully redundant, and fault tolerant with very high system availability performance. In addition, JFK SMS operations are greatly enhanced when all stakeholders have access to valid, reliable, and accurate situational awareness (SA) of the aircraft on the JFK movement area and surface. When the JFK Gate surveillance was initially procured as an evaluation system the installed the data processing racks were equipped with non-redundant servers and equipment. At the time, a non-redundant system was reasonable implementation, based on its known applications of use. However, based on today's needs, it is possible to improve to the system availability by adding redundant equipment to the processing racks. In the unlikely event of an equipment failure this fully redundant processing capability with automatic failover should eliminate, the loss of SA to the JFK SMS stakeholders. So an equipment failure with today's single string of processing equipment results in a surveillance service outage, an equipment failure with redundant processing equipment does not cause a surveillance outage. The redundant processing racks automatically make use of the non-failed equipment and reroute the data as necessary to prevent a service outage. In this case, surveillance service continuity is maintained and appropriate maintenance action to repair the failed equipment can be scheduled and coordinated with the FAA, and other stakeholders.

Based on several years experience with the FAA ASDE-X system, and its similarity to the design of the JFK Gate surveillance system, equipment failures are rare. In addition, system fault isolation and LRU replacement is automated, well defined, and efficient when spares are available on site and maintenance personnel have access to the racks. However, if spares are not on site, or if there is a delay in providing access to the FAA spaces where servers are installed, a fully redundant processing rack provides fault tolerance to an equipment failure. This fault tolerant rack keeps the system available to the JFK SMS stakeholders during the subsequent repair activity.

As the designer of the initial ASDE-X system, and the Ramp surveillance system, Sensis is well positioned to maintain the Ramp surveillance at a high level of availability, as is the case currently under sub-contract to Volpe. It is Sensis' understanding that an MOU between the PANYNJ and the FAA is sufficient to allow the PANYNJ to carry out this option. This change will not affect the base FAA JFK ASDE-X system and the ASDE-X system will not be altered in any way.

2.4 Surveillance Enhancement Option

The Surveillance enhancement option for the JFK Gate Surveillance will upgrade the existing JFK Gate system by the addition of several Remote Unit Sensors. This upgrade improves the surveillance system by adding surveillance coverage to more of the JFK Airport surface. The Surveillance enhancement includes the following items:

- 3 Remote Unit (RU) Sensors for the Gate Multilateration system,
- Site survey, preparation, and installation of the RU Sensors,
- A rough order of magnitude estimate for Subcontract Services to support Site Preparation and Installation.

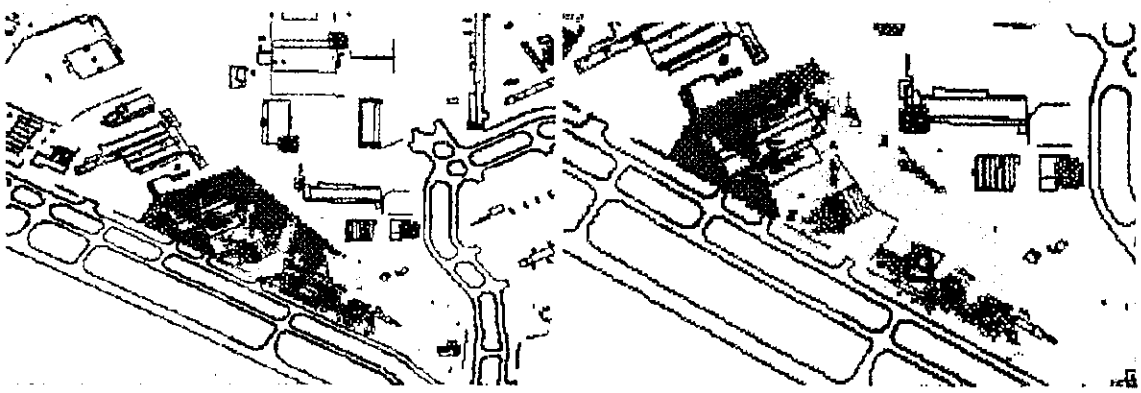
The JFK SMS operations are greatly enhanced when all stakeholders have access to valid, reliable, and accurate situational awareness (SA) of the aircraft on the JFK movement area and surface. This is especially true during periods of constrained operations and poor weather. In addition, the JFK airport airside properties, including terminal buildings, hangars, and other structures, are being demolished, refurbished, enlarged, or built to meet the evolving needs of stakeholders and to meet more green environmental regulations.

The current surface surveillance at the airport was engineered and installed several years ago based on the airside structures in place at the time and in recognition of the applications of use. Since that time there have been changes in structures around the airport surface as well as repurposing of tarmac, resulting in shortcomings in surface surveillance coverage. Fortunately, the surface surveillance in place at the JFK airport was designed to support augmentation to overcome new surface obstructions or to provide SA over new segments of the surface.

With these factors in mind, Sensis has conducted a preliminary analysis of the JFK surface surveillance system and has recommendations to augment the existing systems to provide better SA on the surface. The guiding objectives are to provide accurate SA in cases of constrained operations in poor weather (when conducting de-icing procedures), and in cases of surface congestion (when metering aircraft on the movement area).

As a result of the analysis, the first area that could be improved is in and around the radiant de-icing tent. If the JFK airport does increase the utilization of this area, then improved surveillance will greatly enhance the ability of the SMS users and stakeholders to handle constrained operations in bad weather, when de-icing operations are in place. The following diagrams illustrate the SA improvements in this area:

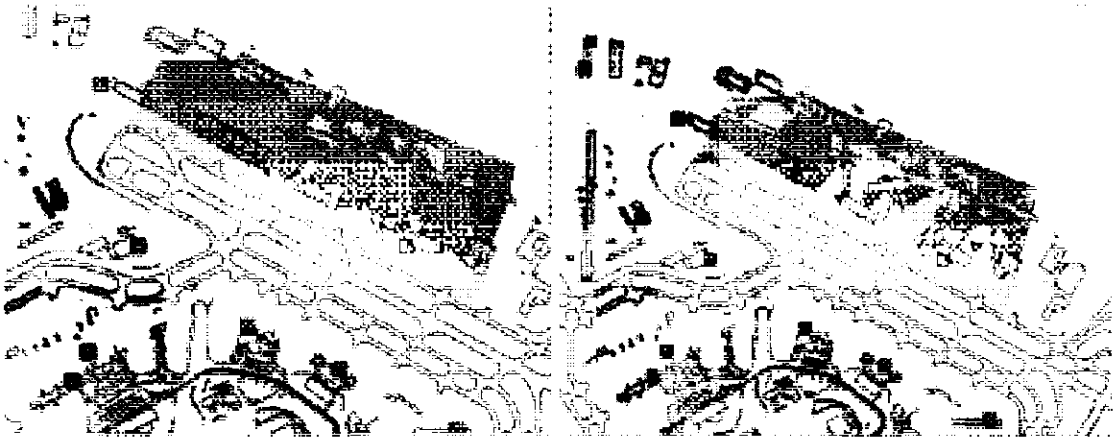
Figure 1 Radiant Tent and Hangar 12 SA. (Left) Current coverage, (Right) enhanced coverage with addition of 2 RU's



These figures are highlighted with either green, to show the areas where the surveillance coverage is of high quality, or red, to show where surveillance coverage is either not available or of low quality. With the Hangar 12 demolition, and with these additional units in place, the coverage improves even more.

The second area that could be improved is Northeast of Taxiway Charlie. If the JFK airport does utilize this area for movement area metering, then improved surveillance will greatly enhance the ability of the SMS users to manage the metering operations. The following diagrams illustrate the SA improvements in this area:

Figure 2 NE of Taxiway Charlie SA. (Left) Current coverage, (Right) enhanced coverage with addition of a single RU



These areas were not analyzed during the ASDE-X system installation they are not part of the airport movement area, and it was not given high priority during the Gate system installation, because of their remote locations with respect to the terminal buildings.

This enhancement is isolated to the FAA JFK Gate surveillance system and it provides, for a modest effort, improved SA in areas that will most benefit the JFK SMS system. It is Sensis' understanding that an MOU between the PANYNJ and the FAA is sufficient to allow the PANYNJ to carry out this option. This change will not affect the base FAA JFK ASDE-X system and the ASDE-X system will not be altered in any way.

2.5 Enhanced Audio Traffic Monitoring Service

The Enhanced Audio traffic Monitoring Service for the JFK SMS includes the following items:

- An upgrade to the audio monitoring service to increase the set of audio frequencies monitored (and available for playback) and to improve system availability.

The Sensis response to the JFK SMS tender includes a service to monitor voice traffic from a set of audio frequencies for a base set of Air Traffic Control radio channels. This set of channels includes those listed in the current Airport/ Facility Directory for the JFK airport, along with some additional frequencies used by airlines. The monitoring capability provides both "Live" listening to the audio data as well as an integrated playback of the audio data time synchronized with the Aerobahn SMS archives.

This option provides an enhancement on the base set of audio channels requested in the JFK SMS tender. This option will provide a full audio monitoring (and playback) capability for the JFK airport by adding audio receivers and performing "smart frequency combining" to listen to a more complete set of audio traffic including:

- Airline Company Channels from the set of published airline frequencies,
- FAA ATC audio channels (the same set as in the base offering),
- Port Authority channels,
- Federal Channels,
- Airline Ground operations channels.

This option also adds more redundant equipment to the service infrastructure to increase the system availability from 99% to 99.9%. The Port Authority and Sensis will work together to ensure that the addition of monitored frequencies and that the predicted availability for this audio monitoring service meets the needs of the JFK SMS.

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1. Management Proposal

The Proposer shall submit a Management Proposal with the following components:

Sensis will rely on its years of experience in delivering surface management systems at 17 of the world's busiest airports (including the existing JFK service), to over 23 air carriers, 4 airport operators, and 4 different air navigation service providers to ensure a smooth set-up and delivery of the Aerobahn SMS at JFK Service. Project implementation plans and schedules for completion of Phase A and Phase B will be modeled after those used to deliver the existing JFK Aerobahn service, Houston and Newark Aerobahn Service for Continental Airlines and most recently Atlanta Aerobahn Service for the City of Atlanta Department of Aviation.

To meet the aggressive schedule for deployment of the JFK SMS, Sensis realizes that effective management of the critical path is essential to project success. After the contract effective date, Sensis will submit a detailed project schedule outlining all tasks and key milestones associated with both Phase A and Phase B. GANNT charts will be used to identify task interdependencies and highlight the critical path. Due of the tremendous amount of experience and knowledge gained over years of delivering SMS systems, Sensis has become very proficient in managing each projects critical path. As a result, Sensis has established a track record of either meeting, and in most cases, bettering project deadlines. Recent examples would be the on-time delivery of the existing JFK Service and ability to turn-up Aerobahn Service in Atlanta several months ahead of schedule.

Descriptions of the Sensis team, with organization charts and the project reporting chain, will be provided. The Sensis Team Contract Manager and SMS Manager will specifically be identified, as will other key personal, along with a description of their roles and responsibilities, in the project. The Contract Manager's principal job responsibilities will be to implement and deliver Aerobahn SMS service. The Contract Manager will be accountable to both Sensis and the Port Authority to meet all the objectives of the service, deliver to the terms of the contract and to ensure adherence to the code of conduct established by the Port Authority. The SMS Manager will act as the primary point of contact for the Port Authority for all things operational during the duration of the Contract. The SMS Manager will be the Sensis employee working very closely with Robinson Aviation, who will be providing the on-site staffing.

After the contract effective date, Sensis will work in cooperation with the Port Authority to establish the Metering Coordination Center (MCC). The MCC is the facility that the Sensis on-site staff would use to operate the SMS system. A conceptual layout of the Sensis proposed MCC, which makes use of the conference room adjacent to the Port Authority Operations Command Center (OCC) located in Building 145 is also included in this section.

Other information related to the management proposal such descriptions of pre-employment screening procedures for each member of the Sensis Team, emergency and

disaster recovery plans, technical and system usage customer service will also be addressed.

1.1 Experience

- *The Proposer shall describe in detail its experience, including relevant contracts performed during the last three (3) years, its financial capability, management structure and proposed staffing, detailing technical training, certifications, applicable licenses, skills and experiences and capability of proposed staff and other supporting documentation demonstrating its ability to perform the work.*

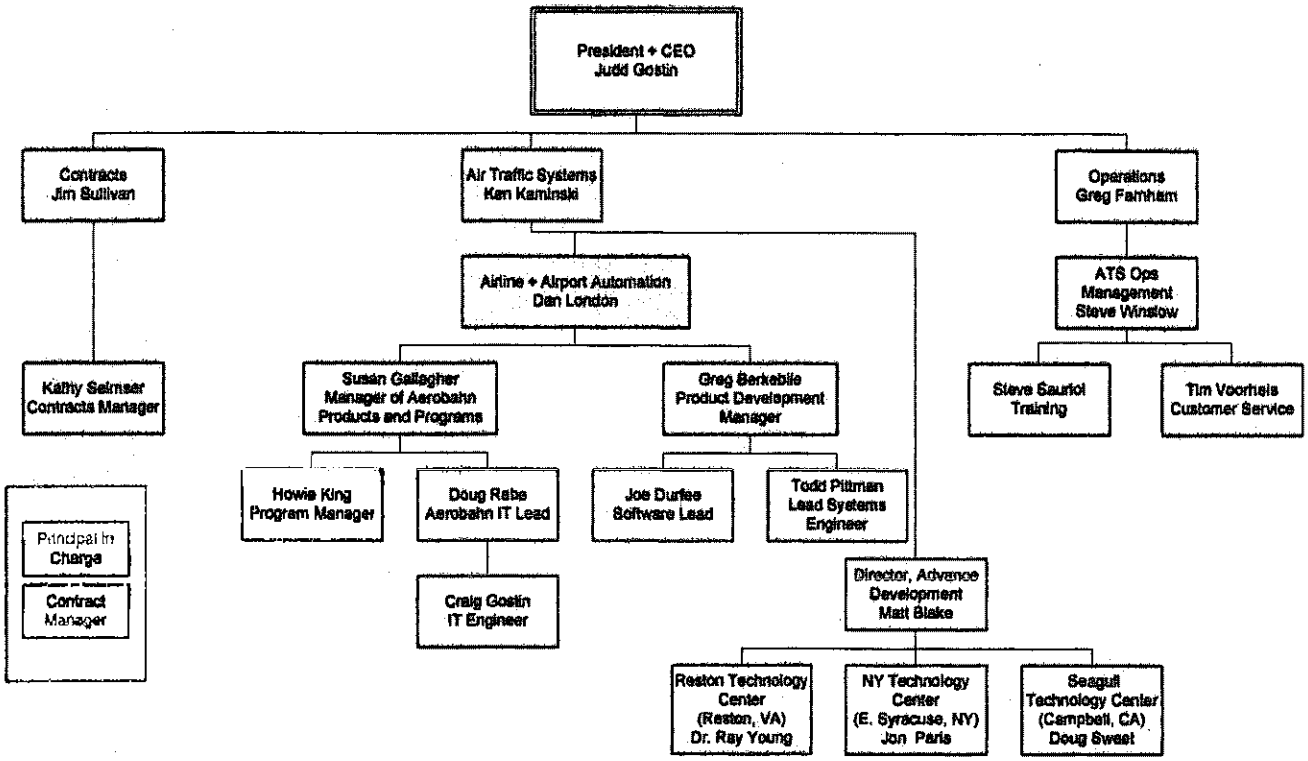
The combined Sensis, Robinson Aviation (RVA), Inc. and Air Network Simulation and Analysis, Inc. (ANSA) team is well positioned to provide an integrated Surface Management System for JFK. Sensis has been delivering Surface Surveillance and Surface Management Systems with systems installed and operating worldwide. RVA brings extensive staffing experience in for Air Traffic Control and Ramp Control operations. ANSA brings extensive research expertise in the areas of control, optimization, and system analysis and design, as well as subject matter expertise with real-world knowledge of airport operations and constraints for over a decade.

In addition to the team information included in this section, please refer to Section E – Documentation of Proposer Prerequisites for full details regarding relevant contract experience and financial capabilities. Please refer to Section F-1 – Requirements for Staffing for full details regarding staff training, certifications, licenses, skills and experiences.

1.2 Sensis Organization Charts

Figure 1 depicts the formal reporting structure of the relevant Sensis organizations and managers that will be involved in implementing and managing the Aerobahn SMS Service at JFK. The Advance Development team is also included as they are the developers of key new technologies that will be implemented in the Aerobahn SMS Service. The detailed project organization charts can be found in section 1.3.2.

Figure 1 Sensis Organization Chart



1.2.1 Key Organizations within Sensis

Resources to implement Aerobahn SMS Service will come from the entire Sensis organization; however the majority of the people will reside in Airline and Airport Automation Organization with support from the Advance Development organization.

1.2.1.1 Airline and Airport Automation Organization

The Airline and Airport Automation organization is comprise of a team of professionals that is both experienced, and skilled, in deploying Aerobahn Service to our current clients including the Port Authority for the Aerobahn JFK Service. The organization is a highly technical team comprised of engineers and program managers. This team will have the overall responsibility for delivery of the Aerobahn SMS Service.

1.2.1.2 Advanced Development

The Sensis Advanced Development Organization provides innovative ATM systems engineering, research, modeling and simulation, and decision support tool development services, primarily to major national aviation research projects and organizations such as the FAA Air Traffic Organization (ATO), National Aeronautics and Space

Administration (NASA) Airspace System Program (ASP), the interagency Joint Planning and Development Office (JPDO), and the US Air Force (USAF).

Sensis has proven experience with a broad spectrum of ATM engineering services and products including:

- Operational Concepts--The definition, development, and evaluation of operational concepts targeting increased air transportation efficiency, safety, and reduced environmental impact;
- Algorithm Development--Development of advanced algorithms for decision support tools to support defined operational concepts, tailored to the Customer's requirements;
- Modeling & Simulation--The definition, development, and implementation of complex simulations of the NAS and its many current and future components;
- Prototype Development--The implementation of a new concept into a viable prototype software and hardware system for field evaluation;
- Product Deployment – Sensis differentiates itself by taking concepts and deliver them as products that are supported over the entire life cycle.

The following figures outline how Sensis Advanced Development's work provides benefits to the Port Authority. Figure 2 outlines research projects and how they are enhancing Sensis' ability to provide industry leading technology to the benefit of the Port as part of the proposed Aerobahn SMS Service. Figure 3 outlines research projects that are relevant to Aerobahn SMS service that has the potential in the future be incorporated into features and capabilities of the Aerobahn SMS Service.

Figure 2 Externally funded IR&D that is leveraged in the proposed Aerobahn SMS service

Project	Sponsor	Project Description	Benefits for the Port	Reference(s)
JFK Departure Manager	NYSERDA	Develop a prototype departure manager for JFK, an associated ConOps, and analyze potential benefits at JFK and other US airports.	The Departure Manager is in the process of being productized and is a key proven element in optimizing the departure sequence at JFK.	Levy, B., 2010. "Draft ConOps and Departure Manager Prototype", 10th Integrated Communications, Navigation, and Surveillance (ICNS) Conference, Herndon, VA; Stroiney, B. Levy, C.J. Knickerbocker, "Departure Management: Savings in Taxi Time, Fuel Burn, and Emissions," 2010 Integrated Communications Navigation and Surveillance (ICNS) Conference; Stroiney, S. and B. Levy, 2011. "Departure Queue Management Benefits Across Many Airports", 11th Integrated Communications, Navigation, and Surveillance (ICNS) Conference, Herndon, VA
Memphis CDQM SDSS Trials	FAA AJP	Develop an approach for integrating commercial SMS applications into FAA Collaborative Departure Queue Management Operations	The Flight Object Surface Application (FOSA) interface standard that we helped create will be used for the Aerobahn SMS Service.	FAA AJP-67, "NextGen Surface Trajectory-Based Operations (TBO) Project: CDQM, FOSA, and CDS: Work Plan for 2011 MEM," briefing, April 28, 2011.
Airport Taxi Time Prediction Study	Sensis IR&D	Design advanced techniques to predict airport surface taxi times	The novel airport surface taxi time predictions are being used to enhance the surface predictions for the Aerobahn SMS Service.	B. Levy and J. Legge, 2008. "Objective and Automatic Estimation of Excess Taxi-Times", 8th ICNS Conference, Bethesda, MD
Florida Test Bed Surface Flight Data Object	FAA AJP	Develop surface flight data object requirements and standard for a Flight Operator Surface Application (FOSA) surface data exchange interface	The Flight Object Surface Application (FOSA) interface standard that we helped create will be used for the Aerobahn SMS Service	Embry Riddle Aeronautical University and Integrated Airport Initiative Partners, "Integrated Airport Initiative Task F: Surface Exchange of Flight Data Object: Demonstration Concept of Use," OTA DTFAWA-08-A-00001, September 16, 2009

Project	Sponsor	Project Description	Benefits for the Port	Reference(s)
JFK Surface Anomaly Detection Research	FAA AVS	Develop surface anomaly detection capabilities to support proactive rather than reactive safety issue identification	This work has lead to a more detailed understanding of the JFK surface environment and allow Sensis to further improve its Surface Predictions and DMAN Accuracy.	Waldron, T., and B. Levy, "Analysis Report Transportation Information Project Support (TRIPS) ASDE-X Analysis, Phase II, Prime Contract No. DTRT57-06-D-30004, Subcontract No. S50001112, Version 1.0, September 30, 2010.
Trajectory-Based Flow Management	FAA AJE	Develop, test, and deploy enhancements to FAA Traffic Management Advisor (TMA)	Sensis capabilities and FAA contacts will help ensure that the desired SMS-TMA integration is done in the most efficient manner possible	Lockheed-Martin, "TBFM Program Time & Material Subcontract Number: DR037460," Govt Contract DTFAWA-10-C-00052, August 10, 2010.
Estimation of Fuel Burn and Emissions from Taxiing Aircraft	Sensis IR&D	Develop estimation capabilities to determine excess fuel burn and emissions from aircraft-specific rates during taxiing, with proprietary algorithms to estimate taxi duration delay from surveillance data	Provides accounting of economic and environmental benefits of active departure management; will be used to support Aerobahn SMS Service fuel burn and emissions calculations	Levy, B., K. Lefebvre, and J. Legge, 2007. "Quantification and Forecasting of Emissions from Taxiing Aircraft", 6th EuroControl Innovative Research Workshop and Exhibition, Bretigny sur Orge, France.

Figure 3 Internally & Externally funded IR&D that may translate into benefits for the Port in the future

Project	Sponsor	Project Description	Benefits for the Port	Reference(s)
Metroplex NRA	NASA	Develop new concepts to increase metroplex departure and arrival planning efficiency	Study of the use of the Route Availability Planning Tool (RAPT) to support New York departure planning will support efficient SMS-RAPT integration	Timar, Sebastian, Lewis, Taryn Butler, Gutterud, Rich, Ren, Liling, Crisp, Donald L., Saraf, Aditya, Sliney, Ben, Levy, Ben, Rappaport, Dave, Stefanidis, Kostas, Clarke, John-Paul, Thompson, Terry, and Dave Schleicher, **"NASA Project** NNX07AP63A Characterization of and Concepts for Metroplex Operations: *New York TRACON Site Report,"* **March 23, 2009**
New York Departure Management Benefits Study	NASA	Develop novel departure management algorithms and analyze the potential benefits of departure management for merging New York airport departure flows into common departure fixes at the New York TRACON	Study of the new New York departure management techniques provides some new departure management algorithms that could enhance the Aerobahn SMS Service	Saraf, Aditya, Schleicher, David R., Griffin, Katy, and Peter Yu, **"Assessment of the Potential** Benefits of an Ideal Integrated Metroplex-wide Departure Planner," *9th AIAA Aviation Technology, Integration, and Operations Conference (ATIO),* Hilton Head, South Carolina, September 21-23, 2009
Airport Surface Optimization NRA	NASA	Develop a suite of novel airport and terminal area optimization-based planning algorithms and analyze their individual and combined potential impact	The novel airport and terminal area optimization-based planning algorithms could be leveraged to enhance the Aerobahn SMS Service	Griffin, K., P. Yu, J.P. Clarke and D. Rappaport, **"Evaluating Surface Optimization Techniques Using** a Fast-time Airport Surface Simulation", **AIAA 10th** Aviation Technology, Integration, and Operations (ATIO) Forum, Fort Worth, TX, 2010
Airport Managed Gate Operations Study	Sensis IR&D	Design advanced techniques to improve airport ramp management	The novel ramp management planning algorithms could be leveraged to enhance the Aerobahn SMS Service	Levy, B., C. Knickerbocker, A. Durston, M. Dong, K. Lewicki, 2010. **"Final** Presentation: Managed Gate Operations Algorithm Feasibility Study," Sensis Innovative Research grant, year 2.

Project	Sponsor	Project Description	Benefits for the Port	Reference(s)
Airport Capacity Prediction NRA	NASA	Develop novel approaches to perform accurate strategic airport capacity prediction	The novel airport capacity prediction algorithms could be leveraged to enhance the Aerobahn SMS Service	Hunter, G., "Probabilistic Forecasting of Airport Capacity," AIAA Digital Avionics Systems Conference (DASC), Orlando, FL, Salt Lake City, UT, October 2010
Market-Based TFM Research	NASA	Develop innovative market-based TFM techniques and test efficacy in fast-time and real-time human-in-the-loop experiments	The novel concepts developed such as permit concepts could be used for integrating airline prioritization into Aerobahn SMS Service departure management processes	Hunter, G., Berardino, F., Hoffman, K., et al., "Development and Evaluation of Market-Based Traffic Flow Management Concepts," NASA Project NNX09AB20A, March 2011

1.3 Project Organization

- *Include a detailed project schedules for completion of Phase A and Phase B as detailed in Attachment C, Scope of Work and Specifications. The Proposer shall provide key milestone dates on the "milestone schedule" and describe all task interdependencies. (While not required, Proposers are encouraged to use GANNT charts and highlight critical path activities). The project schedule shall indicate when Authority-required tasks, including but not limited to providing test hardware, providing connectivity, etc., need to be performed.*
- *The Proposer shall include a detailed organizational chart identifying information key staff*

1.3.1 Project Plan and Schedule

Within five (5) days of contract award, Sensis will submit a Project Implementation Plan (PIP) to the Port Authority's Project Manager. The PIP will describe the content of the Implementation Phase of the contract, including the schedule and corresponding milestones. During the Implementation phase, the Sensis team will work in close cooperation with other the Port Authority Project Manager, to effectively execute all tasks required to deploy a surface management system (SMS), with the functionality required, at JFK. The PIP will provide a comprehensive description of the tasks required to design, build, test, deploy and maintain the various hardware and software elements comprising the SMS. It will also highlight the transition from the Implementation Phase of the contract to the commencement of 24x7 Service at JFK.

Elements of the plan will include, at a minimum:

- A project schedule with a degree of detail to identify at a minimum:
    - All activities, tasks and stages of construction, milestones and deliverables as specified both within the Contractor's system development and installation methodology and those specifically identified herein.
    - All the activities and tasks associated with the development, installation, integration, configuration and preparation of the System and all subsystem components, submittals, testing and training.
    - Project activities with associated tasks and sub-tasks.
    - Interfaces and dependencies with preceding, concurrent, and succeeding work effort.
    - Resources needed and assignments down to the task level for staff, material, and equipment.
- A transition plan to address bringing the system online, by Phase, to minimize disruption of current operations. Includes at a minimum:
    - loading of all software,
    - plans for the loading of the initial database,
    - training plan,

- site equipment installation plans (including drawings and product installation literature for all primary components),
- highlights of on-site staffing plan,
- and roles and responsibilities of key program personnel during the implementation phase.

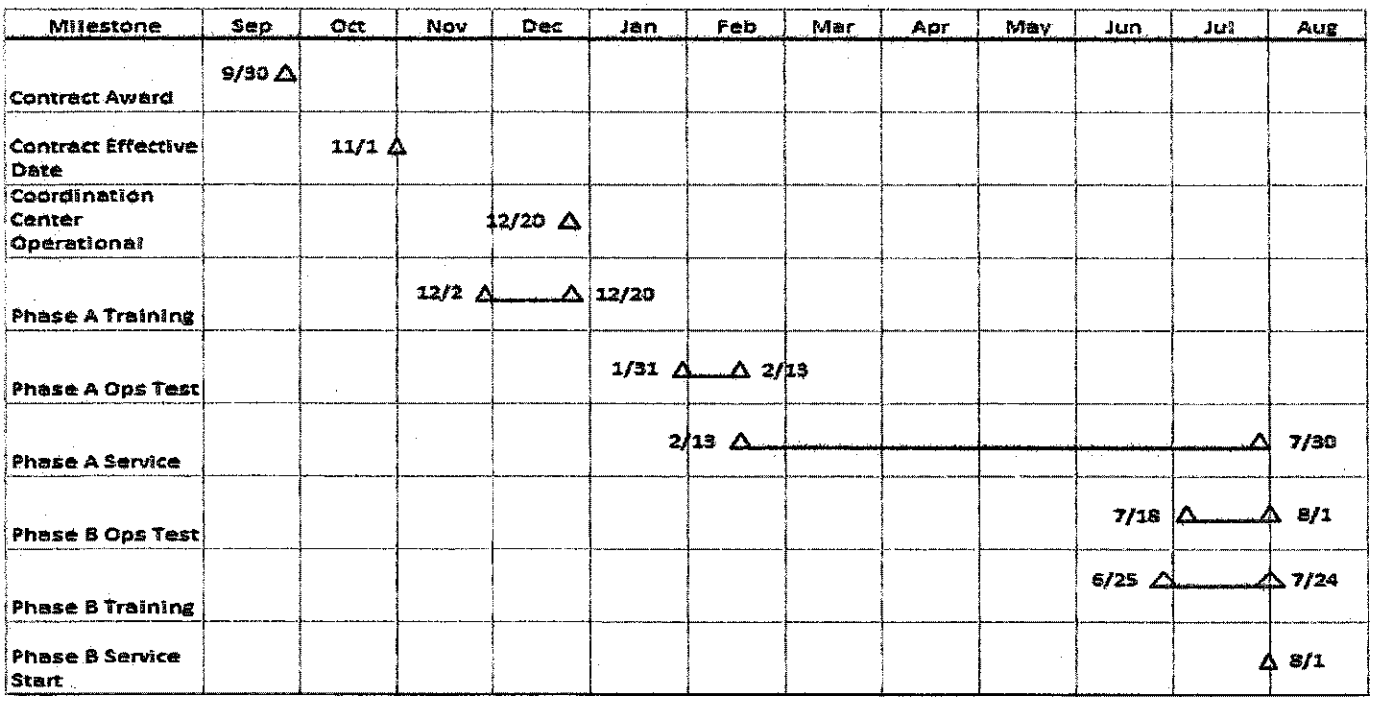
The project schedule will be submitted both electronically and in hard copy. The schedule will include Gantt charts and PERT charts with the critical path identified (using CPM) showing when tasks occur, when resources are required, and what task dependencies exist. The project schedule will be of sufficient detail as to allow the Port Authority Project Manager to monitor progress throughout the implementation phase. Tasks will be presented in a logical sequence, with key dependencies, resources assignments, material and equipment identified. The project schedule will reflect (at a minimum) the following key milestones:

- delivery dates of required documentation, installation of site equipment (to include communications circuits, computer hardware),
- delivery dates of Phase A features,
- delivery dates of Phase B features,
- pre-acceptance testing dates by Phase,
- acceptance testing dates (coordinated with the Port Authority),
- training dates,
- operational test dates,
- and base date of operational usage by Phase.

Included below in)

Figure 4 is a high level schedule overview. *(Note: Detailed Gantt charts will follow.)*

Figure 4 High Level Schedule Overview



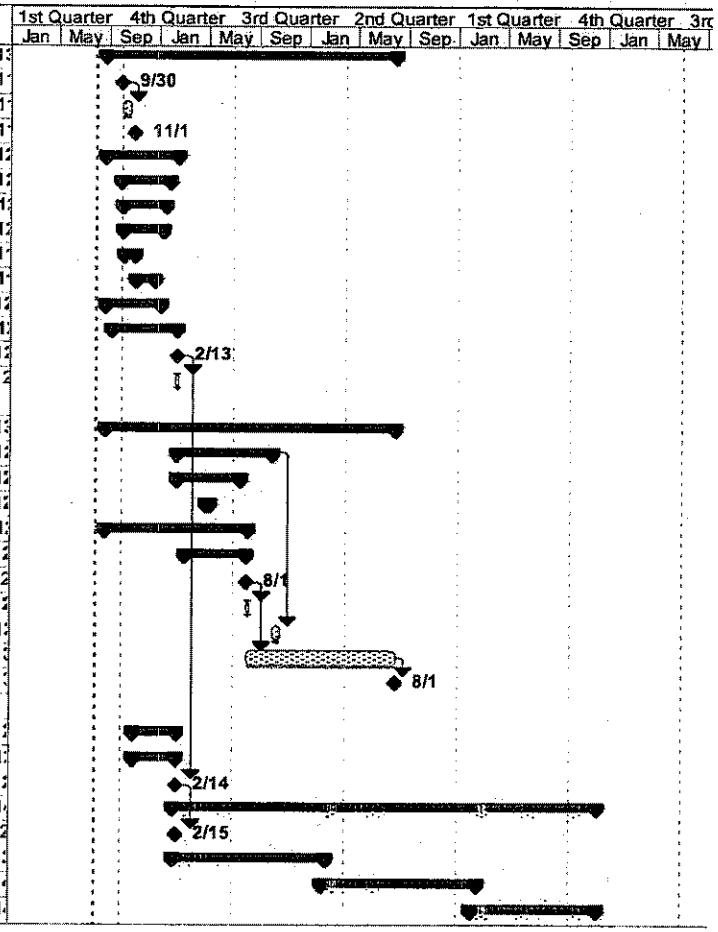
1.3.1.1 Kickoff Meeting – Post Contract Award

Within thirty (30) days of receiving a signed contract, the Sensis team will conduct a kickoff meeting at JFK facilities on a mutually agreeable day and time. During the meeting, Sensis will introduce members of the project team and communicate its approach to management of the contract, specifically the division of work into two phases. Sensis will describe the scope of the program, communicate the schedule and key milestones, identify near-term high priority items, highlight risk areas and plans to mitigate each of the risks, and describe the communication mechanisms that will be employed so that the Port Authority is well informed of Sensis' progress and program issues at all times. Sensis will also solicit ideas for discussion topics from the Port Authority in advance of the kickoff meeting, and will work diligently to address those topics, including areas of concern, during the on-site meeting.

1.3.1.2 Detailed Gantt Charts

Figure 5 Sample Program Schedule

ID	Task Name	Start	Finish
1	**Port Authority SMS Detailed Implementation Plan**	**Mon 8/22/1**	**Thu 8/1/1**
2	Sensis Awarded Contract	Fri 9/30/1	Fri 9/30/1
3	Contract Negotiations	Fri 9/30/1	Fri 10/21/1
4	Contract Effective Date	Tue 11/1/1	Tue 11/1/1
5	**Phase A Implementation**	**Mon 8/22/1**	**Wed 2/15/1**
6	**Program Management & Support**	**Fri 9/30/1**	**Thu 1/26/1**
17	**System Requirements & Support**	**Mon 10/3/1**	**Mon 1/16/1**
25	**Progam Deliverable Documents**	**Tue 10/4/1**	**Tue 1/10/1**
33	**Deliverable Documents**	**Fri 10/7/1**	**Thu 11/3/1**
45	**Coordination Center**	**Fri 11/4/1**	**Tue 12/20/1**
52	**Training and Technical Documentation**	**Mon 8/22/1**	**Thu 1/5/1**
65	**System Inspection and Tests (SOW Section VIII_A)**	**Tue 9/6/1**	**Mon 2/13/1**
80	Phase A Operational Usage Commences	Mon 2/13/1	Mon 2/13/1
81	Phase A Training Coaches On-Site	Thu 2/9/1	Wed 2/15/1
82			
83	**Phase B Implementation**	**Mon 8/22/1**	**Thu 8/1/1**
84	**Program Management & Support**	**Tue 2/14/1**	**Thu 10/4/1**
90	**System Requirements & Support**	**Tue 2/14/1**	**Wed 7/18/1**
94	**Documentation submittals (NLT 21 days prior to Insp**	**Wed 4/25/1**	**Thu 5/3/1**
113	**Training and Technical Documentation**	**Mon 8/22/1**	**Mon 8/6/1**
126	**System Inspection and Tests (SOW Section VIII_A)**	**Mon 3/5/1**	**Wed 8/1/1**
143	Phase B Operational Usage Commences	Wed 8/1/1	Wed 8/1/1
144	**Phase B Training Coaches On-Site**	**Wed 8/1/1**	**Wed 8/8/1**
145	EWR Set-up	Fri 10/5/1	Tue 10/23/1
146	Phase B Warranty Period	Wed 8/1/1	Thu 8/1/1
147	Phase B Maintenance Period Commences	Thu 8/1/1	Thu 8/1/1
148			
149	**Aerobahn Service**	**Tue 11/1/1**	**Tue 2/14/1**
150	**Pre-Service**	**Tue 11/1/1**	**Mon 2/13/1**
154	**Aerobahn Service Phase A Go Live!**	**Tue 2/14/1**	**Tue 2/14/1**
155	**Service**	**Tue 2/7/1**	**Mon 12/8/1**
156	Service Commencement	Wed 2/15/1	Wed 2/15/1
157	**Year 1 (Phase A and B)**	**Tue 2/7/1**	**Thu 2/14/1**
237	**Year 2 (Phase B)**	**Tue 2/5/1**	**Tue 2/18/1**
330	**Year 3 (Phase B) (9.5 months)**	**Tue 2/4/1**	**Mon 12/8/1**



1.3.2 Project Team Organization

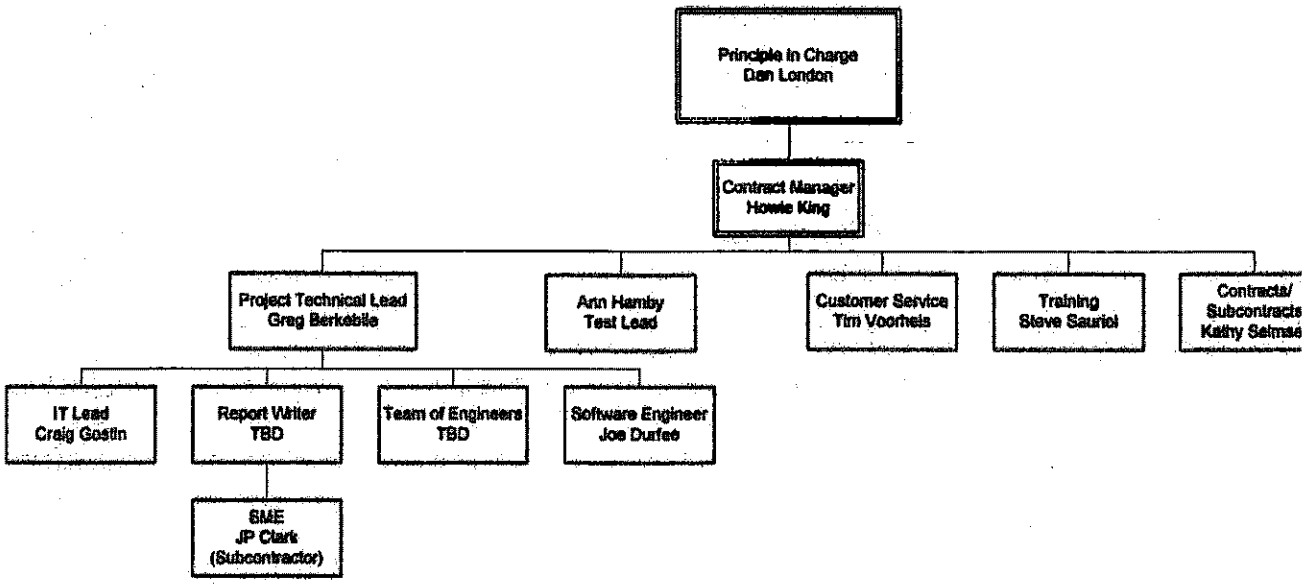
Under the leadership of Dan London, Principle in Charge, is a capable and experienced team of professionals who are committed to providing the Port a reliable, efficient, and cutting edge service to meet the needs of the Port now and into the future.

Sensis, along with Robinson Aviation, will create two teams: an Implementation Team and an Operations Team. The Implementation Team's focus will be to make sure that the Aerobahn platform is deployed, working within specification, and reliable. The Operations Team will consist of professionals who will oversee and operate the metering program during Phase A and Phase B operational periods. The two teams will be led by the Contract Manager, Howie King.

1.3.2.1 Implementation Team Organization

Figure 6 depicts an organization chart of the implementation team. The organizational structure outlines the functional resources the Contract Manager will have available to execute the requirements of the project. In addition to the project organization presented, the Contract Manager will have access to a "very deep bench" of expertise, drawn from other organizations within Sensis.

Figure 6 Sensis Implementation Team



1.3.2.1.1 Roles and Responsibilities

Included below is a discussion of the Roles and Responsibilities of the members of the implementation team. Please also refer to the resumes in Appendix – Resumes.

1.3.2.1.1.1 Principal in Charge – Dan London

The Principal in Charge is the Sensis manager who manages the majority of the people required to implement Aerobahn SMS Service. This person will establish the project mission and overall leadership of this project. The Principal also have direct management oversight of the majority of the resources available to the Contract Manager.

1.3.2.1.1.2 Contract Manager – Howie King

The Contract Manager's principal job responsibilities will be to implement and deliver Aerobahn SMS service. The Contract Manager will be accountable to both Sensis and the Port Authority to meet all the objectives of the service, deliver to the terms of the contract and to ensure adherence to the code of conduct established by the Port Authority. The Contract Manager will be the Port's principal point of contact for contract issues and required reports.

During the implementation phase, the Contract Manager will prepare and submit updated progress schedules to the Port Authority Project Manager every other week. These updates will show tasks completed for the preceding two weeks, the percentage complete for tasks in process and any changes to tasks remaining.

The Contract Manager will, in cooperation with the Port Authority Project Manager, schedule and conduct bi-weekly status meetings to discuss progress during the implementation phase. The status meetings will primarily be conducted via telephone conference calls, and as necessary, in person at a Port Authority approved site. An agenda will be provided at least 2 business days prior to each meeting to outline topics of discussion, which will include (at a minimum):

- status of the tasks in process
- risk items and recommended mitigation plans

The Contract Manager will, in cooperation with the Port Authority Project Manager, schedule and conduct weekly meetings to discuss status of the SMS service. An agenda will be provided at least 2 business days prior to each meeting to outline topics of discussion. In addition to the agenda, a Customer Problem Report (CPR) listing all open issues and documenting the system's performance over the previous measuring period will be provided. The Implementation Phase concludes upon successful execution of Acceptance Testing and the 14 day Operational Test period. At this time, the SMS Manager becomes the primary onsite point of contact for the Port Authority.

1.3.2.1.1.3 Project Technical Lead – Greg Berkebile

The Project Technical Lead is responsible for the overall technical performance of the Aerobahn SMS service. The Project Technical Lead will have both direct resources and resources provided to them by the Principal in Charge to implement the service on time and on schedule.

The Project Technical Lead will also be available on an as required basis to quickly respond to any service issue that comes from Customer Service.

1.3.2.1.1.4 IT Lead – Craig Gostin

The IT Lead is an engineer with a specialized set of skills in computer networking. The IT Lead will be the person who will design the network (in collaboration with the Port), troubleshoot performance issues, and respond quickly to any service issues.

1.3.2.1.1.5 Report Writer

Included in Aerobahn SMS Service is a powerful database. Both the Port and Sensis have learned that it is difficult for individual Users to fully exploit the use of this data. In the RFP, the port has requested a single person be assigned as a report writer. Sensis proposes an alternate approach where the SMS Manager will be the primary report writer available to the Port and then have access to the team of engineers back in Syracuse. This approach will reduce the time to translate the operational need to "the best way to extract if from Aerobahn" The SMS manager will work closely with the appropriate engineer with a specialized set of skills in databases. The engineer the SMS Manager will work with will be highly skilled in both standard database work and surface management.

1.3.2.1.1.6 SME (Subject Matter Expert)

Sensis will obtain the services of Dr. JP Clark, who is professor at Georgia Technical University and co-founder of ANSA. Dr. Clark has authored many papers and is recognized as an expert on surface movement. Dr. Clark will provide expert evaluation and recommendations on reports, specifically the "scorecard."

1.3.2.1.1.7 Software Engineer – Joe Durfee Software leading a team of professionals

Sensis has approximately a dozen software engineers that continually work on the Aerobahn platform. Each engineer has, at a minimum, a bachelor's degree and many have years of experience working on the Aerobahn platform. Almost all of the software engineers were involved in the deployment and delivery of the current Aerobahn JFK service.

1.3.2.1.1.8 Test Lead – Ann Hamby

The Test Lead is an engineer who is intimately familiar with the operation of Aerobahn from a User experience stand point. The Test Lead does not report to the Project Lead but acts as an independent check and balance in ensuring that the Service meets all requirements.

1.3.2.1.1.9 Customer Service – Tim Voorheis

When the Aerobahn SMS Service is operational, the day-to-day operations and management of the JFK Service will be led by a Contract Manager, in cooperation with Sensis Customer Service representatives. The Customer Service representatives will serve as the initial point of contact for all JFK Service Customers. Sensis Customer Service formally documents all correspondence with Customers, and is the first line of defense when automated and/or manual monitoring of the service detects a fault. Customer Service, which is available 24x7, is the bridge between Aerobahn Users and the Service Delivery Manager, who leads the technical efforts required to extend a high quality Service.

Sensis Customer Service uses a CPR as its primary method for recording all Customer contacts. Reported service anomalies are recorded in the Customer Service database, assigned a CPR number and assigned to the appropriate technical resource on the Product Team. CPRs are tracked until the anomaly is resolved. Upon concurrence between the Contract Manager and the Port Authority Project Manager that the issue has been remedied, the issue is "closed." Customer functionality is also discussed in Section F-1-I – General Description of Services.

1.3.2.1.1.10 Training – Steve Sauriol and Staff

Sensis has a very capable training organization. Please refer to section F-1-VII – Users and Training for details on our training approach.

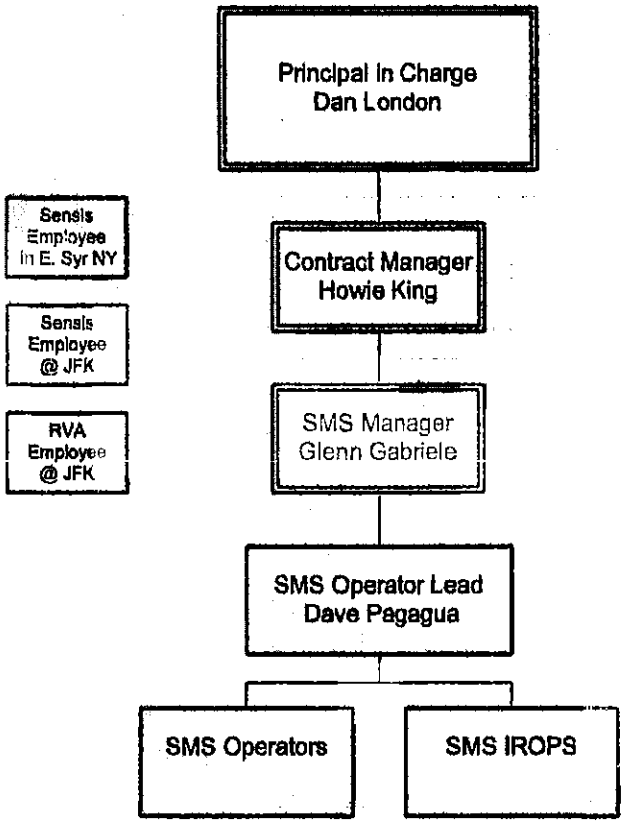
1.3.2.1.1.11 Contracts/Sub Contracts – Kathy Selmser

The Contracts/Sub Contracts Manager will be responsible for implementation, conformance and execution to all contract issues to the Port Authority and Sensis subcontractor. Sensis' contracts professionals will be the same people currently working with the Port on Aerobahn JFK service.

1.3.2.2 Operational Team Organization

After the start of Phase A, the Operational Team is responsible for the day-to-day on-site management of the Aerobahn SMS Service. The Operational Team is shown in Figure 7. The implementation team is still available to ensure smooth delivery and promptly respond to service delivery issues.

Figure 7 Sensis Operational Team



1.3.2.2.1 Leadership Approach

The operational team will be comprised by professionals from both Sensis and RVA. The Principal in Charge and the Contract Manager are responsible for the entire execution of all phases of the project. Sensis will have a Sensis employee on site, the SMS Manager, to work with the Port and the stakeholder community to ensure smooth, compliant, and effective operations of the Aerobahn SMS Service. The SMS Manager will also work with the SMS Operations Lead and the rest of the SMS Operators to ensure proper execution of the Service.

1.3.2.2.2 Staffing Approach

Robinson Aviation (RVA) will be providing the on-site staffing for Aerobahn SMS Service. These Services will be provided at the JFK Airport by employing a SMS Operator Lead, and four (4) SMS Operators. This basic number of operators may be supplemented by part-time operators to provide flexibility in position staffing and to provide for supplemental work. Part-time positions provide efficiency for the operation, as well as contingency staff to and may be used to reduce the overall staffing in Phase B.

There will be one (1) operator on duty from 0700L-1000L and two (2) operators on duty from 1400L-2300L. The scheduled two (2) person shifts can be changed to different time frames based upon traffic flows/peaks and operational requirements as agreed upon with the Port Authority in coordination with FAA and other appropriate agencies/companies. The SMS Operator Lead will maintain a close liaison with the FAA Operational Manager on duty and Airport Operations and will supervise the SMS Operator workforce and ensure safe, efficient and equitable performance of SMS services. Responsibilities of the SMS Operator Lead will include remaining operationally current on the positions of operation. After contract award, detailed services/standard operating procedures will be developed in concert with the Sensis, the Port Authority, the FAA and users. The procedures will be documented and provided to all parties of the agreement.

The SMS Operator Lead provides a monthly staffing plan to Sensis one (1) week in advance of the start of each calendar month. The schedule will include the names of all operators assigned in the coming month, and show the dates they are scheduled to work and the shifts. He executes that plan using his more than 15 years of experience as a manager/supervisor. He will have a cell phone or beeper by which the Sensis SMS Manager can contact him 365 days per year, 24 hours per day. He will attend User group meetings as needed during the year.

1.3.2.2.3 Interaction with the FAA

Aerobahn SMS Services include maintaining close coordination with the FAA ATCT to insure ramp tower operations support and compliment the FAA's flow of aircraft on the airport, communicating as needed with airport users of the SMS. Personnel will maintain status of all construction projects and other activity that may affect the status of ramp areas and other egress/ingress to ramps/taxiways. Recommend departure locations as requested by ramp controllers, adding ad hoc flights to the system as needed, assign taxi times and readjust as needed due to flight/taxi delays, coordinate with FAA New York facilities during periods of severe weather and severe weather avoidance plan (SWAP) events and work with NY TRACON when JFK is departing two runways and they are departure fix restricted.

1.3.2.2.4 RVA's Approach to JFK Aerobahn Service

RVA's approach to customer relations is a philosophy that permeates throughout the company and begins with the Chief Executive Officer, filtering down to every employee. The motto "do the job right the first time, every time" is accompanied by teaching the methodology of developing excellent relations with not just our clients, but also our fellow contractors on a job, be we prime or sub, and in the case of working in operations, with all users and parties who are effected by our service. Each operator employed by RVA will soon learn that we have a history of developing and promoting the best possible working relationships. In the case of air traffic and ramp towers we emphasize fostering associations with airport management, FAA staff, air carrier and terminal operators, flight plan service providers. This approach encourages problem

identification, informal investigation (in most cases) and prompt solution and resolution to most issues that arise. One demonstration of the benefits of this corporate principle can be seen in the following quote, taken from a letter received by RVA's Ramp Tower Manager at the Seattle Tacoma International Airport (SeaTac) Ramp Control Tower (Seattle Ramp Tower (SRT):

> *Paul,*
>
> *Please accept my sincere appreciation to the efforts you and all the RVA staff contributed to the success of the Ramp Construction phase of this summer's airfield construction project. Not only were RVA staff instrumental in the conduct of daily movements of aircraft around the ramp construction sites, but your participation and input in the pre-construction coordination helped immensely in assuring a safe project and an efficient flow of aircraft despite the amended routes and procedures.*
>
> *Sincerely,*
> *Patrick Clancy*
> *Manager Airport Certification*
> *Airport Operations, Seattle-Tacoma International Airport*

1.3.2.2.5 Roles and Responsibilities

Included below are the roles and responsibilities of the Operational Team.

1.3.2.2.5.1 Principal in Charge – Dan London

This person is the same person for both the Implementation Team and Operational Team and has the same responsibilities.

1.3.2.2.5.2 Contract Manager- Howie King

This person is the same person for both the Implementation Team and Operational Team and has the same responsibilities.

1.3.2.2.5.3 SMS Manager – Glenn Gabriele

The SMS Manager is a Sensis employee who will be on-site full time. The proposed SMS manager has been working with the Port over the past year and has personally trained and worked with all of the current Aerobahn JFK stakeholders. He also was a former pilot with US Airways and brings a unique perspective from a pilot's viewpoint. The SMS Manager will also act as the on-site Report Writer working as needed with the professional staff he will be uniquely capable of understanding both the operational needs

from the port and the detailed capability of the tool in order to achieve the maximum benefit for the Port.

The SMS Manager will act as the primary point of contact for the Port Authority for all things operational during the duration of the Contract. The SMS Manager will be the Sensis employee working very closely with RVA. The SMS Manager is responsible for training the SMS Operator Lead and the SMS Operators to the Port Authority approved Standard Operating Procedures and implement any changes to procedural protocol and/or System throughout the life of the Contract.

For the initiative to be successful, the Port Authority believes that understanding the needs of the Users is critically important. The SMS Manager shall participate in User Group Meetings at JFK throughout the life of the Contract to gain feedback on the quality of the Service, outstanding issues, product features, future enhancements and so forth.

1.3.2.2.5.4 SMS Operator Lead - Dave Pagagua

RVA's Operator Lead has an extensive aviation background and nearly 20 years of operations service experience as a Supervisor/Manager at the John F. Kennedy International (JFK) Airport and even more with the surrounding airspace. This position will be located on Site at JFK. His credentials include FAA Air Traffic Controller experience at JFK and the New York TRACON; Traffic Management Specialist at the TRACON, first line supervisor and Operations Manager at JFK. He completed the FAA Air Traffic Training Instructor Course and has a BA degree from Brooklyn College (please refer to Appendix – Resumes). The knowledge, skills and hands on experience of the proposed Aerobahn SMS Service will allow RVA to have an immediate ability to proceed with the procedures development and implementation required for this operation. He is FCC licensed and has extensive experience in operating the Ground Control frequency on site at JFK, and is fully capable of interfacing via radio with aircraft to communicate appropriate information if the Port Authority deems it necessary. The normal learning curve to gain local area knowledge, personnel familiarization and detailed knowledge of the airport/gate/ramp areas will not be required. The SNS Operator Lead has experience and detailed knowledge of the FAA personnel and other personnel within the Port Authority complex which will provide us the ability to be highly effective in minimum time.

When the SMS Lead Operator/Supervisor is not available he/she will designate an Operator in Charge (OIC) from the staff on duty and that person will perform the duties of the lead operator for the period of time the SMSS is not present. The OIC duties will rotate among the operators and each will be trained on the OIC duties prior to being assigned to OIC.

1.3.2.2.5.5 SMS Operator

An SMS Operator shall be a highly qualified professional who will support the System in a tactical and pre-tactical nature, shall work on site at JFK and shall be the primary

System Operator during all times that the System is in operation. An SMS Operator shall have a thorough working knowledge of Air Traffic Management in the New York Region, in particular, the impact of fix and route availability in relation to the health of the surface operation at JFK.

Each SMS Operator will be an experienced and skilled air traffic controller that has been previously certified by the FAA in a terminal facility or the individual will have considerable experience as a pilot, previous ramp tower operator or in a related aviation field. To the extent possible, local personnel that have previous experience at this or other large air carrier airports will be hired to operate the SMS. During Phase A, one (1) operator will be assigned to a shift from 0700 to 1000 daily. Two operators will be assigned to a shift from 1400 to 2300. The hours of double coverage may change based on requirements by the Port Authority and other signatory parties to the agreement. For Phase B we anticipate a reduction in staff for the 1400 to 2300 shift based upon enhancements to the SMS and utilization of part time operators. These positions will be located on Site at JFK.

1.3.2.2.5.6 SMS IROPS

When there is a major IROPS event, the SMS Operator lead will call in additional staff from the pool of SMS Operators in order to augment staff during the event.

1.4 Pre-employment Screening Procedures

- *The Proposer shall provide detailed descriptions of its pre-employment screening procedures; safety and emergency procedures including, but not limited to, disaster recovery plans.*

Please refer to proposal section F-4 - Contractor Identity Check-Background Screening Plan for a full description of this process.

1.5 Requirements of Authority

1.5.1 Resource Requirements

- *The Proposer shall also include a separate list describing the (human) resources that it expects the Authority to provide. This list shall also indicate the skill-set of the Authority-provided resources and the expected percentage of their involvement.*

Sensis does not anticipate any resources above specific resources articulated in the RFP.

1.5.2 Equipment Requirements

- *The Proposer shall provide a separate list of any equipment or requirements (workstations, office space, etc.) it expects the Authority to provide or fulfill.*

1.5.2.1 Metering Coordination Center

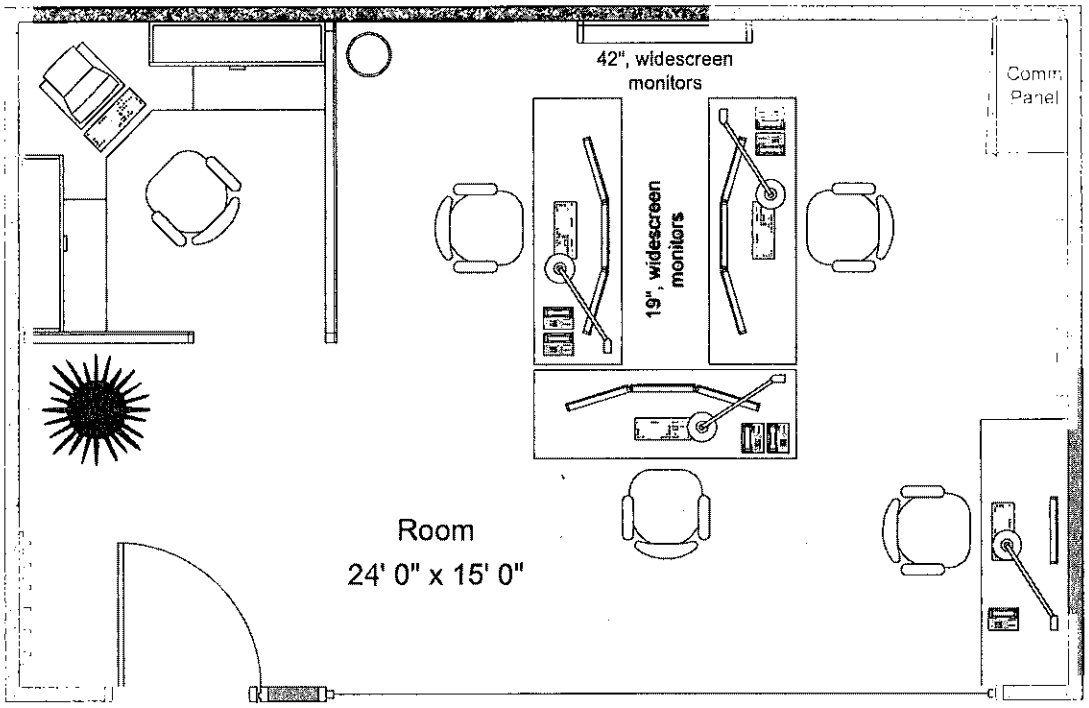
After the contract effective date, Sensis will be working in cooperation of our partner, RVA, and the Port Authority to establish the Metering Coordination Center (MCC). Sensis proposes to make use of the conference room adjacent to the Port Authority Operations Command Center (OCC) located in Building 145. Due to its proximity to the Command Center, his space provides an ideal location for the MCC.

Pending a site survey, it is expected that Sensis will furnish and install equipment and furniture necessary to create three working positions. Per Figure 8 below, the MCC would include one workstation for the SMS Operator, one for the SMS IROPs Operator, and one spare position. There will be an office for the SMS Manager and a space for local Sensis Team computer access. In addition to the working positions, a large screen monitor for surface situational awareness will be installed.

The MCC will have physically diverse redundant connections to the Aerobahn SMS, one via the MPLS network and one via a dedicated site-to-site VPN connection over the Internet.

It is anticipated that parking for the MCC staff would be provided by the Port Authority at Building 145.

Figure 8 Proposed Metering Coordination Center (MCC) Layout



Equipment List
3 Aerobahn Client Computers (Pretty Powerful, can drive 3 monitors)
1 Aerobahn Client Computer to drive 42" HD Display
1 Workstation to support RVA/Sensis network access(?)

10 19-22" Widescreen Monitors
1 42" HD Monitor
7 Phones (+ lines)
1 Laptop Docking Station
4 Keyboards
4 Lamps (So room can be dim)
4 Desk Chairs
4 6' Desks
1 Whiteboard
1 Coat Rack
2 Wastebaskets
2 2811 Routers
2 Network Switches (?)
Network Cables
Cabinet/Panel to hold Network/Comm equipment

Note: Cubicle and equipment inside supplied by RVA

1.5.3 Aerobahn SMS Client Machine Specifications

In order for the Port Authority to use the Aerobahn SMS Service, the Port Authority (or its designated users) will be responsible for providing the workstations that the clients will use to access and use the service. Sensis has identified three functional groups of users that require different client PC specifications. Sensis offers the requirements for the client PC's under the assumption that the PC is primarily used to run Aerobahn. If other demanding programs are in use on the PC, then more processing power, memory or hard disk space may be required. The three tiers of client are described with the Client PC requirements for each tier following.

1.5.3.1 Client PC Function Tiers

Sensis has identified three functional tiers of users of the Aerobahn SMS Service.

- **Tier I:** Users that only require basic surface situational awareness. These users will be running the TaxiView Map Display function exclusively and will be using Dynamic Rules and alerting functions and OpsView reporting functions minimally if at all.
- **Tier II:** Many users will fall into this category. These are users that will be leveraging the surface situational awareness of Tier I users, but will also be using a moderate number of Dynamic Rules and Alerts with some visual actions on the display. These users may also run simple reports for limited time periods (e.g. yesterday).
- **Tier III:** This is the group of power users. These users are utilizing all of the capabilities of the service, and are using them in powerful ways. This would include situational awareness of both the surface and the surrounding airspace, significant numbers of alerts and rules, and larger more complicated reports. Typically this would be a smaller number of users such as the Ramp Controllers or Data Analysts.

1.5.3.2 Client PC Tiered Specifications

The Client PC requirements common to all of the User Tiers described in the preceding section are provided in Figure 9 and Figure 10.

Figure 9 User Common PC Requirements

Hard Disk	1 GB Available Space
Mouse	Scroll Wheel Mouse
Display	Minimum Resolution of 1280x1024

Figure 10 User Common Software Requirements

Java Runtime Environment (JRE)	1.6.0_11 or Higher Cache set to 1000 MB
Internet Browser	Must support required JRE Cookies, JavaScript, Pop-Ups Enabled Set to NOT re-use windows Open Links in New Windows (If Tabbed Browsing Capable)
Third Party Software	Pop-Ups Enabled on any blocking toolbars and software

The Client PC requirements that are specific to each User Tier are specified in Figure 11.

Figure 11 User Tier PC Requirements

	Tier I	Tier II	Tier III
Processor	Intel Pentium 4 2 GHz or comparable	Intel Core 2, or AMD Dual Core Processor	Intel Core i5-2400, or AMD Phenom™ II X4 945
Memory	2 GB	4 GB	8 GB
Operating System	Windows XP SP 2 Windows Vista Windows 7	Windows XP SP 2 Windows Vista Windows 7	Windows 7, 64-Bit

1.6 Technical Customer Service Experience

- *Describe technical customer services experience and capabilities*

Sensis has a separate Customer Service organization where any User can contact Sensis 24 hours per day, 7 days per week, 365 days per year (24x7). This dedicated team of professionals maintains thousands pieces of equipment deployed around the globe and stands ready to ensure optimum Aerobahn JFK Service performance and availability by:

- Quickly determining the severity of an issue and marshal the appropriate Sensis resource quickly and consistently;
- Acting as a single point of contact for all Users;
- Logging, tracking, and communicating the status of all problem resolution efforts;
- Providing information about how to use functions/features; and
- Capturing User suggestions for new features and sharing them with the Aerobahn Product Team.

1.6.1 Getting Assistance

Sensis Customer Service is available 24x7 via telephone or email. Telephone contacts are answered upon receipt and e-mail contacts are acknowledged within one business day. Typical Customer Service Requests many include;

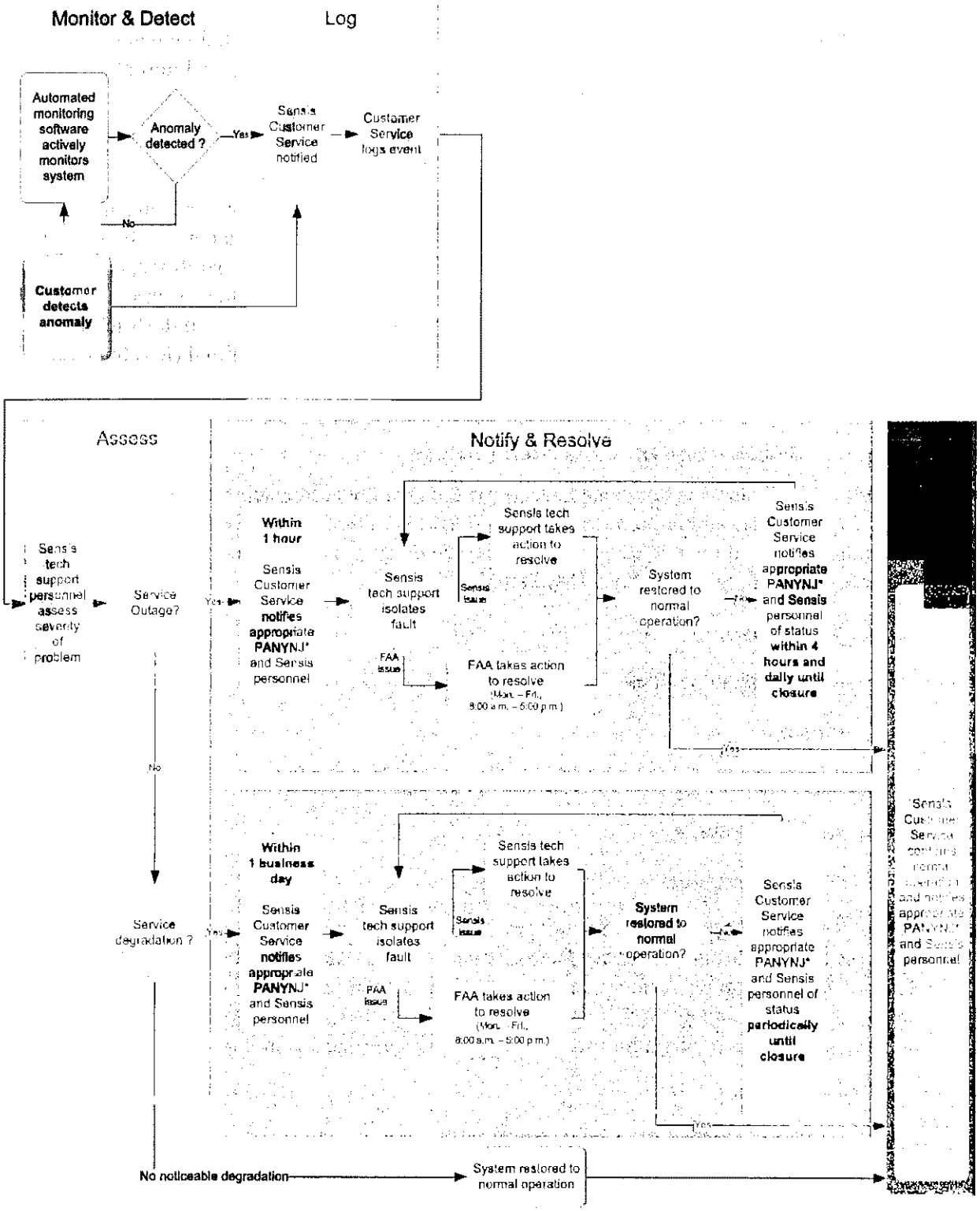
- Report a Service outage;
- Report a Service degradation;

- Inquire about Aerobahn functions and features, or
- Suggest new Aerobahn features.

1.6.2 Reporting and Tracking Service Anomalies

Sensis will capitalize on its existing proven process to promptly respond to Aerobahn SMS Service User requests for support. This process, described in Figure 12, seeks to maintain accurate, timely communications between Sensis and authorized Users. When an anomaly has been identified, Sensis Customer Service uses a Customer Problem Report (CPR) as its primary method for recording all Customer contacts. All issues and requests for assistance are assigned a CPR number and are reviewed in detail by the Product Team on a regular basis, until there is concurrence that the issue is closed. A report of an Aerobahn Service outage is given the highest priority and work immediately commences to restore Service. A report of any Aerobahn Service degradation is assigned to the appropriate technical resource within one business day.

Figure 12 Process for Reporting and Tracking Problems



* PANYNJ can be PANYNJ personnel or authorized sub-licensees.

1.6.3 Disaster Recovery

Sensis has a robust strategy to ensure continuity of service in the unlikely event of a disaster. The strategy entails having Two Data Centers and Data Center Internal Redundancy.

1.6.3.1 Two Data Centers

We are deploying two geographically diverse Data Centers, each of which can support the running of the entire service. The two Data Centers both contain a copy of hardware, software and data supporting the Aerobahn Service. During normal operations, all changes and data in the primary Data Center are kept within 15 minutes or less of the secondary Data Center. The cut over from the primary Data Center due to destruction involves a 15 minute or less cut over of services. There will be a minimal (less than 15 minute) loss of historical data.

1.6.3.2 Data Center Internal Redundancy

In each Data Center, the hardware and network communications are built to be fully redundant, with no single points of failure. In the event that a Data Center internal component fails, there will be no outage of service and the component can be fixed and replaced without service outage. This includes:

- VPN connections
- communications lines
- routers
- switches
- storage resources
- compute resources

In the event that the primary Data Center is destroyed, communications will be redirected from the primary to the secondary Data Center using Border Gateway Protocol (BGP). This switchover can be achieved in an automated fashion and results in less than a minute or two of service outage. At that time, work will begin to reconstruct the primary Data Center, while the Aerobahn Services are delivered from the secondary.

1.7 Quality and Standard Operating Procedures (SOPs)

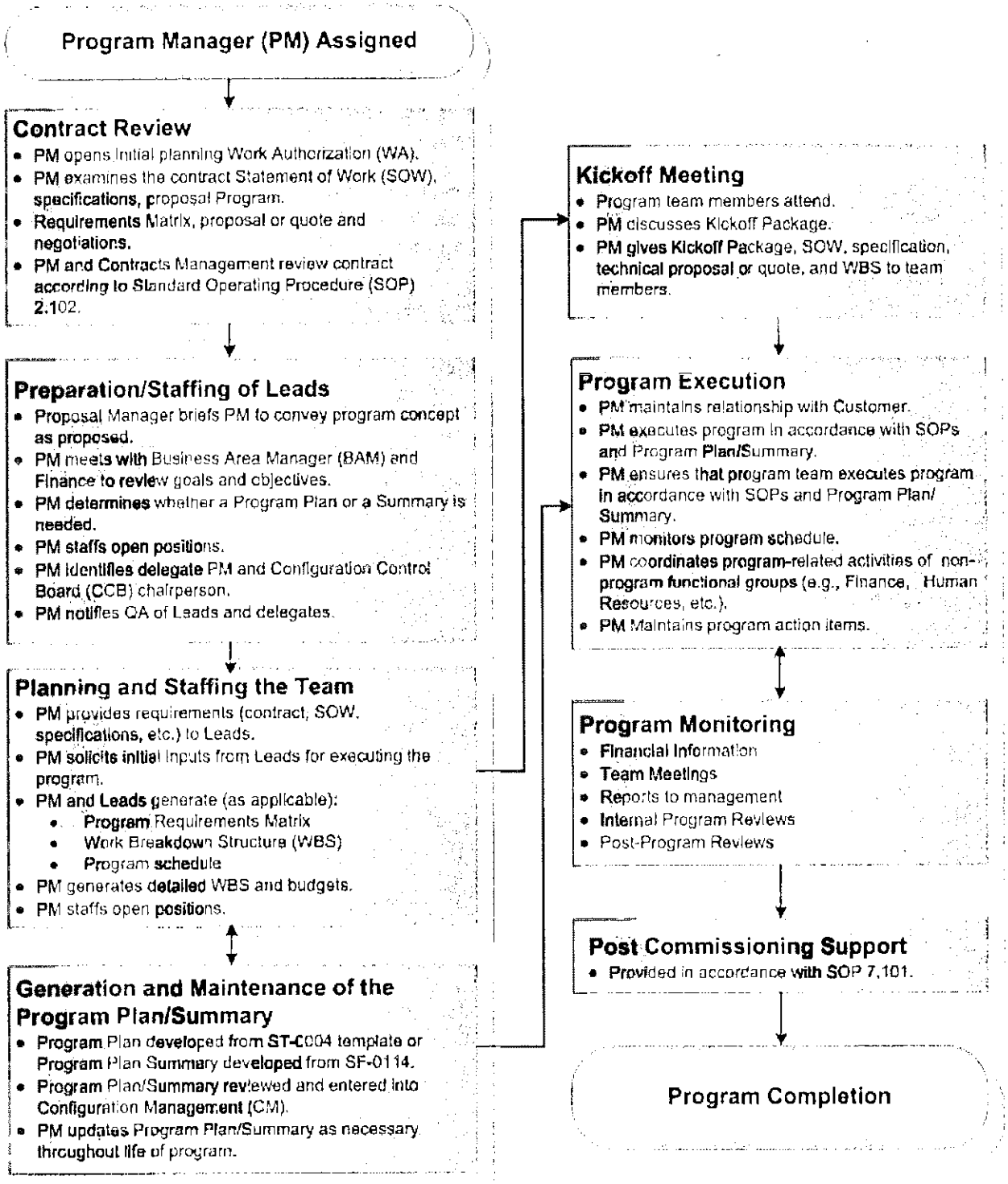
1.7.1 Proven Program Management Process

The Sensis Program Management Process is created and executed in accordance with ISO-9001:2000 Standards.

The Sensis Standard Operating Procedures (SOPs) for Program Management provide detailed processes for Project Estimating, Project Planning, Monitoring and Control, Risk Management, Decision Making, and Project Closure. Aside from monitoring the cost, schedule, and technical goals of the project, the Program Manager oversees the project execution. The project is executed in accordance with all other Sensis policies and procedures – such as those that define document reviews, technical reviews, test conduct, configuration management, and quality assurance.

The Sensis Program Management process is illustrated in Figure 13.

Figure 13 ISO 9001:2000 approved Program Management Process



A full complement of associated SOPs, forms, and templates support this process and are shown in Figure 14. These items provide detailed guidance and control for the Program Manager and ensure a comprehensive and consistent approach to managing projects.

Figure 14 Supporting SOPs, Templates and Forms ensure consistency in approach

Item		Description
SOPs	1.203	Deviation and Waiver
	1.302	Configuration Item Releases and Change Control
	1.303	Receipt and Delivery of Configuration Items
	1.701	Employee Training and Certification
	2.101	ROMs, Quotes and Proposals
	2.102	Contract Review
	3.101	Project Management
	4.101	Design Control
	4.102	Technical Reviews
	4.103	Test
	5.101	Purchasing Process
	5.201	Control of Customer Property
	5.301	Handling, Storage, Packaging, Preservation and Delivery
	6.103	Installation and Servicing Process Control
	6.501	Control of Inspection, Measuring, and Test Equipment
	7.101	Customer Service
Templates	0004	Program Plan
	0017	WBS Template
	0018	Internal Program Review (IPR) Template
	0020	Program Kickoff Package Template
	0021	Program Requirements Matrix Template
Forms	0052	Work Authorization
	0109	Proposal/Program Manager Checklist
	0114	Program Plan Summary

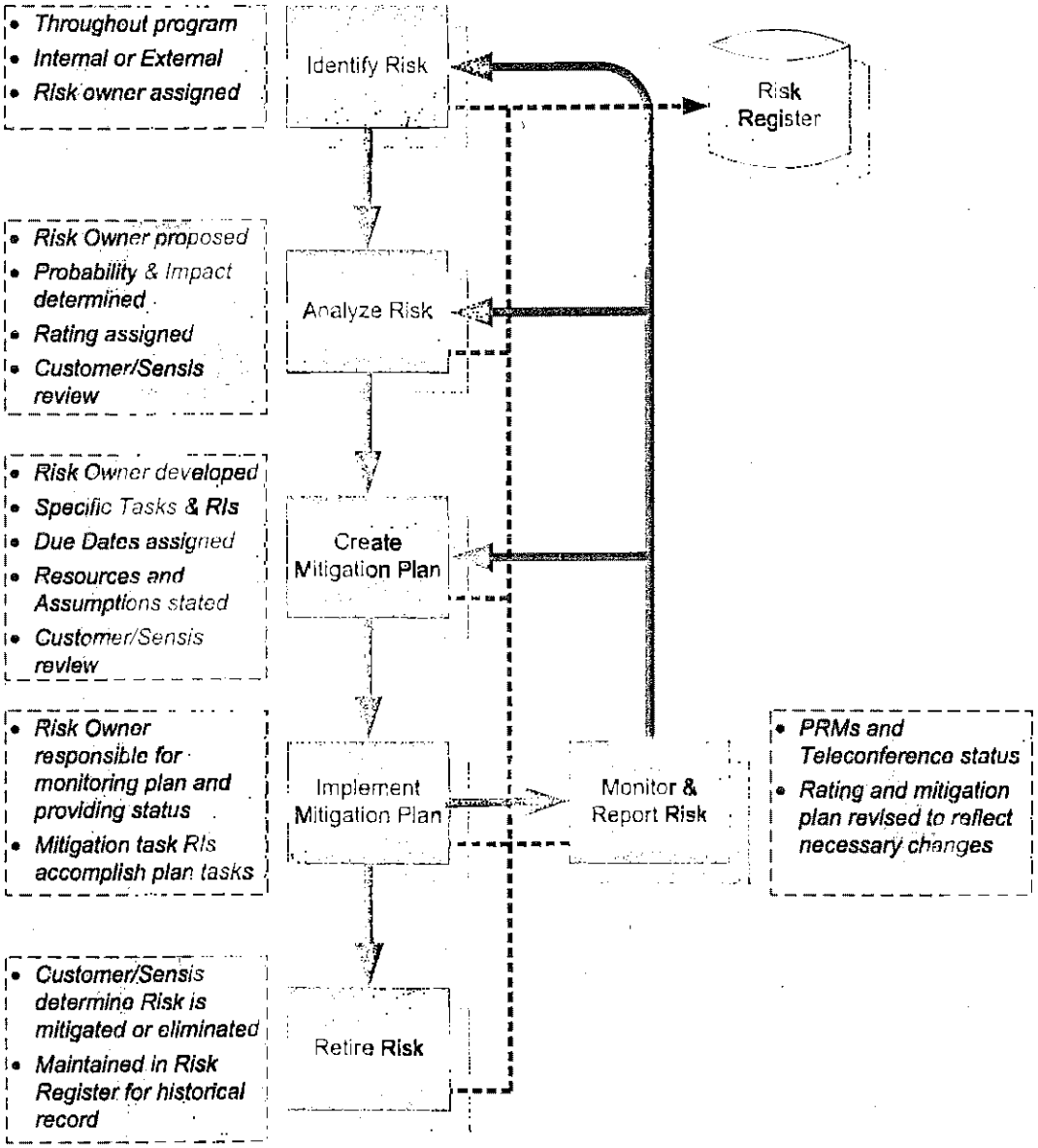
1.7.2 Risk Management

Managing risk is an integral part of the Sensis ISO-9001:2008 compliant project management process.

Sensis has a proven risk management process and uses established techniques and tools to identify risks. This process defines how risks are identified and assessed, as well as how mitigation strategies are developed. The Sensis Risk Management process ensures that all aspects of the program, from design to site selection to training, are performed in a way that minimizes risk.

The Sensis Risk Management process is illustrated in Figure 15.

Figure 15 Risk Management Process



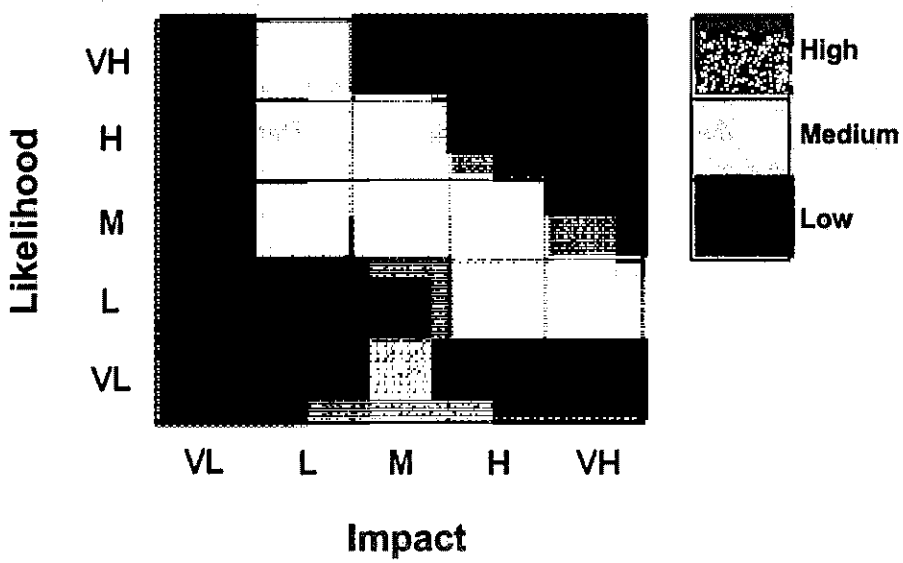
The entire project team, including the customer, plays a role in identifying and managing risks. The Risk Register is reviewed regularly during Team Meetings, Project Review Meetings, and Sensis Management Project Reviews.

An analysis of each risk is performed regarding the likelihood of the risk being realized and the potential impact the risk may have on the project. Both the likelihood and the impact are assigned one of the following ratings:

- **(VL) Very Low**
  - Likelihood: Normal processes will prevent this risk from being realized
  - Impact: Minimal impact on project
- **(L) Low**
  - Likelihood: Normal processes will usually mitigate this risk
  - Impact: Minor impact on project
- **(M) Medium**
  - Likelihood: Normal processes may mitigate, but work around should be identified.
  - Impact: moderate performance shortfall, or minor schedule slip, minor affect on project budget
- **(H) High**
  - Likelihood: Normal Processes will not mitigate this risk, a different approach will be required.
  - Impact: Unacceptable performance, critical path affected, moderate impact on project budget
- **(VH) Very High**
  - Likelihood: Processes cannot mitigate, no known workaround is available.
  - Impact: Unacceptable performance, milestone cannot be achieved, major affect on project budget.

Together, the Likelihood and Impact are used to analyze the criticality or priority of the risk. The risk can then be plotted on a summary chart as shown in Figure 16.

Figure 16 Example Risk Summary



The Sensis risk mitigation process allows Sensis and its customers to fully identify, plan for, monitor, and successfully mitigate any project risks that may be encountered.

1.7.3 Quality Control and Configuration Management

Configuration management planning is an integral part of overall project planning. Please refer to the Quality and Configuration Management processes and draft plans for more detailed descriptions.

1.7.4 Subcontractor/Supplier Management

Sensis maintains a robust subcontractor/supplier management process that ensures only qualified suppliers are included on the Approved Supplier List. All suppliers are evaluated and rated prior to inclusion on the Approved Supplier List. Purchased material quality requirements are documented on Purchase Orders, and receiving and incoming inspections performed as appropriate to ensure the receipt of quality material and products from suppliers. Sensis employs a dedicated Supplier Management Specialist who is responsible for ensuring suppliers are qualified based on the material, products or services being provided, meet the intent of the quality system requirements, as well as administration of a proactive surveillance program that monitors quality and performance of all suppliers.

1.7.5 Total Quality Management

1.7.5.1 Project Total Quality Management Plan

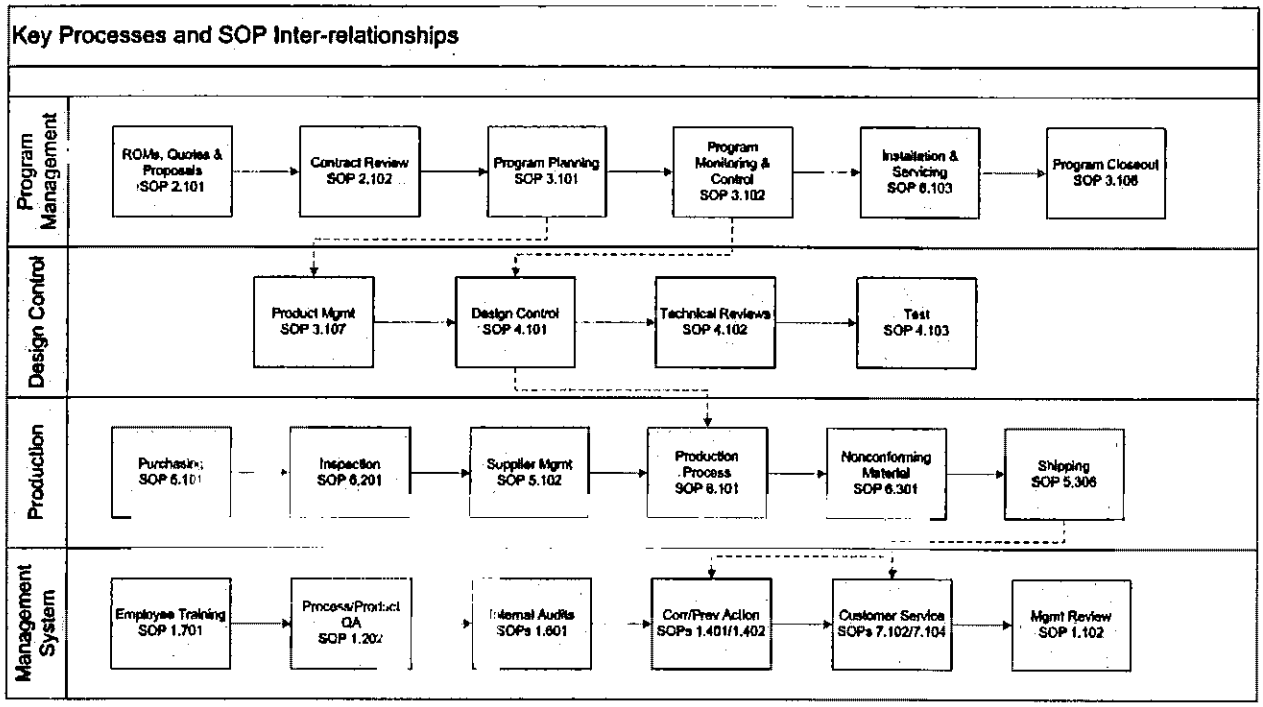
Sensis' proven and third-party certified Quality Management System (QMS) is the foundation for all programs and product development efforts. The QMS is governed by the Quality Manual which is reviewed and approved by Senior Management, including the President and CEO of the company.

This section provides an overview of the quality program, and specific quality activities are planned and documented in the attached Quality Control Plan.

1.7.5.2 Key Process Areas

Quality system activities are planned during the initial program planning stage and address all aspects of program execution, product development, production, product support and services. Figure 17 depicts the key process areas and associated Standard Operating Procedures (SOPs) that comprise the QMS. These key process areas are supported by additional SOPs and work instructions as described in the Quality Manual, and tailored to address program specific requirements in the program Quality Plan.

Figure 17 Key Process Areas



1.7.5.2.1 Detailed Planning and Design Control

Sensis program planning and design control processes ensure that all pertinent design and development activities are planned, documented and completed. Production and manufacturing program managers are involved in the design control activities as appropriate to ensure a smooth transition to production.

QA provides the necessary oversight and performs product and process evaluations as appropriate to ensure all planned design and development activities are conducted in a timely manner and in compliance with Standard Operating Procedures (SOPs). Specific QA evaluations are detailed in the Quality Plan for the program. Sensis' software development methodologies are based on the requirements of *ISO 12207 – Software life cycle processes* which provides a thorough and detailed software development, inspection, review and test process. Software specific design and development activities are integrated in the overall design control plan.

1.7.5.3 ISO 9001:2000 Certified

Sensis maintains a third party certification to ISO 9001:2008 and has been certified to ISO 9001 since 1999. Figure 18 provides a copy of the Sensis Corporation ISO 9001:2008 certificate.

Figure 18 ISO 9001:2008 Certification

CERTIFICATE

TÜV

TUV Rheinland of North America, Inc.
12 Commerce Road, Newtown, CT 06470

Hereby certifies that

Sensis Corporation

5717 Enterprise Parkway
East Syracuse, NY 13057

85 Collamer Crossing
East Syracuse, NY 13057

has established and applies a quality management system for the

Design, Manufacture and Servicing of Hardware and Software for Sensor and Information Systems.

An audit was performed and documented in Report No. 3295.
Proof has been furnished that the requirements according to

ISO 9001:2008

are fulfilled. Further clarification regarding the scope of this certificate and the applicability of ISO 9001:2008 requirements may be obtained by contacting TRNA.

Certificate Registration No.

74 300 3295

Original Certification Date:
December 22, 2009

Certificate Validity Date:
December 22, 2009

Certificate Modification Date:
N/A

Certificate Expiration Date:
December 21, 2012

ANAB ACCREDITED

Richard Bernier
Certification of Management Systems

1.7.5.4 Changes in Certification Status

Sensis is responsible for communicating any changes in ISO certification status to the Customer via the Sensis Program Manager and/or Contracting Office.

1.7.5.5 Subcontractor/Supplier Management

Sensis maintains a robust subcontractor/supplier management process that ensures only qualified suppliers are included on the Approved Supplier List. All suppliers are evaluated and rated prior to inclusion on the Approved Supplier List. Purchased material quality requirements are documented on Purchase Orders, and receiving and incoming inspections performed as appropriate to ensure the receipt of quality material and products from suppliers. Sensis employs a dedicated Supplier Management Specialist who is responsible for ensuring suppliers are qualified based on the material, products or services being provided, meet the intent of the quality system requirements, as well as administration of a proactive surveillance program that monitors quality and performance of all suppliers.

1.7.5.6 Audits and Customer Surveillance

Internal process and product evaluations/audits are documented in the program specific Quality Plan. Process and product evaluations are performed to assure that approved processes are implemented and potential problems are identified early. The early identification of potential problems or trends facilitates timely risk mitigation strategies. Records of quality evaluations provide insight into the maturity of the design and development products. During the life of the program, quality records provide the assurance that prescribed industry practices are adhered to in producing products within cost and schedule requirements.

Customer audits and inspections are supported as required by contract, including system, process and/or product audits.

1.8 Attachment G: Certified Environmentally Preferable Products/Practices Form

- *The Proposer's Certified Environmentally Preferable Products/Practices Form ensuring compliance with all applicable federal, state and local standards in their business practices, in accordance with the Certified Environmentally Preferable Products/Practices Provision*

Please refer to Appendix - Attachment G - Certified Environmentally Products Practices.

Table of Contents

1. DANIEL H. LONDON – PRINCIPLE IN CHARGE 1
2. HOWARD J. KING III – CONTRACT MANAGER 2
3. GLENN GABRIELE – SMS MANAGER 3
4. DAVID PAGUAGA – SMS OPERATOR LEAD 6
5. GREGORY BERKEBILE – PROJECT TECHNICAL LEAD 8
6. DR. GEORGE HUNTER, SENIOR SCIENTIST 10
7. DR. BENJAMIN LEVY, SMS RESEARCHER 13
8. DR. ADITYA SARAF, SMS RESEARCHER 15
9. DR. STEVEN STROINEY, SMS RESEARCHER 18

1. Daniel H. London – Principle in Charge

Daniel H. London
Director, Airline and Airport Automation

Summary:

- 27 years of Experience in the Aviation industry including
- Managing Director- Chicago O'Hare Hub
- Managing Director - Ramp Operations Planning
- Cargo Sales and Service, Call Center Planning, M&A Integration
- 10 Years International Operations, Sales and Business Management

Education:

Bachelor of Arts- Economics

University of California - Davis

Project Experience:

- Responsible for the Airline and Airport Automation business Segment and all Aerobahn installations
  - JFK International Airport (JFK) - Port Authority New York / New Jersey
  - JFK International Airport (JFK) - Delta Airlines
  - Detroit International Airport (DTW) – Delta Airlines
  - Minneapolis International Airport (MSP) – Delta Airlines
  - Newark International Airport (EWR) – Continental Airlines
  - George Bush International Airport (IAH) - Continental Airlines
  - Philadelphia International Airport (PHL) – US Airways
  - Charlotte International Airport (CLT) – US Airways
  - Hartsfield Jackson International (ATL) Airport – City of Atlanta
  - JFK International Airport (JFK) and Memphis International Airport (MEM) - FAA
  - Seattle International Airport (SEA) – Port of Seattle
  - Charles De Gaulle Airport (CDG) – DSNA Direction des Services de la Navigation Aérienne
  - Orly International Airport (ORY) – DSNA Direction des Services de la Navigation Aérienne
  - Sydney International Airport (SYD) – Airservices Australia
  - Melbourne International Airport (MEL) – Airservices Australia
  - Brisbane International Airport (BNE) – Airservices Australia
  - Perth International Airport (PER) – Airservices Australia
  - Hong Kong International Airport (HKG) – HKIA - Hong Kong International Airport

2. Howard J. King III – Contract Manager

Howard J. King III
Senior Program Manager, Airport Automation

Education:

Bachelor of Science Business Administration,

Columbia College

Summary:

- 25 years of program and project management, system installation, service implementation and training experience in the military and aviation fields.
- 16 years experience in program management, overall responsibility for all aspects of implementation efforts to ensure that the Service is deployed on schedule.
- 9 years experience of management, implementation and technical training experience in the logistics and product support field
- Developed and conducted numerous training courses to MIL and ISD standards

Program Experience:

- Program manager for a number of Sensis Air Traffic Systems (ATS) Division Aerobahn programs, including:
  - Installation of surveillance system and implementation of Aerobahn at Houston George Bush International Airport (IAH) for Continental Airlines
  - Installation of surveillance system and implementation of Aerobahn at Newark International Airport (EWR) for Continental Airlines
  - Implementation of Aerobahn service at John F. Kennedy International Airport (JFK) for the Aviation Development Council/Port Authority of New York and New Jersey
  - Installation of surveillance system and implementation of Aerobahn at Hartsfield-Jackson Atlanta International Airport (ATL) for City of Atlanta Department of Aviation (DOA)
  - Currently in the process of installing a gate augmentation surveillance system and implementing of Aerobahn at Denver International Airport (DIA) for the City and County of Denver

3. Glenn Gabriele – SMS Manager

Glenn Gabriele
Business Development Manager, Sensis Corporation

Education:

Bachelor of Science, Aviation Technology,
Letourneau University, 1991

Associate of Science, Independent Studies in Science,
Columbia-Greene C.C., 1987

High School Diploma,
Catskill High School, Catskill, NY, 1986

Licenses / Certifications:

Airline Transport Pilot Certificate

Certified Flight Instructor/Instrument

Certified Advanced & Instrument Ground Instructor

Airframe & Powerplant Technician Certificate

Summary:

- One and one half years as Account Manager for multiple Aerobahn SMS service-based programs.
- Three and a half years of technical training design, development and delivery. Management of numerous programs with varying requirement, skill and documentation levels.
- Three years dedicated to FAA programs.
- Over 15 years of experience in the aviation industry in the operational environment, communicating with and managing various airport stakeholders. More than 8 years of commercial airline experience in daily aircraft line operations and classroom training.
- Over 8 years of experience in adult education and professional training environments.

Relevant Experience:

Sensis Corporation, East Syracuse NY, (2005 – Present)

- **Business Development Manager –** (2010-2011) Responsible for managing and cultivating Aerobahn SMS accounts with multiple airport and airline stakeholders. Developing an understanding of the problems and issues experienced in the airport environment that airport, airline and FAA stakeholders are dealing with in order to develop solutions to address them. Assisting these stakeholders in the use of tools and solutions to mitigate congestion, delays and excessive fuel burn through a better understanding of the overall airport and air traffic situation and flow. Managing program personnel to meet the requirements, needs and schedule for each contract that the company holds with a customer.
- **Technical Training Specialist/Lead – (2005-2010)** Responsible for project estimation, program training execution and personnel management; cultivate positive and beneficial customer relations; and ensure schedule and program milestones are achieved.

  - Developed and delivered operator training to Air Traffic Controllers (ATC) from New Delhi, India on Sensis A-SMGCS.
  - Updated and modified the A-SMGCS and ASDE-X Course Design Guides to reflect the evolution of the system.
  - Continue to update and revise A-SMGCS training materials as the system upgrades are

implemented.

- Delivered A-SMGCS operator training to Air Traffic Control (ATC) onsite in Hong Kong and Australia.
- Developed a working relationship with the FAA National ATC Training Cadre and trained them in the operational use of the FAA Airport Surface Detection Equipment – Model X (ASDE-X). Supported the Cadre in training and updating the ASDE-X Air Traffic Training materials through numerous system baselines.
- Updated and delivered Aerobahn User and Maint & SysAdmin courses to numerous customers.
- Delivered Aerobahn User training to Airline Operations personnel.
- Developed and delivered factory and on-site ASDE-X TO delta training supplements.
- Delivered ASDE-X TO Core Course factory training to FAA site technicians.
- Designed, developed and delivered WAM TO Maintenance course.
- Conducted successful Operational Tryout and First Course Conduct.

MidAtlantic Airways, a division of USAirways, Inc., Crystal City, VA. (2004-2005)

- **Airline First Officer:** Performed the duties required to support the captain in the safe and efficient operation of an aircraft in daily, passenger carrying, airline service. Ensured compliance with company and FAA mandated regulations and safety procedures, as well as company standard operating procedures for efficient and profitable operation.

Allegheny Airlines, Inc., Middletown, PA (1998-2004)

- **Airline Captain, First Officer, Recurrent Ground Instructor:** Performed the leadership duties and functions of the Captain, managing an airline crew and aircraft while completing safe, efficient, daily operations. Trained professional pilots, in a corporate setting, on FAA regulations, company standard operating procedures and safety precautions and procedures. Provided professional analysis of training program.

Valet Air Services, Inc., Burlington, VT (1998)

- **Charter Captain, A&P Mechanic:** Performed the duties required of a captain, including planning, flying, and concluding flights safely and efficiently on passenger and cargo flights. Performed various maintenance functions in compliance with FAA regulatory and safety requirements.

Rig-All, Inc., Utica , NY (1994-1998)

- **Operating Engineer:** Operated varying heavy equipment in multiple locations and businesses. Responsible for rigging and millwright duties in support of crane operations. Planned and completed assignments in a timely and efficient manner.

Cooperstown-Westville Airport, Cooperstown, NY (1994)

- **Flight Instructor, A&P Mechanic:** Instructed students in a non-structured environment, conducted flight reviews and evaluations of pilots and their skills. Performed the duties required to maintain an aircraft, complying with FAA mandated regulations and safety procedures.

LeTourneau University - Longview, TX (1991-1993)

- **Flight Instructor:** Instructed primary, advanced, instrument, and Certified Flight Instructor students in all aspects pertaining to the safe handling of an aircraft, compliance with FAA regulations and safety procedures. Maintained classroom and in-flight instruction in the rigorous

schedule of a university setting. Conducted flight reviews, and evaluations of pilots and their skills.

4. David Paguaga – SMS Operator Lead

Work experience

06/1975- 06/1979 US Navy
Electrician's Mate, USS Recovery (ARS 43)
• Maintained electrical system on ship. Ended tour as Electrical Division Lead Petty Officer

11/1979-02/1982 Federal Aviation Administration
Maintenance Mechanic, JFK Airport
• Installed, maintained and certified visual landing aids (ALSF, VASI and LDIN), standby power and air conditioning systems

02/1982 – 09/1986 Federal Aviation Administration
Air Traffic Controller, JFK Tower
• Certified to Full Performance Level Controller in 14 months (average 30 months). Served on Facility Advisory Board.

09/1986 – 06/1989 Federal Aviation Administration
Air Traffic Controller, New York TRACON
• Certified to Full Performance Level Controller in the Newark area in 8 months. This was the busiest and most complex area in N90.

06-1989 – 09/1992 Federal Aviation Administration
Traffic Management Coordinator, New York TRACON
• Managed traffic flows and made tactical decisions for the New York Metropolitan area.

09/1992 – 07/2005 Federal Aviation Administration
Operations Supervisor, JFK Tower
• Provided watch supervision and collateral duty of tower's STMC. Nominated Eastern Region Supervisor of the year in 2003 for level 9-10 towers. Served on facility Quality Through Partnership for 6 years. Tower SUPCOM representative for 4 years.

07/2005 – present Federal Aviation Administration
Operations Manager, JFK Tower
• Oversaw daily operations at the airport. Represented JFK Tower at local CDM meetings. Local FAA lead in developing plans to mitigate the 2007 35 percent traffic increase and subsequent delays working collaboratively with airport authority and airline customers. Designed alternate runway configurations and local controller training to maximize capacity and lessen the delay impacts during a 4 month closure of runway 13R/31L.

Awards received	1978 Sailor of the Year, USS Recovery
	14 Letters of Commendation
	12 Outstanding Performance Ratings
	2 Quality Within Grade Pay Increases
	2 Meritorious Achievement Awards
	2010 Eastern Region Award for Excellence in Innovation
Education	2003 Brooklyn College B.A. Political Science – Magna Cum Laude

5. Gregory Berkebile – Project Technical Lead

Gregory Berkebile

Project Technical Lead

Education:

BS in Electrical Engineering / 1987 / Pennsylvania State University

MS in Electrical Engineering / 1991 / Stevens Institute of Technology

Summary:

- Over 20 years experience in Airport Surface Management, Radar and Communication Systems technology.
- Thorough understanding of all aspects system engineering, software development and test engineering.
- Proven ability to communicate effectively in diverse environments through frequent interaction with military, civil service and contractor personnel.
- Vast experience in technical writing of whitepapers and product documentation.
- Capable of handling multiple projects concurrently.

Project Experience:

- Product Development Manager for the Airport and Airline Automation (AAA) business area within the Air Traffic Systems (ATS) Division Responsible for:
  - Managing all aspects of new Development for products and programs within AAA including Aerobahn Version 3, 4, 5 and 6 releases.
  - Defining and reviewing system solution architectures for AAA customers
  - Product architectures for the AAA products, leading proposal efforts
  - Writing and reviewing design specifications, performing systems analysis
  - Defining and developing product roadmaps
  - Providing mentoring for AAA systems and test engineers
- Technical Lead for the Data Products and Programs (DPP) business area within the Air Traffic Systems (ATS) Division. Responsible for:
  - Defining and reviewing system solution architectures for DPP customers
  - Product architectures for the DPP products, leading proposal efforts
  - Writing and reviewing design specifications, performing systems analysis
  - Defining and developing product roadmaps
  - Procuring necessary resources for DPP systems and test activities

  - Providing mentoring for DPP systems and test engineers

- Technical lead for the Radar Target Data Extractor (TDX) product family. Responsibilities included writing technical proposal and design specifications, leading team in implementing contract and IR&D efforts, performing as the primary technical customer interface, performing system performance analysis and testing coverage analysis, and assisting team in developing new tests for existing and new functionality. Responsible for:

  - The development and integration of significant improvements to the TDX-2000 product resulting in greater performance and stability for the FAA and other customers. Worked in convincing the FAA to change their method of remote interfacing with the TDX-2000 resulting in more capability for the FAA and increased business for Sensis.

  - The technical leadership during the capture process from inception through proposal of the DWID program resulting in $1 M contract win. Executed the project successfully despite a very demanding customer in excess of anticipated margin.

  - The building of the TDX development team that was stable and very capable which resulted in better and more consistent performance. This has resulted in higher margins and faster project completion.

- Wrote the real-time processor software for the Weather Extractor (WEX) processor program on the TDX program. Performed the integration, testing and installation of the TDX weather processor. Performed modifications to all of the real time processor programs in the TDX to fix bugs and to develop new functions and algorithms.

- Worked on the TGRES program simulating and analyzing the ARSR-4 signal processing. Wrote new functions for TGRES and identified methods to improve the ARSR-4 processing using this analysis program.

6. Dr. George Hunter, Senior Scientist

EDUCATION

Ph.D., Biophysics and Computational Biology, University of Illinois, 2001

M.S., Aerospace Engineering, University of Michigan, 1982

B.S., Aerospace Engineering, University of Michigan, 1980

PROFESSIONAL EXPERIENCE

Dr. Hunter has over 40 conference and journal publications and has established his expertise in non linear systems analysis and optimal estimation with applications in trajectory prediction, weather-ATM integration, and traffic flow management research.

Dr. Hunter's current research includes evaluating the strategic prediction of airport capacities and demand, derivation and evaluation of market-based traffic flow management concepts that can enable more efficient planning incorporating airline flight priorities, integrating meteorological data into air traffic management, extension of SMS ETA predictions to include en route trajectory predictions as well as integration of NOWrad weather, METAR, and TAF data, decision support tool trajectory prediction, and evolution and performance of the National Airspace System, including the future NextGen system. Specific topics of research he directs include: trajectory modeling and simulation and evaluation of the importance of trajectory prediction errors in future decision support tools, the benefits assessment of Collaborative Air Traffic Management concepts, evaluation of the potential for user gaming of the NextGen system, probabilistic traffic flow management decision making, analysis and modeling of the impact of weather on the NAS, and the design and development of NAS decision support tools.

In his recent market-based traffic flow management research with Dr. Karla Hoffman and Frank Berardino, Dr. Hunter has analyzed the performance of traffic flow management approaches including both current day rationing approaches such as Ration-By-Schedule (RBS) as well as future "permit-based" concepts that enable airlines to explicitly provide their dynamic flight priorities.

POSITION SUMMARY

Sensis Corporation STC., Campbell, CA — **4/01–present**

Senior Scientist

University of Illinois., Urbana, IL — **8/98–4/01**

Graduate Student

Seagull Technology, Inc., Los Gatos, CA — **5/90–5/98**

Senior Scientist

TRW, Inc., Sunnyvale, CA — **8/84-5/90**

Senior Investigator

Lockheed Missiles & Space Corp., Sunnyvale, CA **6/82 -6/84**

Senior Investigator

RECENT AND RELEVANT PUBLICATIONS

Saraf, Aditya, Ramamoorthy, Kris, Hunter, George C., Escala, Diego, "Preliminary Results from the Comparison of TFM Optimization Technique Outputs with Traffic Management Initiatives and Sensitivity Analyses," Accepted for publication at the 11th *AIAA Aviation Technology, Integration, and Operations Conference (ATIO)*, Virginia Beach, VA, September 201

Hunter, G., Berardino, F., Hoffman, K., et al., "Development and Evaluation of Market-Based Traffic Flow Management Concepts," NASA Project NNX09AB20A, March 2011

Hunter, G., "Probabilistic Forecasting of Airport Capacity," AIAA Digital Avionics Systems Conference (DASC), Orlando, FL, Salt Lake City, UT, October 2010.

Ramamoorthy, K., Berkebile, G., Bodily, B., Boisvert, B., Brown, R., Escala, D., Hunter, G., and Todd Pittman, "Sensis Innovation Research Project: Integrated Aerobahn and Probabilistic NAS Platform System," final presentation, June 15, 2010.

George Hunter, Robert A. Vivona, Carlos Garcia-Avello, "Preliminary Evaluation of Trajectory Prediction Impact on Decision Support Automation," AIAA Digital Avionics Systems Conference (DASC), Orlando, FL, October, 2009.

G. Hunter, K. Ramamoorthy, "Integration of Terminal Area Probabilistic Meteorological Forecasts in NAS-wide Traffic Flow Management Decisionmaking," 13th Conference on Aviation, Range and Aerospace Meteorology, New Orleans, LA, January 2008.

George Hunter, Ben Boisvert, Kris Ramamoorthy, "Advanced Traffic Flow Management Experiments for National Airspace Performance Improvement," 2007 Winter Simulation Conference, Washington, DC, December, 2007.

George Hunter, Kris Ramamoorthy, Alexander Klein, "Modeling and Performance of NAS in Inclement Weather," AIAA Aviation Technology, Integration and Operations (ATIO) Forum, Wichita, KS, September 2006.

George Hunter, Kris Ramamoorthy, Joe Post, "Evaluation of the Future National Airspace System in Heavy Weather," AIAA Aviation Technology, Integration and Operations (ATIO) Forum, Arlington, VA, September 2005.

Hunter, G., "Toward a Standardized Reference Set of Trajectory Modeling Errors," AIAA Modeling and Simulation Conference, Providence, RI, August 2004.

Roth, K., Blake, M., Hunter, G., Couluris, G. and Phillips, J. "National Airspace System Simulation Capturing the Interactions of Air Traffic Management and Flight Trajectories," AIAA Modeling and Simulation Technologies Conference, Austin TX, AIAA-2003-5597, August 2003.

Bortins, R. and Hunter G. "Sensitivity of Air Traffic Control Automation System Performance to Storm Forecast Accuracy," AIAA Guidance, Navigation and Control Conference, Boston, MA, August 1998.

Krozel, J., Weidner, T.J. and Hunter, G. "Terminal Area Guidance Incorporating Heavy Weather," AIAA Guidance, Navigation and Control Conference, New Orleans, LA, August 1997.

Hunter, C.G. and Bortins, R. "Effects of Weather Forecasting Errors on Air Traffic Control Automation System Performance," AIAA Guidance, Navigation and Control Conference, Baltimore, MD, August 1995.

Mei-Mei Shen, George Hunter, "Consistency of FMS Approaches in the Minneapolis-St. Paul TRACON," Seagull Technology TR93118-01, Contract No. DTRS 57-89-C-00044, Seagull Technology, Inc., Sunnyvale, California, August 1993.

Mei-Mei Shen, George Hunter, "Time to Fly in the DFW TRACON," Seagull Technology TR92120-03, Contract No. F19628-85-C-0002, Seagull Technology, Inc., Sunnyvale, California, November 1992.

George Hunter, "Aircraft Flight Dynamics in the Memphis TRACON," Seagull Technology TR92120-01, Contract No. F19628-85-C-0002, Seagull Technology, Inc., Sunnyvale, California, January 1992.

Hunter, G., and Shvarts, A. "Investigation of Wind Field Modeling and Forecasting in ATC Automation," Seagull TM 91112-02, January 1991.

7. Dr. Benjamin Levy, SMS Researcher

EDUCATION

Ph.D., Civil Engineering, University of Maryland, College Park, MD, 1999

M.S., Environmental Sciences, University of Virginia, Charlottesville, VA, 1987

B.A., Geology, Carleton College, Northfield, MN, 1982

PROFESSIONAL EXPERIENCE

Dr. Levy manages the Operations Research (OR) group, which develops prototypes of decision support tools and algorithms for Sensis' airport automation technology products to improve efficiency and safety. The OR group has developed a JFK Departure Manager; a 'machine-learning' system to predict airport taxi-times; a prototype to resolve conflicts between arrival and departure aircraft in airport terminal area alleyways; a system to estimate fuel burn and emissions of taxiing aircraft; algorithms for the measurement and categorization of avoidable and unavoidable sources of surface delay based on surveillance data; and, a system for the detection of safety precursors and the quantification and attribution of delays on the airport surface through the analysis of ASDE-X data. Dr. Levy has over 20 years of experience in engineering, with 11 years in modeling and analysis of air traffic control and management.

Dr. Levy developed algorithms for characterization of aircraft behavior on the airport surface: detection of holding and generation of taxi routes from positional data. He is an expert in characterization of the magnitude and causality of airport surface delays. He is responsible for having won the contract which led to Sensis' development of its JFK Departure Manager prototype for the State of New York's NYSERDA.

POSITION SUMMARY

Advanced Development, Sensis Corporation, East Syracuse, NY — 03/08–present

Manager of Operations Research

Advanced Development, Sensis Corporation, East Syracuse, NY — 02/04–03/08

Senior ATM Research Engineer

MITRE/CAASD, McLean, VA — 01/00–02/04
Senior ATM Research Engineer

RECENT AND RELEVANT PUBLICATIONS

Stroiney, S. and B. Levy, 2011. "Departure Queue Management Benefits Across Many Airports", 11th Integrated Communications, Navigation, and Surveillance (ICNS) Conference, Herndon, VA.

Stroiney, B. Levy, C.J. Knickerbocker, "Departure Management: Savings in Taxi Time, Fuel Burn, and Emissions," 2010 Integrated Communications Navigation and Surveillance (ICNS) Conference.

Levy, B., 2010. "Draft ConOps and Departure Manager Prototype", 10th Integrated Communications, Navigation, and Surveillance (ICNS) Conference, Herndon, VA.

Levy, B., C. Knickerbocker, A. Durston, M. Dong, K. Lewicki, 2010. "Final Report: Managed Gate Operations Algorithm Feasibility Study," Sensis Innovative Research grant, year 2.

Levy, B., C. Knickerbocker, S. Stroiney, and F. Ralbovsky, 2009. "Analysis and Causality of Airport Surface Delays", 28th Digital Avionics Systems Conference (DASC), Orlando, FL.

B. Levy and J. Legge, 2008. "Objective and Automatic Estimation of Excess Taxi-Times", 8th ICNS Conference, Bethesda, MD.

8. Dr. Aditya Saraf, SMS Researcher

EDUCATION

Ph. D., Aerospace Engineering, University of Cincinnati, Cincinnati, Ohio, 2007.

M. S., Aerospace Engineering, University of Cincinnati, Cincinnati, Ohio, 2003.

B.S., Control and Instrumentation Engineering, University of Pune, Pune, India, 2000.

PROFESSIONAL EXPERIENCE

Dr. Saraf has extensive experience in the development and analysis of advanced surface and Air Traffic Management (ATM) concepts, terminal area and airport surface scheduling algorithms, decision support tool development and simulation and Traffic Flow Management (TFM) algorithms integration and validation. At Sensis Corporation, Dr. Saraf has been a key contributor in the areas of algorithm development, modeling, and integration for airport surface and Metroplex operations, and TFM.

Dr. Saraf has been a developer of advanced Metroplex-wide arrival/departure/surface scheduling algorithms and an integrator of them into terminal area traffic simulation systems for multiple research efforts. Dr. Saraf has also analyzed the potential benefits of advanced metroplex scheduling algorithms for departure flows out of multiple New York TRACON airports into common departure fixes. He conducted an assessment of the potential benefits of an ideal metroplex-wide departure planner using a NAS-wide simulation system and high fidelity models of New York area airports and the New York TRACON. Recently, he has developed a model of the Traffic Management Advisor (TMA) to more precisely model potential terminal area scheduling system benefits.

Dr. Saraf led the airport and terminal model development efforts for the System Level Design Analysis and Simulation Tools (SLDAST) research focus area (RFA). Under this project, Dr. Saraf's team developed 60 detailed airport link-node models, and more than 20 fully functioning airport and terminal airspace traffic control models including JFK, LGA, and EWR.

Dr. Saraf was a key contributor to the Sensis Terminal Modeling Enhancement (TME) modeling effort. TME is a significant enhancement to the terminal airspace and airport surface modeling in NASA's Airspace Concepts Evaluation System (ACES) National Airspace System (NAS) simulation. Dr. Saraf led the development of functional designs for arrival/departure scheduling and traffic flow management functionalities for the terminal area and airport simulation.

Dr. Saraf is currently the Principal Investigator for a three year NASA-funded research project focused on Advanced Traffic Flow Management Validation Techniques. This research aims to support NASA by developing and demonstrating techniques and approaches for validating the TFM controls produced by NASA's NextGen TFM algorithms. Dr. Saraf's team has accomplished successful integration of the TFM algorithms into a NAS-wide simulation platform as well as preliminary validation of the optimization algorithm functionality against real-world operations.

During his four-year Ph.D. studies, Dr. Saraf's research involved developing (i) an Artificial Intelligence based optimal, dynamic scheduling algorithm called the Distributed Optimal Scheduling Algorithm (DOSA) for arrivals at congested airports, and (ii) an adaptive Eulerian model for air traffic flows and its application to the computation of optimal Traffic Flow Management (TFM) control strategies.

POSITION SUMMARY

Sensis Corporation, Campbell, CA **10/07–present**

Research Engineer

NASA-Ames Research Center, Moffett Field, CA **10/06–01/07**

Intern

University of Cincinnati, Cincinnati, OH **05/04–09/06 and 02/07–09/07**

Graduate Student

RECENT AND RELEVANT PUBLICATIONS

Saraf, Aditya P., Schleicher, David R., Timar, Sebastian, "Modeling of Traffic Management Advisor Scheduling Capability as a Baseline for the Assessment of NextGen Metroplex Time-based Scheduling Concepts," Accepted for publication at the 11th *AIAA Aviation Technology, Integration, and Operations Conference (ATIO)*, Virginia Beach, VA, September 2011.

Schleicher, David R., Clarke, J-P, Saraf, Aditya,, and Sebastian Timar, "Concept of Operations for a NextGen Metroplex Scheduling Concept," Accepted for publication at the 11th *AIAA Aviation Technology, Integration, and Operations Conference (ATIO)*, Virginia Beach, VA, September 2011.

Saraf, Aditya, Ramamoorthy, Kris, Hunter, George C., Escala, Diego, "Preliminary Results from the Comparison of TFM Optimization Technique Outputs with Traffic Management Initiatives and Sensitivity Analyses," Accepted for publication at the 11th *AIAA Aviation Technology, Integration, and Operations Conference (ATIO)*, Virginia Beach, VA, September 2011.

Saraf, A., Clarke, J-P., McClain, E., "Discussion and Comparison of Metroplex-wide Arrival Scheduling Algorithms," *10th AIAA Aviation Technology, Integration, and Operations Conference (ATIO)*, Fort Worth, Texas, September 13-15, 2010.

Saraf, Aditya, Schleicher, David R., Griffin, Katy, and Peter Yu, "Assessment of the Potential Benefits of an Ideal Integrated Metroplex-wide Departure Planner," *9th AIAA Aviation Technology, Integration, and Operations Conference (ATIO)*, Hilton Head, South Carolina, September 21-23, 2009.

Saraf, Aditya, Schleicher, David, Griffin, Katy, Ashok, Sylvester, Yu, Peter, Bushman, Janae, Cheng, Victor.H.L., and Michael B. Downs, "A Fast and Efficient Method for Generating Detailed Airport and Terminal Area Models to Support National Airspace System Analyses,"

AIAA Modeling and Simulation Technologies Conference and Exhibit, Chicago, Illinois, August 10-13, 2009.

Ren, L., Saraf, A., Thompson, T., Mullick, L., Stefanidis, K., Schleicher, D.R., Lewis., T., Arora, N., Wong, L., Crisp, D.L., and Clarke, J.-P., "Metroplex Operations And The Metroplex Problem: A Literature Review," NASA Metroplex NRA Project Report, Contract No. NNX07AP63A, 1 July 2009.

Timar, Sebastian, Lewis, Taryn Butler, Gutterud, Rich, Ren, Liling, Crisp, Donald L., Saraf, Aditya, Sliney, Ben, Levy, Ben, Rappaport, Dave, Stefanidis, Kostas, Clarke, John-Paul, Thompson, Terry, and Dave Schleicher, "NASA Project NNX07AP63A Characterization of and Concepts for Metroplex Operations: *New York TRACON Site Report*," March 23, 2009.

Saraf, Aditya and Slater, Gary, "Adaptive Eulerian Model for Air Traffic Flow Management," *Journal of Aircraft*, Volume 45, Number 5 (September - October 2008).

Saraf, Aditya and Slater, Gary, "Optimal Dynamic Scheduling of Aircraft Arrivals at Congested Airports," *Journal of Guidance, Control, and Dynamics*, Volume 31, Number 1 (January - February 2008).

Saraf Aditya, "Efficient Algorithms for Optimal Arrival Scheduling and Air Traffic Flow Management," *Doctoral Thesis*, University of Cincinnati, 2007.

9. Dr. Steven Stroiney, SMS Researcher

EDUCATION

Ph.D. & M.S., Physics, Cornell University, 2008

B.S., Physics, Case Western Reserve University, 2003

PROFESSIONAL EXPERIENCE

Dr. Stroiney develops concepts, tools, and algorithms to measure and improve the efficiency and safety of airport surface traffic. He led Sensis' JFK Departure Manager project, which designed and built a surface optimization decision support tool for JFK airport and evaluated the savings that could be achieved through its use. He has performed and published studies quantifying the potential benefit of departure queue management across many airports. His work also includes NASA-supported research to design and study conflict detection and resolution systems suitable for a NextGen environment. In addition, Dr. Stroiney has worked to quantify delays on the airport surface and the associated costs, and to perform simulations of airport surface traffic. In these projects, he has drawn on extensive experience with scientific computing, statistics, and Monte Carlo simulation.

POSITION SUMMARY

Sensis Corporation, Syracuse, NY 01/09 – present

Research Engineer

Cornell University Laboratory for Elementary-Particle Physics, Ithaca, NY 06/04 – 12/08

Graduate Research Assistant

RECENT AND RELEVANT PUBLICATIONS

Stroiney, S. and B. Levy, 2011. "Departure Queue Management Benefits Across Many Airports", 11th Integrated Communications, Navigation, and Surveillance (ICNS) Conference, Herndon, VA.

Stroiney, S., B. Levy, and C.J. Knickerbocker, 2010. "Departure Management: Savings in Taxi Time, Fuel Burn, and Emissions", 10th Integrated Communications, Navigation, and Surveillance (ICNS) Conference, Herndon, VA.

ATTACHMENT G - Certified Environmentally Preferable Products/Practices

Proposer Name: Sensis Corporation **Date:** 6/30/2011

In line with the Port Authority's efforts to promote products and practices which reduce our impact on the environment and human health, Proposers are encouraged to provide information regarding their environmentally preferable/sustainable business practices as they relate to this contract wherever possible. Proposers **must** complete this form and submit it with their response, if appropriate. Proposers **must** submit appropriate documentation to support the items for which the Proposer indicates a "Yes" and present this documentation in the proper sequence of this Attachment.

1. Packaging

Has the Proposer implemented any of the following environmental initiatives? **(A checkmark indicates "Yes")**

No Use of corrugated materials that exceed the EPA recommended post-consumer recycled content

No Use of other packaging materials that contain recycled content and are recyclable in most local programs

Yes Promotes waste prevention and source reduction by reducing the extent of the packaging and/or offering
packaging take-back services, or shipping carton return

No Reduces or eliminates materials which have been bleached with chlorine or chlorine derivatives

Yes Eliminates any packaging that may contain polyvinyl chloride (PVC), or polystyrene or heavy metals

If yes, a description of the practices being followed must be included with the submission.

2. Business Practices / Operations / Manufacturing

Does the Proposer engage in practices that serve to reduce or minimize an impact to the environment, including, but not necessarily limited to, the following items? **(A checkmark indicates "Yes")**

Yes Recycles materials in the warehouse or other operations

No Use of alternative fuel vehicles or vehicles equipped with diesel emission control devices for delivery or transportation purposes

No Use of energy efficient office equipment or signage or the incorporation of green building design elements

No Use of recycled paper (that meets federal specifications) in their marketing and/or resource materials

No Other sustainable initiative

If yes, a description of the practices being followed must be included with the submission.

3. Training and Education

Does the Proposer conduct/offer a program to train or inform customers and employees of the environmental benefits of the products to be offered under this contract, and/or does the Proposer conduct environmental training of its own staff?

☐ Yes ☒ No If yes, Proposer must attach a description of the training offered and the specific criteria targeted by the training.

4. Certifications

Has the Proposer or any of its manufacturers and/or subcontractors obtained any of the following product / industry certifications? **(A checkmark indicates "Yes")**

No ISO 14000 or adopted some other equivalent environmental management system
No Other industry environmental standards (where applicable), such as the CERES principles, LEED Certification, C2C Protocol, Responsible Care Codes of Practice or other similar standards
No Third Party product certifications such as Green Seal, Scientific Certification Systems, Smartwood, etc.

If yes, Proposers must attach copies of the certificates obtained.

5. Other Environmental Criteria
Proposers are encouraged to respond to criteria specifically indicated in this RFP as "Management Approach" (and attach the appropriate documentation) to receive consideration in the evaluation.

I hereby certify, under penalty of the law that the above statements are true and correct.

_____ **Name** 6/30/11 **Date**

John Spinosa - Facilities Manager - Sensis Corporation

Sensis

Environmental Policy

February 19, 2009

Sensis is committed to compliance with all applicable laws and regulations pertaining to Environmental Management. Sensis has reviewed the ISO 14001 international standard and has concluded that products manufactured by the Air Traffic Systems (ATS) and Defense & Security Systems (D&SS) divisions are done in accordance with the intent of this standard.

Components and sub-assemblies used in Air Traffic Systems (ATS) and Defense & Security Systems (D&SS) products are typically purchased and assembled by Sensis. Machining, painting, plating, and similar type operations are sub-contracted to other suppliers. Based on this business decision, Sensis has concluded that registering its facilities to the ISO 14001 standard is not applicable. However, Sensis does comply, as required, with all applicable environmental laws including:

Commonly Applicable Federal Environmental Laws in the US

Clean Air Act (CAA) [40 CFR Parts 50-99] - Establishes ambient and source emission standards and permit requirements for conventional and hazardous air pollutants.

Clean Water Act (CWA) [40 CFR Parts 100-145, 220-232, 410-471] - Establishes ambient and point source effluent standards and permit requirements for water pollutants, including sources that discharge directly to a waterbody or to a public sewer system.

Toxic Substances Control Act (TSCA) [40 CFR Parts 700-799] - Regulates the use, development, manufacture, distribution and disposal of chemicals. Certain chemicals (such as PCB's) are subject to specific management standards.

Hazardous Materials Transportation Act (HMTA) [49 CFR Parts 100-180] - Establishes standards for the safe transportation of hazardous materials.

Sensis will continue to adhere to this policy. In addition, Sensis will continue to review changes made to the laws and regulations pertaining to the protection of our environment and make changes to this policy as needed.

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1. CONTRACTOR IDENTITY CHECK / BACKGROUND SCREENING PLAN 1

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1. Contractor Identity Check / Background Screening Plan

Sensis routinely processes background and identity checks for standard business and for more secure clearances. Sensis will ensure that employees and subcontractors are screened appropriately for this contract. This section outlines the basic processes that Sensis and RVA, our proposed staffing subcontractor, routinely follow, as well as the additional SWAC requirements that will be observed for this contract.

1.1 Sensis Standard Practices

1.1.1 Reference Checks

Prior to extending an employment offer, Sensis recruiters conduct three (3) professional phone references. Professional references are identified by the interview candidate. Reference checks verify prior dates of employment, title, responsibilities and when attainable, employee performance.

1.1.2 Background Checks

When extending an employment offer to all temporary and regular new hires (excluding co-ops/interns), a background check release form is sent to the candidate. Upon acceptance of employment offer, background check process begins. Background checks are conducted by American Background Information Services. Employment offer is contingent upon successful completion of a background check. Turnaround time is usually 2-3 days.

Background check will include:

- 7 year criminal search
- employment verification
- education verification

1.1.3 Employment Eligibility Verification

For each individual we hire for employment at Sensis, employment eligibility is verified to ensure proper authorization to work in the United States. This is done through the completion of an I-9 (Employment Eligibility Verification Form) and E-Verify.

As a contractor for the United States Department of Defense, Sensis is an E-Verify participant. Sensis enrolled in E-Verify as of 10/14/2009 and chose the option to verify the entire existing workforce as well as all new hires.

E-Verify is an Internet-based system operated by the Department of Homeland Security (DHS) in partnership with the Social Security Administration (SSA). E-Verify currently is the best means available for employers to determine employment eligibility of new hires and the validity of their Social Security numbers. E-Verify electronically compares information contained on the Employment eligibility Verification Form I-9 with records contained in SSA and DHS database to help employers verify identify and employment eligibility of newly-hired employees. This includes citizens and noncitizens (when appropriate).

The I-9 forms are completed on the first day of employment. Employees are required (within three (3) business days) to provide the documents they choose from those listed on the most recent Lists of Acceptable Documents, which can be found on the I-9 form. (If employees are unable to provide documentation within three (3) business day, they will no longer be employed by Sensis). We examine the employment eligibility and identity document(s) an employee presents to determine whether the document(s) reasonably appear to be genuine and relate to the individual and record the document information on the I-9 form. All new hire documentation contained on the Form I-9 is entered into E-Verify within 3 days of hire date.

I-9 forms are filed separately from employee files and are retained for three years after the date of hire or for one year after employment is terminated, whichever is later.

1.1.4 Security Clearance Process

In addition to standard background checks for all employees, Sensis also has experience obtaining formal security clearances. An individual at Sensis is permitted access to classified information only if appropriately cleared by the U.S. Government and has a need-to-know the information. An individual's need-to-know is determined only after Security and program/functional management determine that the individual's access to classified information is necessary to perform tasks or services essential to the fulfillment of a contract or program. A request for a Security clearance is initiated by the employee as a JIRA Security Request. Security will route the request for proper approval prior to initiating the appropriate security clearance request process.

In addition to U.S. Government security clearances, Security is responsible for establishing and maintaining processes and procedures to manage FAA Public Trust, NATO classified and COMSEC briefings when required by contract/program.

1.1.4.1 DoD Security Clearances

Security evaluates existing DoD Security Clearances for Sensis employees at least annually. If clarification is required for continuance of an existing DoD Security Clearance, Security requires that the cleared employee completes the Security Clearance Necessity Questionnaire (SF-0097). Security reviews the request with the appropriate

management, and takes necessary actions to continue/discontinue the employee's security clearance.

1.1.4.2 NATO Clearances

Access to NATO classified information requires a final PCL at the equivalent level. NATO RESTRICTED does not require a PCL for access. Security conducts a NATO Briefing. The employee is required to review the NATO briefing material and complete a NATO Briefing Acknowledgement Form (SF-0230). This is provided to Security upon completion prior to access to NATO controlled data. Security is responsible for updating the employee's SIMS and JPAS records to reflect the date that the NATO clearance was granted.

1.1.4.3 FAA Public Trust

FAA Public Trust clearances are submitted to Security using the JIRA Security Request system. The FSO initiates the request in the Federal Aviation Administration (FAA) Vendor Application (VAP) system. FAA Security notifies the employee directly via e-mail if a background check is required using eQIP. Security monitors the status of FAA Public Trust clearances.

1.2 RVA Standard Practices

RVA expects a high level of performance, professional conduct, effective communications and teamwork from its employees. These traits and characteristics are essential to efficient operations and high productivity and are included in all employee performance standards. RVA's appraisal of employees' performances will help determine how well the employees meet these expectations and which employees deserve additional recognition, rewards and promotions.

RVA supervisors establish performance standards and provide position descriptions for all employees under his/her supervision. The standards are developed for each position category and level of responsibility. Supervisors use these as a basis for on-going informal performance discussions throughout the year and to formally evaluate and document the employee's work on an annual basis. Such appraisal sessions provide an excellent opportunity for the employee and supervisor to assess the total work situation and define future goals, career objectives and training requirements. If an employee's performance is unsatisfactory, the supervisor must give that employee a written copy of the unsatisfactory performance appraisal. However, before such an appraisal is given to the employee, the supervisor must discuss performance with the employee and provide the employee an opportunity to improve that performance. Discussions of this nature shall be documented and kept in the employee's personnel file. The supervisor shall, considering those circumstances, direct every effort within reason (i.e., closer supervisory

attention, additional training, counseling, etc.) toward correcting and/or improving the employee's performance.

RVA is committed to providing safe, efficient and professional services. Personnel are indoctrinated, from the outset of their job, in RVA's requirement of not only providing outstanding services but conducting themselves in a professional manner. We understand that appearance is a factor of professionalism, and RVA personnel will dress accordingly.

It is the policy of Robinson Aviation (RVA), Inc. not to discriminate and to provide equal employment opportunity to all qualified persons regardless of race, color, sex, religion, national origin, disability, or status as a special disabled veteran or Vietnam era veteran. This policy is applied to all employment actions including but not limited to recruitment, hiring, upgrading, promotion, transfer, demotion, layoff, recall, termination, rates of pay or other forms of compensation and selection for training.

Employees of and applicants to Robinson Aviation (RVA), Inc. will not be subject to harassment, intimidation, threats, coercion, or discrimination because they have engaged or may engage in filing a complaint, assisting in a review, investigation/hearing or have otherwise sought to obtain their legal rights related to any federal, state, or local law regarding EEO for individuals with disabilities or protected veterans.

In furtherance of the policy of Affirmative Action and Equal Employment Opportunity, RVA has developed a written Affirmative Action Program, which contains specific and results-oriented procedures to which Robinson Aviation (RVA), Inc. is committed to apply every good faith effort. Procedures without efforts to make them work are meaningless, and effort undirected by specific and meaningful procedures is inadequate.

All employees or applicants who feel that they have been subject to harassment, intimidation, threats, coercion, or discrimination because of their disability or status as a protected veteran should contact Melissa Markel at (405) 840-3771 for assistance. This policy is communicated to all employees and supervisors annually and a notice is posted in the RVA employment office.

RVA's policies and procedures recognize that all personnel and employment information is considered personal and confidential as well as proprietary and is treated accordingly. An official personnel file for each employee is maintained in the Oklahoma City Corporate Headquarters. Employees may review their personnel files.

1.2.1 Physicals and Drug Testing

The JFK SMS Operation will be added to the RVA Anti-Drug and Alcohol Misuse Program. RVA requires a drug-free workforce. All SMS personnel will be hired contingent upon completion of pre-employment Ten-Panel drug screen with negative results. Thereafter, drug testing will be conducted for all SMS personnel randomly at the written request from the Port Authority, to ensure personnel remain drug free. RVA's Drug and Alcohol Program Manager, Ms. Kelly O'Rourke will coordinate the drug

testing as needed, utilizing Lab Corps or other qualified provider. RVA will administer, document and deliver to Sensis, to be furnished to the Port, for its satisfaction, the information concerning the requirements and qualifications of RVA's personnel as required by the RFP and shall submit evidence substantiating said qualifications and requirements, from the pre-start period through the transition out at the end of contract.

1.2.2 Background Checks

RVA manages 94 air traffic control towers and two ramp towers, as part of these contracts RVA ensures that the following requirements have been satisfactorily completed for all personnel prior to performing their duties as operators: an education/experience background investigation, fingerprint-based criminal history record check processed by the FBI, and the ability to be issued a security badge required by the FAA/TSA. All background checks are accomplished as part of the SIDA (Security Identification Display Area) badge requirements. RVA understands and schedules the following steps for badging:

1. A badge application form must be completed for which a Port Badge official must verify Proof of Citizenship documents and Photo ID.
2. Additionally applicants must submit a "Privacy Act Notice" allowing the Department of Homeland Security (DHS) the collection of information from the Social Security Administration and the forwarding of fingerprint information to the FBI to conduct a criminal history records check.
3. The applicant completes a "Fingerprint Application" form in which he testifies that he has not been convicted of any disqualifying crimes.

Badge fees are promptly processed and paid by the Corporate Office. RVA is experienced in the badge rules and regulations regarding care and use of badges and adhere to them. The background checks and badging process are pre-employment requirements.

1.3 Secure Worker Access Consortium (S.W.A.C.)

Sensis and RVA will follow the Identity Check/Background Screening Plan for this project which is based on the Secure Worker Access Consortium (S.W.A.C.) program. We will furnish to the Port Authority, prior to the Commencement Date as required, or shortly following the execution of the subcontract, and at any time during the period of the Contract, including Option and/or Extension Periods, the necessary documents to ensure that the security requirements of the Port have been met. The following requirements will be satisfactorily completed for all on site staff prior to performing their duties:

- a Port Authority designated background screening inspection verifying the employees name and residence: screening federal, state, and/or local criminal justice agency information databases and files;
- screening of any terrorist identification files;
- access identification to include some form of biometric security methodology such as fingerprint, facial or iris scanning, or the like.

The personal identity verification check and the background check shall be conducted by S.W.A.C. and will include a minimum of 10 years of employment history or verification of what an employee documented they have done in the past 10 years preceding the date of the investigation.

Further we will comply with the facility-specific photo identification credential requirements, as well as the applicable Port Authority Information Security Handbook and other security requirements as these apply to the operators and this contract. Sensis will supply the necessary training to the operators in the Mission and the safety and security plans prior to the start of Phase A "Operational Usage". This policy will continue during the period of performance including Option and/or Extension Periods.

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1.3.1 Technical Risk Mitigation 2
1.3.2 Schedule Risk Mitigation 3
1.3.3 Staffing Risk Mitigation 3
1.3.4 Programmatic Risk Mitigation 3

1. Business Risk

The Proposer shall submit a risk assessment and succession plans to the Contractor and the Port Authority that assess the business risk in taking on the significant amount of new work that will be required under this Contract. The risk assessment plan should take into account all work currently under contract, as well as work that is under contract to companies which the Proposer owns, controls or has an interest.

1.1 Risk Assessment

The primary risks associated with the scope of work requested by the Port Authority fall largely into the following three categories:

- Contractors ability to transition from the current environment
- Contractor's ability to meet technical requirements
- Contractor's ability to meet an aggressive implementation schedule

The requested SMS requires a mature product with significant functionality and flexibility. A product that needs substantial new development in order to implement the requested features adds a significant risk for the Port Authority.

The Port Authority has also requested a very aggressive schedule that does not allow time for development by Phase A, and very little time for Phase B. If a product is not currently ready to be deployed, there is minimal chance that a contractor could meet the Phase A deadline.

A new product will also require training of a very large user base, as the Port Authority has requested licenses for 400 users. The logistics of providing this training, especially during the holiday season, offers a challenge to any contractor, but includes significantly more risk for contractors proposing brand new technologies.

1.2 Succession Plan

Sensis is, by far, the best suited to transitioning from the current environment to that defined by the RFP. Sensis has years of experience working with the Port, training staff on Aerobahn, and learning how the Port intends to use the service.

As Sensis runs the current Aerobahn service, we can ensure that there is a smooth transition and that service will not be disrupted.

Based on our experienced staffing partner, RVA, we have assembled a team of SMS Operators who understand the scope of work required, and will be fully trained on Aerobahn at the time of cutover.

Should there be any unforeseen delays, Sensis can work with the Port to continue existing service as needed and ensure a successful cutover.

1.3 Risk Mitigation with a Sensis Solution

Sensis, a company with over 600 employees and over $170M in 2010 annual revenues, has been delivering Surface Surveillance and Surface Management Systems for over a decade with systems installed and operating worldwide. With installations including surface and airspace coverage for ATC separation and efficiency of traffic flow, as well as operational efficiency applications for airline and airport operators, Sensis is the world's leading provider of Surface Management Systems and is well positioned to provide an integrated SMS for JFK.

What the Port Authority is asking for in this procurement is a significant amount of new work that will be a challenge for any company that does not have the appropriate number of resources, excellent project management teams with systems integration expertise, and wealth of experience with airport SMS and surveillance system installation and operation as well as integration with FAA operational systems will be a very high risk for the Port Authority.

Sensis' unique JFK and SMS experience, expertise in existing JFK surface management, surveillance systems and departure planning processes, and unparalleled FAA operational system (incl. ASDE-X, TMA and TFMS) capabilities make Sensis the lowest risk provider for the Port Authority.

More directly, Sensis has been the SMS provider for the Port Authority for the last three years, demonstrating the capacity to carry out this work and building a strong base of users who are already trained and reliant on Sensis technology.

Sensis also has an incredibly strong track record of delivering on its promises, particularly as they relate to aggressive, cutting-edge Aerobahn SMS deployments. Case in point, one of Sensis most recent successes was in a competitive procurement with the Department of Aviation at Hartsfield-Jackson Atlanta International Airport (ATL). In similar circumstances as JFK, Sensis leveraged its Aerobahn platform for an ATL SMS system on top of which it developed significant, and truly innovative, predictive capabilities. The result was that Sensis delivered the most sophisticated SMS on the market, and did so ahead of schedule. The same Sensis team is more than ready and capable of delivering to the Port Authority's needs.

1.3.1 Technical Risk Mitigation

Since the inception of Aerobahn, the system has been under continuous development and improvement due to Sensis' sustained investment and commitment to providing industry leading solutions. Sensis strives to stay at the cutting edge of SMS development and is

the only provider that is properly prepared to meet the requirements of this RFP without extensive development. Furthermore, Sensis will be hosting the service from a secure and geographically redundant pair of data centers that far exceed availability requirements and meet all disaster recovery requirements.

1.3.2 Schedule Risk Mitigation

For Phase A, Sensis will supply a solution that is largely already in place at JFK, with some enhancement that will be available in the next version of Aerobahn. This solution provides the Port Authority with greater assurance that they will receive the required functionality with minimal risk.

Because the Port Authority is familiar with the system, there is less risk that the required site tests will encounter issues and more confidence that the operational test period will occur without incident.

Because many of the Port Authority and stakeholder users are already trained, a solution based on the Sensis Aerobahn product will be ahead of the curve compared to new technologies. Sensis will have fewer new users to train, and the existing user base will provide the Port Authority with additional internal support resources.

1.3.3 Staffing Risk Mitigation

To supplement the technical solution, Sensis has partnered with Robinson Aviation, a leading staffing provider for aviation professionals.

With their extensive experience in staffing and operating Air Traffic Control and Ramp Control facilities, Robinson Aviation provides the required skill necessary to manage daily Departure Metering at JFK. Robinson Aviation (RVA), Inc. is an aviation services company that specializes in air traffic control operations; communications engineering, installation, & maintenance; navigation and landing system engineering, installation & maintenance; aviation safety and CNS/ATM studies, and transportation security studies and planning. In business since 1986, they currently operate 93 air traffic control towers under the FAA Contract Tower Program. RVA, Inc. employs over 500 air traffic controllers, engineers and technicians that are dedicated to satisfying their customers' requirements.

1.3.4 Programmatic Risk Mitigation

The major system integration and program management tasks involved in delivering and operating the JFK SMS, while significant, are not a major risk to Sensis. Sensis currently has many system integration and deployment contracts being delivered on simultaneously for dozens of airport customers worldwide. With over 600 personnel, the size and scope of the JFK SMS project are well within our existing corporate capabilities.

Our unparalleled and outstanding surface system program management skills are a big reason why Sensis wins and delivers on major surface-focused ATM development and deployment contracts. Sensis has been the successful prime contractor on major airport system integration contracts such as the US's safety-critical ASDE-X system (now deployed at 35 major US airports) and Runway Status Lights (to be deployed at 22 major US airports) and Airservices Australia's National Tower Program Technology Project (to be deployed at up to 26 major Australian airports). In fact, our program management expertise was highlighted in our recent receipt (with the FAA) of the 2011 Jane's ATC Global Runway Safety Award for our deployment of the ASDE-X technology.

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1. DEMONSTRATIONS 1

1. Demonstrations

Sensis' proposed solution consists of an enhanced version of its existing Aerobahn SMS Service which is already being provided to the Port Authority and airport stakeholders at JFK. If at any time during the evaluation period, or after contract award, the Port Authority would like a thorough demonstration and explanation of Aerobahn or any of its features, then Sensis will be happy to provide one. Sensis' Phase A and Phase B departure metering solutions heavily leverage existing work, namely the Sensis Departure Manager (DMAN), developed in collaboration with NYSERDA, and the Sensis' Flight Operator Surface Application (FOSA) product, developed and delivered in MEM with the FAA. Both of these systems, along with the detailed design of how they would be integrated into the Kennedy operation, will be immediately available for in depth discussion and demonstration. Lastly, much of the new functionality requested by the Port Authority has already been on Sensis' internal Aerobahn development road map and its design and development is underway. As such, Sensis will be prepared to elaborate on and provide a presentation and design material for any new functionality described in this proposal.

THE PORT AUTHORITY OF NY & NJ

PURCHASING SERVICES DIVISION
ONE MADISON AVENUE 7TH FL.
NEW YORK, NY 10010

Date: July 7, 2011

ADDENDUM #1

To prospective Proposers on Request for Proposals (RFP) # 24997 for Surface Management System at John F. Kennedy International Airport (JFK)

☒ **Proposals due back on August 8, 2011, no later than 2:00 P.M.**

☒ Proposals originally due on July 11, 2011, no later than 2:00 P.M.

The following changes/modifications are hereby made to the solicitation documents:

1. Delete Attachment B, Contract Specific Terms and Conditions, Section 5. "Insurance Procured by the Contractor" in its entirety and replace with the attached revised "Insurance Procured by the Contractor".

All answers to Prospective Proposers' questions will be submitted at a later date.

This communication should be initialed by you and annexed to your proposal upon submission.

In case any Proposer fails to conform to these instructions, its proposal will nevertheless be construed as though this communication had been so physically annexed and initialed.

THE PORT AUTHORITY OF NY & NJ

KATHY LESLIE WHELAN, MANAGER
PURCHASING SERVICES DIVISON

PROPOSER'S FIRM NAME: Susis Corporation

INITIALED: [illegible]

DATE: 7/11/2011

QUESTIONS CONCERNING THIS ADDENDUM MAY BE ADDRESSED TO LESLEY BROWN, WHO CAN BE REACHED AT (212) 435-3969.

Revised

Insurance Procured by the Contractor

The Contractor shall take out, maintain, and pay the premiums on Commercial General Liability Insurance, including but not limited to premises-operations, products-completed operations, and independent contractors coverage, with contractual liability language covering the obligations assumed by the Contractor under this Contract and, if vehicles are to be used to carry out the performance of this Contract, then the Contractor shall also take out, maintain, and pay the premiums on Automobile Liability Insurance covering owned, non-owned, and hired autos in the following minimum limits:

Commercial General Liability Insurance - $25 million combined single limit per occurrence for bodily injury and property damage liability.

Automobile Liability Insurance - $2 million combined single limit per accident for bodily injury and property damage liability.

In addition, the liability policy (ies) shall name The Port Authority of NY and NJ and City of NY, as additional insured, including but not limited to premise-operations, products-completed operations on the Commercial General Liability Policy. Moreover, the Commercial General Liability Policy shall not contain any provisions for exclusions from liability other than provisions for exclusion from liability forming part of the most up to date ISO form or its equivalent unendorsed Commercial General Liability Policy. The liability policy (ies) and certificate of insurance shall contain cross-liability language providing severability of interests so that coverage will respond as if separate policies were in force for each insured. These insurance requirements shall be in effect for the duration of the contract to include any warrantee/guarantee period.

The certificate of insurance and liability policy (ies) must contain the following endorsement for the above liability coverages:

"The insurer(s) shall not, without obtaining the express advance written permission from the General Counsel of the Port Authority, raise any defense involving in any way the jurisdiction of the Tribunal over the person of the Port Authority, the immunity of the Port Authority, its Commissioners, officers, agents or employees, the governmental nature of the Port Authority, or the provisions of any statues respecting suits against the Port Authority."

The Contractor shall also take out, maintain, and pay premiums on Workers' Compensation Insurance in accordance with the requirements of law in the state(s) where work will take place, and Employer's Liability Insurance with limits of not less than $1 million each accident.

In addition, the policy (ies) shall include the Authority and its wholly owned entities as an additional insured and the policy (ies) and its certificate must be specifically endorsed

to contain a provision that the policy may not be canceled, terminated, or modified without thirty (30) days' prior written notice to the Port Authority of NY and NJ, Att: Facility Contract Administrator, at the location where the work will take place and to the General Manager, Risk Financing.

The Port Authority may at any time during the term of this agreement change or modify the limits and coverages of insurance. Should the modification or change results in an additional premium, The General Manager, Risk Financing for the Port Authority may consider such cost as an out-of-pocket expense.

Within five (5) days after the award of this agreement or contract and prior to the start of work, the Contractor must submit an original certificate of insurance, to the Port Authority of NY and NJ, Facility Contract Administrator, at the location where the work will take place. This certificate of insurance MUST show evidence of the above insurance policy (ies), stating the agreement/contract number prior to the start of work. The General Manager, Risk Financing must approve the certificate(s) of insurance before any work can begin. Upon request by the Port Authority, the Contractor shall furnish to the General Manager, Risk Financing, a certified copy of each policy, including the premiums.

If at any time the above liability insurance should be canceled, terminated, or modified so that the insurance is not in effect as above required, then, if the Manager shall so direct, the Contractor shall suspend performance of the contract at the premises. If the contract is so suspended, no extension of time shall be due on account thereof. If the contract is not suspended (whether or not because of omission of the Manager to order suspension), then the Authority may, at its option, obtain insurance affording coverage equal to the above required, the cost of such insurance to be payable by the Contractor to the Port Authority.

Renewal certificates of insurance or policies shall be delivered to the Facility Contractor Administrator, Port Authority at least fifteen (15) days prior to the expiration date of each expiring policy. The General Manager, Risk Financing must approve the renewal certificate(s) of insurance before work can resume on the facility. If at any time any of the certificates or policies shall become unsatisfactory to the Port Authority, the Contractor shall promptly obtain a new and satisfactory certificate and policy.

The requirements for insurance procured by the Contractor shall not in any way be construed as a limitation on the nature or extent of the contractual obligations assumed by the Contractor under this contract. The insurance requirements are not a representation by the Authority as to the adequacy of the insurance to protect the Contractor against the obligations imposed on them by law or by this or any other Contract.

Cits# 3710

THE PORT AUTHORITY OF NY & NJ

PURCHASING SERVICES DIVISION
ONE MADISON AVENUE 7TH FL.
NEW YORK, NY 10010

Date: July 25, 2011

ADDENDUM #2

REQUEST FOR PROPOSALS# 24997 FOR SURFACE MANAGEMENT SYSTEM AT JOHN F. KENNEDY INTERNATIONAL AIRPORT (JFK)

Proposals are due back on August 8, 2011, no later than 2:00 P.M.

Originally Proposal due on July 11, 2011, no later than 2:00 P.M.

CHANGES/MODIFICATIONS:

The following changes/modifications are hereby made to the solicitation documents:

1. Throughout the document, remove and replace Enhanced Traffic Management System (ETMS) with Traffic Flow Management System (TFMS)

2. Delete Attachment B, Part I, Section 9, d., and replace with:

   (d) Must pass a drug screening test, including a comprehensive ten-panel drug screen or its equivalent, to include screens for the following.

Amphetamines	Methaqualone	Benzodiazepenes 6MAM – if indicated
Barbiturates	Methadone	Opiates
Marijuana	Propoxyphene	Morphine – if indicated
Phencyclidine (PCP)	Cocaine	Codeine – if indicate

   Tests shall be administered by and at the sole expense of the Contractor, at the commencement of this Contract or immediately prior to working at the Airport under this Contract, and randomly thereafter at the written request of the Port Authority.

The Contractor shall furnish to the Port Authority, prior to the Commencement Date and at any time during the period of the Contract, including Option and/or Extension Periods, if any, at no expense to the Port Authority, information concerning the requirements and qualifications of the Contractor's personnel as listed above and shall submit evidence substantiating said qualifications and requirements to the satisfaction of the Port Authority.

3. Remove from Attachment C, Scope of Work, 41, requirement 7, "A site specific manual shall also be provided to document the specific site related configuration and operations/maintenance."

4. In Attachment C, Scope of Work and Specifications, 2, Table of Contents, VIII. B. and in Attachment C, Scope of Work and Specifications, 4, I. A. paragraph 2, remove "30-Day Operational Test" and replace with "14 Day Operational Test".

5. Change all references to Base Date of Operational Usage to February 15, 2012. .

6. Delete the following sentence from *Attachment C, 45, IX.B.13,* "System Documentation shall be provided in both a bound copy and an electronic version in a machine-readable form, which is viewable with the Microsoft Office 2007 suite of tools and Auto-Cad (if used)." and replace it with, "System Documentation shall be provided in both a bound copy and an electronic version in a machine-readable form, which is editable with the Microsoft Office 2007 suite of tools and Auto-Cad (if used)."

7. In Exhibit 5, Application Controls Checklist, General, delete sixth (6th) bullet point, which reads "Remote access should be restricted and documented in accordance with PA policy." and replace with: "Remote access should be restricted and documented in accordance with the security requirements stated in Attachment C Section V.B. Security Requirements and industry best practices."

8. Delete the last sentence in Attachment B, Sec. 16, subsection B.

9. Delete the word "workstation" from fourth (4th) bullet point in Attachment C, Scope of Work and Specifications, Section V.M (page 31 of 51)

10. Replace the words "Code of Conduct" in Attachment C, Scope of Work and Specifications, Section IV.C.25 and 26 with "Procedures".

11. Add Exhibit 10 – Surface Flow Metering Procedures

12. Add Exhibit 11 – Ramp Tower Guidance for Metering Procedures at JFK

13. Change all references to the date in which Phase B must be operational to August 1, 2012.

QUESTIONS AND ANSWERS

The following information is available in response to questions submitted by prospective Proposers. The responses should not be deemed to answer all questions, which have been submitted by Proposers to the Port Authority. It addresses only those questions, which the Port Authority has deemed to require additional information and/or clarification. The fact that information has not been supplied with respect to any questions asked by a Proposers does not mean or imply, nor should it be deemed to mean or imply, any meaning, construction, or implication with respect to the terms.

The Port Authority makes no representations, warranties or guarantees that the information contained herein is accurate, complete or timely or that such information accurately represents the conditions that would be encountered during the performance of the Contract. The furnishing of such information by the Port Authority shall not create or be deemed to create any obligation or liability upon it for any reason whatsoever and each Proposers, by submitting its proposal, expressly agrees that it has not relied upon the foregoing information, and that it shall not hold the Port Authority liable or responsible therefor in any manner whatsoever. Accordingly, nothing contained herein and no representation, statement or promise, of the Port Authority, its Commissioners, officers, agents, representatives, or employees, oral or in writing, shall impair or limit the effect of the warranties of the Bidder required by this Proposal or Contract and the Proposers agrees that it shall not hold the Port Authority liable or responsible therefor in any manner whatsoever.

The Questions and Answers numbering sequence will be continued sequentially in any forthcoming Addenda that may be issued.

QUESTION 1:
General Contract Provision 3a – Please explain the intent of this provision given the criticality of communication to the success of the system, and as a supporter of the propagation of similar systems throughout the National Air Space.

ANSWER 1:
Because communication is necessary, permission will be forthcoming upon execution of the Contract.

QUESTION 2:
General Contract Provision 4a – The Port Authority is requesting proposals for a commercial service. The service is to be delivered via a combination of JFK specific processes and the adaptation of existing, transferable technologies owned by contractors. Please confirm the Port Authority has no intention of claiming ownership rights of contractor developed technologies adapted or introduced in conjunction with this service offering.

ANSWER 2:
The Port Authority has no intention of claiming ownership rights of pre-existing contractor developed technologies.

QUESTION 3: General Contract Provision 28 – Please confirm that the service offering being procured under this RFP will NOT "control, collect, dispense, contain, manage, administer, or monitor revenue "owned" by the Port Authority".

ANSWER 3:
The service offering being procured under this RFP will not "control, collect, dispense, contain, manage, administer, or monitor revenue "owned" by the Port Authority."

QUESTION 4:
Contract Specific Terms and Conditions 8 – Job Classifications – Describing the types of skills needed to provide the service makes assumptions about the technology used, but the technological solution will vary from contractor to contractor. We recommend limiting the description of skills needed to key personnel. We recommend classifying the SMS manager and the Contract Manager as key personnel and allowing the technological offering to dictate the other skill sets needed.

ANSWER 4:
If the proposer offers an alternative solution tailored to its particular technological offering, the proposer should propose it.

QUESTION 5:
Contract Specific Terms and Conditions 13, 14, and 22 refer to the ability of the Port Authority to direct changes in level of contract support. Please confirm these directed changes are eligible for equitable adjustment(s) to the contract.

ANSWER 5:
The Contract Specific Terms and Conditions 13 and 14 will be paid in accordance with Attachment C. Section X. F. at the associated Proposed Maximum Hourly Rate in Cost Proposal Form, Table 5. Contract Specific Terms and Conditions, Section 22 will be paid in accordance with the terms in that section, Attachment B, pages 50 and 51, Section 22.

QUESTION 6:
Contract Specific Term and Condition H – Union jurisdiction. Please disclose whether current staff performing same or similar role is currently under Union jurisdiction and whether there are any pending complaints that would put union jurisdiction in question.

ANSWER 6:
The current staff is not under Union jurisdiction and the Port Authority is unaware of any pending complaints that put union jurisdiction into question.

QUESTION 7:
Contract Specific Term and Condition 9 – please provide guidance on what is required for the physical exam.

ANSWER 7:
Please refer to CHANGES/MODIFICATIONS item 2.

QUESTION 8:
Contract Specific Term and Conditions 18 and 20 – please inform us when to expect a decision on the allocation of space and parking for pricing purposes.

ANSWER 8:
There is no charge to the contractor for the rental of space or parking.

QUESTION 9:
Demonstration – please estimate the date(s) contemplated for the demonstration in relation to proposal submission, and the projected duration of the demonstration. Please confirm that the demonstration is also an opportunity to present the contractor's offering as a whole.

ANSWER 9:
Presently a presentation date (s) has not been confirmed. However, presentations may provide Proposers an opportunity to present their proposal submissions. Proposer demonstrations may not exceed four hours.

QUESTION 10:
Scope of Work – Requirement D1a, page 10, defines the predictive window as 4 hours in advance. Please confirm that this window applies to all predictive requirements within phases A and B.

ANSWER 10:
Yes.

QUESTION 11:
Scope of Work – Requirement 19, page 9 – How will cancellations and time changes be provided by the airline and airport operators? FIDS?

ANSWER 11:
A feed from FIDS will be made available to the Contractor, however the Service must be capable of accepting manual inputs for amendments.

QUESTION 12:
Scope of Work – Requirement 23, page 9 – Please provide a list of supporting tools. Are these tools intended to be data sources for the system or stand alone tools. If stand alone tools, are they intended to be run on SMS operator desktops?

ANSWER 12:
A supporting tool, such as FIDS, is intended to be a data source for the system. If Users are able to provide data (i.e. readiness indicators) in an alternate, automated fashion and the data is deliverable and readable, the required open architecture of the system should be able to receive and process such data to increase predictability.

QUESTION 13:
Scope of Work – Requirement 25, page 9 – please provide a copy of the Code of Conduct established by the Port Authority.

ANSWER 13:
Please see CHANGES/MODIFICATIONS, items 10, 11 and 12. These Procedures are living documents, subject to continuous improvement as lessons are learned. It is the intention of the Authority and Users for the Procedures to remain amendable to continue growth and program improvement.

QUESTION 14:
Scope of Work – Requirement 31, page 9 - Please provide an industry standard of the current terminology and nomenclature. Will meeting the base map requirements from pages 12-17 constitute meeting interoperability requirement?

ANSWER 14:
FAA's NextGen Implementation Plan, FAA Pilot/Controller Glossary, and the FAA FAR/AIM are recommended source of current terminology and nomenclature.

QUESTION 15:
Scope of Work – Requirement b, page 10 – "Provide alert notifications that correspond to specific operational events." Is this covered by the events defined on pages 8 and 9 at IV.C. 17: Automate alerts for critical events such as: aircraft arriving at key locations both Enroute and/or on the ground (such as a metering location or arrival fix), arrival aircraft assigned to a gate that is currently occupied, and when the taxi time of an aircraft exceeds a user-defined number of minutes. Users shall select the method of notification, to include, but not limited to: on screen display highlighting the aircraft that triggered the alert condition, audible workstation alarm and electronic methods such as email, text message, etc.) to an individual or groups." And throughout section 4?

ANSWER 15:
Attachment C, Scope of Work, page 10, IV. D. 1. B. states "Provide alert notifications to specific operational events." This is covered by events defined Attachment C, Scope of Work, pages 8 and 9, IV. C. 17, "Automate alerts for critical events such as: aircraft arriving at key locations both Enroute and/or on the ground (such as a metering location or arrival fix), arrival aircraft assigned to a gate that is currently occupied, and when the taxi time of an aircraft exceeds a user-defined number of minutes. Users shall select the method of notification, to include, but not limited to: on screen display highlighting the aircraft that triggered the alert condition, audible workstation alarm and electronic methods such as email, text message, etc.) to an individual or groups."

QUESTION 16:
Scope of Work – Requirement ii, page 18 – "the user shall set thresholds based on stated criteria for those alerts based on exceeding or falling below set criteria. The System shall provide the User the ability to monitor any data point in real time or in the system database and create an alarm that will notify the User when the data point either exceeds or falls below a threshold value set by the user." Please define what "data points" must be configurable for alerts.

ANSWER 16:
As stated in Attachment C, Scope of Work, Section IV.D.4.o.ii, any data point used for operational purposes, whether raw, unprocessed data from a sensor reading, or processed data stored in the database, such as a time count, the result of a calculation, etc.

QUESTION 17:
Scope of Work – Requirement b, page 17 – "Active aircraft icons positioned on the surface graphical display will indicate scheduled gate/stand occupation for aircraft in the aircraft data tag." What is the difference between an active and inactive flight? Is there an expectation to display inactive flights?

ANSWER 17:
An active flight has the intention of departing or has recently arrived. Often, aircraft with a transponder turned on relates to an inactive flight whereas an aircraft with a transponder turned off is inactive. The System should graphically depict if a gate is occupied even when occupied by an aircraft with the transponder turned off, as required in Scope of Work, page 17, section D. k. a. to represent an inactive flight.

QUESTION 18:
Scope of Work – Requirement a, page 20- "Region of Interest Report (i.e. departure or deicing queue)- Provides a list of all aircraft that are currently within a selected, configurable ROI along with the time of entry, time of exit, and total occupancy time." – This requirement asks for a report of aircraft that are within the ROI but also asks for the time the aircraft has left the ROI and implies the aircraft is no longer with the ROI. Is it intended for these reports to be after the fact?

ANSWER 18:
The Region of Interest (ROI) report described in Attachment C, 20, IV. E. 2.a. is intended to be after the fact. The Region of Interest report, Attachment C, 23, IV. E. 4. a, is in real time and dynamic.

QUESTION 19:
Scope of Work – Requirement X, page 45-47 – Please confirm that scheduled maintenance does not count against the "up-time" of the system.

ANSWER 19:
Authority-approved, scheduled downtime during the scheduled preventive maintenance window does not count against the operational availability of the system.

QUESTION 20:
Scope of Work – Requirement e, page 19 – Please provide the source, format, and size of the 5 years of historical data we are required to provide access to at the beginning of the contract. Also, please provide a definition of a "hold out".

ANSWER 20:
Once the data is collected, the System shall have the capability to retrieve, at a minimum, 5 years data. Archived data, stored off-line to the System, shall be made available within two days of request.

QUESTION 21: Scope of Work – Requirement 7b and 7c, page 42 – We do not believe that these requirements are relevant to a "software as a service" contract. Administration of our system and applications is considered proprietary data.

ANSWER 21:
The Port Authority specified the minimum requirements for system administration of this critical application for which the Services will be based and they are consistent with industry best practices. If the Proposer agrees to meet or exceed these requirements, state it in the proposal. If the Proposer offers an alternative that meets or exceeds these requirements, state the proposed alternative solution.

QUESTION 22:
Scope of Work – Requirement 7, page 41 – "A site specific manual shall also be provided to document the specific site related configuration and operations / maintenance." We do not believe that there are any site specific configuration requirements because the system is web enabled.

ANSWER 22:
See CHANGES/MODIFICATIONS item 3.

QUESTION 23:
Exhibit 5 – Security requirements, page 15-16 – Most specific security requirements listed have no relevance to our system.

ANSWER 23:
The system will be audited by the Port Authority's Audit Department independent of the SAS-70 Level 2 Audit and the security requirements are a part of the Contract. If a proposer considers some of the security requirements not relevant to the System, then an adequate explanation as to why they are not relevant must be provided and an exception taken in the proposal.

QUESTION 24:
Would the Port Authority consider re-evaluating the contract proposal schedule if it would attract a greater number of competitive responses?

ANSWER 24:
See Addendum #1, which changed the Proposal Due Date, and Changes/Modifications #5 and #13.

QUESTION 25:
Would the PA consider re-evaluating the operational readiness schedule if it would attract more competitive responses?

ANSWER 25:
See Answer 24.

QUESTION 26:
In Phase A, may we assume that the existing ASDE-X DDU will be directly connected to the PA SMS via PAWNET or existing secure PA subnet? If no, where will the surveillance data come from?

ANSWER 26:
The data will be provided through an agreement with the Federal Aviation Administration.

QUESTION 27:
In Phase A, may we assume that the existing ASDI (ETMS) feed is directly connected to the PA SMS via PAWNET or existing secure PA subnet?

ANSWER 27:
No, it is not a direct feed.

QUESTION 28:
Has the PA already secured FAA authorization for a direct feed for ASDE-X DDU data for the winning contractor?

ANSWER 28:
No.

QUESTION 29: Has the PA already secured FAA authorization for a direct feed for ASDI (ETMS) data for the winning contractor?

ANSWER 29:
No.

QUESTION 30:
Has the PA considered the impact of external dependencies, such as FAA approvals, in its desired operational readiness schedule?

ANSWER 30:
The Authority understands that the operational readiness schedule is subject to amendment based on the FAA approval process for access to NAS Data.

QUESTION 31:
In Phase B, are the ASDE-X tracks provided by the FAA via the Enterprise Service Gateway (i.e. FTI ED8)?

ANSWER 31:
For access to ASDE-X data, the contractor shall make application to the FAA under sponsorship of the Port Authority. Such data will be accessible through the local Data Distribution Unit and the Enterprise Security Gateway.

QUESTION 32:
How long has the PA been using the current prototype system?

ANSWER 32:
The current system has been in use since March 2010.

QUESTION 33:
How are the ASDE-X and ASDI (ETMS) data provided to the prototype system?

ANSWER 33:
Currently, the data is provided through Memorandum of Agreements between the FAA and the Vendor.

QUESTION 34:
What requirements in Attachment C are met by the current prototype system?

ANSWER 34:
The requirements met by the current prototype are irrelevant to this Request for Proposals.

SEG Not really, they need to know that what is expected of them is what is outlined in Phases A and B.

QUESTION 35:
Has the PA collected and analyzed usability data from the prototype and incorporated the requirements into Phase B?

ANSWER 35:
Yes, but not formally.

QUESTION 36:
The schedule in the SOW is extremely aggressive considering the scope described in the RFP. Will the Authority reconsider the program schedule? *(RFP, all, all)* –

ANSWER 36:
Please refer to Answer 24.

QUESTION 37:
Intellectual Property (IP):
The terms stipulate, "all process flows, codes, ... figures or delineations, which are prepared or compiled in connection with this Agreement shall become the exclusive property of the Authority, and the Authority shall have the exclusive right to use or permit the use of them and any ideas or methods represented by them for any purpose and at any time without other compensation than that specifically provided herein."

Our proposed solution to meet the SOW system specification requirements will include the provisions of an existing commercial product suite. Will the Authority reconsider its position and give the contractor co-ownership rights to data first produced under this contract similar to federal

government contracts with civil agencies such as the FAA and NASA? Specifically, the contractor who develops Intellectual Property should be given the same rights to co-ownership. Perhaps the Authority would consider modifying the IP terms similar to those in the FAA government contracts, specifically AMS Clause 3.5-13 Rights in Data - General (January 2009). *(Attachment B Part III, 5, 4)*

ANSWER 37:
See Attachment C, 26, V., D., 1. Data Ownership
The Authority will not claim rights to the provisions of an existing commercial product suite. Additionally, the Authority will not give the contractor co-ownership rights to data first produced under this contract similar to federal government contracts with civil agencies such as the FAA and NASA.

QUESTION 38:
Training Provided by the Contractor:
This term states, "The Contractor will be compensated for training hours. No compensation will be paid for any required training of the Project Manager and manager."

How and at what rate(s) will the Contractor be compensated for the training hours for its personnel? There are no provisions in the Cost Proposal Forms for hourly compensation, other than the Supplemental Work, which is effective November 1, 2012. *(Attachment B Part I, 46, 17(e))*

ANSWER 38:
The statement "The Contractor will be compensated for training hours" refers to training provided by the Contractor to Port Authority and airline staff and representatives who will be using the services provided by the System. The Contractor will not be compensated for training its own personnel, as stated in Section 17 (b).

QUESTION 39:
Space Provided for Contractor:
18(a) - This term states, "The Authority may furnish to the Contractor, subject to availability, and without charge to the Contractor, ..."
18(e) – This term states, "In the event the Authority does not furnish the Contractor with Space, the Contractor will be required to obtain its own space... The Authority shall pay to the Contractor for the monthly cost of such space as set forth in the Contractor's Cost Proposal Form and accepted by the Authority."

For purposes of this work, will the Authority be providing the Contractor with Space or will the Contractor be required to rent Space? If rental is required, on which Cost Proposal Form(s) should the rental fees be identified? *(Attachment B Part I, 46, 18(a), 18(e))*

ANSWER 39:
The Contractor is not required to rent space. Proposers are required to utilize Building 145, General Aviation Terminal, 1st Floor, JFK, for their proposed system operation (See Attachment B, pg 36, Section 8, SMS Operator). Proposers will not have the option of

proposing to locate their system operation at a different JFK location or off-site outside of JFK property.

QUESTION 40:
References: Specifically Statement on auditing Standards No. 70-Level 2 (SAS-70 level 2). Why is this certification required for essentially a Firm Fixed Price contract? Would the Authority consider eliminating this requirement? If not eliminated, when is the certification required? Companies which are not publicly traded typically do not require this or similar certifications. *(Attachment C, SOW, 4, I.B)*

ANSWER 40:

- **SAS-70 Level 2 certification is required to ensure that the system is designed and built to meet the security requirements included in the RFP and that the contractor employs those security policies and practices in the operation of its System, in accordance with the Scope of Work Section IX. B.9.**
- **The requirement will not be waived.**
- **The certification is required to be furnished as part of acceptance testing, see the system, Scope of Work Section VIII. A.13.**

QUESTION 41:
Please clarify the Authority's plan to ensure access to third-party data sources is granted and technical documentation is provided in a timely manner, i.e. FAA and Tenant Airlines? Examples of external data sources included in this question are DSP, TMA, EDC, ARMT, EFSTS, RAPT, ITWS, CIWS, ACARS, and TDLS. Please clarify how to interpret the NY Center, ATCT and TRACON as data sources. Additionally, in the event access is denied or a data interface cannot be established for technical or any other reason, what is the Contractor's responsibility after good faith is exercised? *(Attachment C, 4, I.A)*

ANSWER 41:
Under sponsorship of the Port Authority, the Contractor will be required to complete and submit Form 1200-5 to the FAA and receive written approval. Additionally, the Contractor shall become an approved CDM Service Provider under sponsorship of the Port Authority. It is the responsibility of the Contractor to interpret information and/or data received from FAA sources, and to provide the communications network that enables the exchange and display of information. If the Proposer has any reason to believe they will not be approved, they should state the reason.

QUESTION 42:
There are numerous system administration requirements, including database administration and training that are not consistent with the procurement of a Hosted web solution. Would the Authority consider that these requirements be limited to system availability, data integrity, archive data storage and access, and diverse geographic disaster recovery. The contractor's design and hosted solution support approach will have to address all necessary system administration and database administration functions to meet these requirements. *(Attachment C, 4, I.A)*

ANSWER 42:
The Port Authority specified the minimum requirements for system administration of this critical application for which the Services will be based and they are consistent with industry best practices. If the Proposer agrees to meet or exceed these requirements, state it in the proposal. If the Proposer offers an alternative that meets or exceeds these requirements, state the proposed alternative solution.

The Authority requires administrative access to examine and modify some of the system data, such as parameter settings, threshold values, user accounts, etcetera as needed for proper system monitoring and analysis. Administrative training should be provided at a level to support this capability.

QUESTION 43:
Please define the Authority's use of the term "pre-tactical" in the context of the functions described in the SOW. Please define the Authority's use of the term "tactical" in the context of the functions described in the SOW. *(Attachment C, 6, IV.A)*

ANSWER 43:
Tactical - Planning for the purpose of achieving an immediate of short-term goal.
Pre-tactical – Planning for the purpose of achieving a near or mid-term goal.

QUESTION 44:
Has the Authority been granted access to the existing FAA ASDE-X surface surveillance data for the entire airport movement and non-movement areas for the duration of the contract period? Please confirm the authorized access will be extended to the contractor. *(Attachment C, 7, IV.A)*

ANSWER 44:
Please see response to question 27.

QUESTION 45:
Please clarify if this is a Phase A or Phase B requirement. *(Attachment C, 8, IV.C)*

ANSWER 45:
As indicated in the title, Functional Requirements of Initial Implementation – Phase A, the items listed within Attachment C, 8, IV. C are in Phase A.

QUESTION 46:
The SOW requirements do not seem to reflect the procurement of a hosted web-based solution. Please confirm that the Authority is seeking to deploy a fully hosted solution for which the proposer will maintain all server level and database level administration, thereby providing a clear division of responsibility required to meet the high availability / fault tolerance requirements. Accordingly, a fully hosted web-based solution would provide only user administration functionality (e.g., user account management and user access roles) to the Authority users. *(Attachment C, 30, V.G)*

ANSWER 46:
The Authority is seeking to deploy a fully hosted solution for which the proposer will maintain all server level and database level administration, thereby providing a clear division of responsibility required to meet the high availability / fault tolerance requirements. The Port Authority will not provide any database administration, which will be responsibility of the Contractor, although we will have the capability to query the database and extract system data. The Authority also requires administrative access to examine and modify some of the system data, such as parameter settings, threshold values, user accounts, etcetera as needed for proper system monitoring and analysis.

QUESTION 47:
Please provide a list of NAS Operators which have already committed to provide access to relevant JFK operational data. Please list all planned NAS Operator interfaces that the SMS will establish connectivity to for access to this data. *(Attachment C, 11, IV.D.3.f)*

ANSWER 47:
Local JFK stakeholders (Users) will continue to provide relevant information manually. It is expected that the Service will have features as described throughout Attachment C that enable user-friendly manual updates to readiness indicators. If NAS Operators choose to provide such information in an automated fashion, the open architecture required shall be capable of accepting and processing such information.

QUESTION 48:
Please clarify the role of the SMS in ensuring safety critical taxi and runway conformance monitoring? *(Attachment C, 18, IV.D.4.o)*

ANSWER 48:
The intention of the subject section is not to ensure safety critical in taxi and runway conformance monitoring. The intention is to alert users that one or more of their aircraft are involved in an off-nominal event and prompt them to take necessary action.

QUESTION 49: The requirement for the Authority to approve all screen layouts for existing products is not a practical approach to achieve the aggressive contract schedule and introduces significant risk for the contractor. Would the Authority consider removing this requirement? *(Attachment C, 30, V.I)*

ANSWER 49:
No, however, we will expedite the review of screen layouts as necessary to maintain the project schedule.

QUESTION 50:
The "Cost Proposal Form" states that 25% payment will be made after successful completion of a 30 day operational test. In Attachment C of the RFP the request is for a 14 day operational test. Please confirm the duration of the operational test. *(Attachment B, 57, 57)*

ANSWER 50:
See CHANGES/MODIFICATIONS item 4.

QUESTION 51:
Please identify applicable local codes. *(Attachment C, 4, I.B)*

ANSWER 51:
Applicable electrical codes for equipment installation.

QUESTION 52:
When is the approval request for the hosting facility location to be submitted? In what format and by what medium is the approval request for the hosting facility location to be submitted? How much time will it take for the Authority to indicate approval of the hosting facility location approval once the proposed hosting location information has been submitted? *(Attachment C, 5, II.A*

ANSWER 52:

- **The approval request for the hosting facility location should be submitted in accordance with the project schedule proposed by the Contractor. The submittal should be scheduled to allow the Contractor to perform all work necessary to meet or exceed the project Implementation schedule stated in Attachment C. Section II A.**
- **See Attachment C IX.A.2 for the submittal format.**
- **See Attachment C IX.A.1 for the Submittal review time.**

QUESTION 53:
Please clarify that the Authority's use of the term "current contract" refers to the contract expected to be awarded as described in this RFP and not a separate existing contract. If this is referring to an existing contract, please identify the contract title, contractor, and period of performance. *(Attachment C, 5, II.A)*

ANSWER 53:
The Port Authority has an agreement with the Aviation Development Council to provide Passur IROPSnet and Sensis Aerobahn computer software services to JFK Airport. Passur IROPSnet services have been provided to the airport for approximately 8 years and Sensis Aerobahn Services have been available for approximately 2 years. The Port Authority does contract directly with Passur or Sensis Aerobahn for these services.

QUESTION 54:
Please clarify the Base Date of Operational Usage on or before 2011. Should the date be 2012? *(Attachment C, 5, II.B)*

ANSWER 54:
See CHANGES/MODIFICATIONS item 5.

QUESTION 55:
Please clarify the Authority's use of the term "SMS Site". Please clarify which positions are expected to be staffed onsite (Authority facility) and which positions are expected to be staffed off-site, where off-site is a facility that is not owned or leased by the Authority. Please clarify the responsibilities of the SMS Operator. *(Attachment C, 5-6, III)*

ANSWER 55:
SMS Site refers to the location at JFK, Building 145 where the site visit took place during the Pre-proposal meeting on June 17, 2011. It is assumed that the SMS Operator is the only position that is expected to be staffed at the SMS Site. Please refer to Attachment B, Contract Specific Terms and Conditions, 35, Section 8 for detailed explanation of Job Classifications. A proposed plan indicating how the Contractor will staff the Service to meet the terms of the Contract and Specifications is expected.

QUESTION 56:
Please describe the Authority's standard operating procedures as related to aircraft metering and specifically departure management. *(Attachment C, 8, IV.C)*

ANSWER 56:
Exhibit 10 and Exhibit 11 includes task-specific versions of the current procedures. They living documents, subject to continuous improvement as lessons are learned. It is the intention of the Authority and Users for the Procedures to remain amendable to continue growth and program improvement.

QUESTION 57:
Please clarify this requirement and how the access of the 15 users is different from the 3200 authorized users: "*16. Provide live flight tracking of inbound and outbound flights from the surface to 10,000 feet and within an 100-mile radius of the airport for 15 Port Authority Users." (Attachment C, 8, IV.C)*

ANSWER 57:
The 15 Port Authority Authorized Users affected by this requirement are described in Attachment C, 29, V, F, 1. g. Such Users are not direct participants in Surface Management but will benefit by having access to flight tracking information.

QUESTION 58:
Please clarify the Authority's use of the term "flight tracking software". *(Attachment C, 31, V. M. bullet 4)*

ANSWER 58:
See Attachment C, 8, IV. C. 16

QUESTION 59:
Please confirm that any identified supporting tools would be addressed as Supplemental Work. *(Attachment C, 9, IV.C)*

ANSWER 59:
Integration of FIDS data is not Supplemental Work and should be accounted for in the cost proposal Integration of "other data" sources addressed in the document will be treated as Supplemental Work when or if they become available.

QUESTION 60:
Please clarify that integration with any "Other data" will be addressed as "Supplemental Work". *(Attachment C, 11, IV.D.3)*

ANSWER 60:
Integration of FIDS data is not Supplemental Work and should be accounted for in the cost proposal. Integration of "other data" sources addressed in the document will be treated as Supplemental Work when or if they become available. Integration of "other data" sources addressed in the document will be treated as Supplemental Work when or if they become available.

QUESTION 61:
Please clarify the Authority's use of the terms "Estimated" and "Predicted" times of arrival and departure. *(Attachment C, 12, IV.D.4.a)*

ANSWER 61:
The estimated time may come from a source such as TFMS, TMA or the Operator. The System shall provide the predicted or forecasted time through calculation.

QUESTION 62:
Please explain the specific aircraft movement that this requirement is trying to determine travel time. Is this all on the surface at JFK or is this a representation of the total time for the flight leg? *(Attachment C, 12, IV.D.4.a)*

ANSWER 62:
Attachment C, 12, IV.D.4.a refers to the specific aircraft movement on the surface at JFK.

QUESTION 63:
Please provide the format of the physical details of the airport layout to be made available at contract award. *(Attachment C, 13, IV.D.4.c)*

ANSWER 63:
After contract reward and within five business days of request by the Contractor, the Authority will provide to the Contractor, an electronic version in AutoCAD or PDF format containing all required details.

QUESTION 64:
Please clarify that the airport layout provided by the Authority will contain all required features (i.e. runways, hold bars, taxiways, ramps, gates/stands, and other fixed elements). *(Attachment C, 13, IV.D.4.d)*

ANSWER 64:
After contract reward and within five business days of request, the Authority will provide to the Contractor, an electronic version in AutoCAD or PDF format containing all required features.

QUESTION 65:
Please clarify the Authority's use of the terms 'calendar days', 'business days', 'working days' and 'days' throughout the RFP. *(Attachment C, 19 IV.D.5.E, 26 V.D.1, 39 IX.B.5, 46 X.A.2)*

ANSWER 65:
Calendar days: 1 day
Business days: Monday-Friday, not including Federal Holidays
Working days: Refers to the individual employee's work schedule
Days: 24 hours, analogous to Calendar day

QUESTION 66:
Does the requirement to extract XML include the voice recordings from monitored local frequencies? *(Attachment C, 28, V.D.10)*

ANSWER 66:
No. Please refer to Attachment C, 10, IV. D. 1. E. for voice playback capability requirements.

QUESTION 67:
Function based access control would provide access to general functionality including map display, reports, flight lists, alerts, etc., but not be data focused as listed here with airport terminal data, ramp area data, and airline data identified. Please describe the expected functionality associated with this level of control (e.g., if a user doesn't have airport terminal data access, can a data tag include the expected parking gate - or is parking gate considered airline data). *(Attachment C, 28, V.F)*

ANSWER 67:
Due to the mixed operating environment at JFK, some terminal operators and airlines require access to multiple Airline's information where others do not. This expected functionality is required to protect proprietary information while enabling ease of job function.

QUESTION 68:
The hardware and software used for the system will be "state-of-the-art" however, the timing of third party vendor releases compared to system testing and integration and releases does not seem to make it practical to provide the latest commercially available software and hardware once these phases have initiated. Would the Authority accept software and hardware that has been made commercially available within the last year? *(Attachment C, 30, V.H)*

ANSWER 68:
Yes

QUESTION 69: Is there an "approved Change Management" procedure in existence that the Authority expects to be followed, or will the Contractor be expected to propose such a procedure? *(Attachment C, 31, V.L)*

ANSWER 69:
Contractor is expected to propose an acceptable change management a procedure, which will be reviewed and commented upon in accordance with the submittal requirements stated in Attachment C, Section IX A.

QUESTION 70:
As this is a hosted system, how would the contractor control workstation memory and disk usage? *(Attachment C, 32, VI.A)*

ANSWER 70:
Although the Contractor does not control workstation memory and disk usage, the proposed web-based solution should not require the use of much disk space. The memory performance requirement is waived as the operating system will determine its usage.

QUESTION 71:
Please clarify the term 'Administrative Training'? *(Attachment C, 32-33, VII.B)*

ANSWER 71:
Administrative training is defined in Attachment C, Section V.F.1.h.

QUESTION 72:
Please clarify the respective roles of the Authority and the Proposer in the conduct of the Operational tests. *(Attachment C, 35, VIII.B)*

ANSWER 72:
See Attachment C, VIII.B, "The Port Authority operating staff with the advice and assistance of the Contractor shall perform the Operational Test ...Port Authority staff and Users will operate the System using the latest version of all applicable manuals, printed guides and procedures."

QUESTION 73: There are a number of items specified as part of the project plan that are not consistent with a hosted, web-based application (e.g. installation plans, communications conduit, etc.). Do these requirements apply to the hosted facilities or the installations on the Authority property? *(Attachment C, 37-38, IX.B)*

ANSWER 73:
Any work that impacts the delivery of services for the contract needs to be included in a project plan and schedule to enable the Port Authority to monitor progress towards gaining operational usage and delivery of the services stated therein, such as building a new data center, or installation of specialized equipment, developing new software, configuration of the database, etc.

QUESTION 74:
Please confirm when the Authority will provide specific users, roles, and workstation locations to enable the Contractor to submit the required documentation. *(Attachment C, 40, IX.B.5.a)*

ANSWER 74:
The Authority will respond to Contractor requests for specific information after issuance of a Contract Award Letter.

QUESTION 75:
Are the drawings required for the hosted web-based application and the Authority location? *(Attachment C, 41, IX.B.6.b)*

ANSWER 75:
No, only for Authority locations.

QUESTION 76:
Is this requirement specific to equipment on Authority property? *(Attachment C, 41, IX.B.6.c)*

ANSWER 76:
Yes.

QUESTION 77:
Please clarify the term "master set of all manuals"? *(Attachment C, 44, IX.B.10.b)*

ANSWER 77:
One set of the final edition of all manuals that contain all editing changes.

QUESTION 78:
Is PDF an acceptable file format to submit artifacts to the Authority? *(Attachment C, 45, IX.B.13)*

ANSWER 78:
See Change/Modification #6

QUESTION 79:
Does this requirement refer to cost associated with disaster recovery for the hosted web-based application or for the Authority sites? *(Exhibit 3, 1, I.A.2)*

ANSWER 79:
The requirement refers to costs associated with disaster recovery for the hosted web-based application.

QUESTION 80:
Please clarify that this checklist item refers to the system documentation requirements (section IX.B.5 System Documentation) and would not introduce additional documentation requirements. *(Exhibit 5, 1, General)*

ANSWER 80:
Attachment C Section IX.B.5 System Documentation refers to system documentation that shall be submitted to the Authority as part of the Contract. Exhibit 5, Section 1 General requires the Contractor to have documented procedures for the work it has to perform, as an example, the process to add a new user to the system: the Authority submits a request to the

Contractor to add a new user with certain access privileges, the Contractor adds the new user, records the date and time the new user was added and notifies the Authority that the work was performed. The documented procedure would not necessarily be submitted to the Authority for review and comment but would need to be produced in response to an Audit request.

QUESTION 81:
Please clarify that all requirements associated with "PA policy" are stated explicitly in the SOW. If all requirements associated with "PA policy" are not stated in the SOW, please identify the requirements necessary to meet the "PA policy". *(Exhibit 5, 1, General)*

ANSWER 81:
See Change/Modification #7

QUESTION 82:
For the current system that will be replaced by Phase A, can you please make available the following documents:
- Functional Requirements
- External interfaces and corresponding ICDs
- Hardware and network architecture
- Reporting requirements including sample reports
- # of users
- Type of users (access roles)
- Locations of users

(Attachment C, 4, II.A)

ANSWER 82:
All of the information relevant to the requirements of Phase A are detailed in Attachment C, Scope of Work and Specifications, pages 7 and 8, 4. C.

QUESTION 83:
Please clarify that all components of the system be must considered Fault Tolerant versus Highly Available to meet the requested goal of 99.99% availability. *(Attachment C, 32, VI.B)*

ANSWER 83:
The System shall be redundant and fault tolerant, in accordance with the requirements stated in Attachment C, VI.B, which includes all components of the System.

QUESTION 84:
RFP Section 8.F.1 paragraph 2 states that "The Proposer shall respond to each heading included in the Scope of Work and Specifications, Attachment C". Please confirm that "each heading" for the response is limited to Levels 1 through 3 (e.g., IV.B.1 Hosting the System) which matches the Attachment C Table of Contents. *(RFP, 18, 8.F.1)*

ANSWER 84:
Correct. "Each heading" for the response should cover, at a minimum, levels one through three (e.g., IV.B.1 Hosting the System).

QUESTION 85:
In the RFP there is no specific limit on page count for any of the sections. Please confirm that all material submitted will be read and considered in the proposal evaluations. *(RFP, All, All)*

ANSWER 85:
As per Section 8 page 15 of the RFP "Proposal Submission Requirements", all materials that are submitted with the proposal will be read and considered during the proposal evaluation process providing that the Proposal Submission Requirements are followed.

QUESTION 86:
When will the proposer's presentations/demonstrations be made to the Authority and how much time will be allocated for each presentation/demonstration? *(RFP, 22, 8.F.6)*

ANSWER 86:
See answer 9. The proposer demonstration may not exceed four (4) hours.

QUESTION 87:
In order to provide you with a thorough proposal with comprehensive solutions, we require an extension to the proposal due date. As such, we respectfully request an extension to the proposal due date for the above-referenced solicitation from 11 July 2011 to 12 August 2011.

ANSWER 87:
See answer 24.

QUESTION 88:
Section E Proposal submission requirements asks for documents to be submitted in a "form that can be easily recycled (i.e., no plastic covers or binding)". Does this suggest that all materials must be paper bound? Would submission in a standard three ring binder be acceptable?

ANSWER 88:
All materials do not require paper binding. A three ring binder is acceptable.

QUESTION 89:
With regard to the metering room, would construction activities for outfitting this room need to be done as a tenant project?

ANSWER 89:
No. It will be handled as a maintenance letter since the contractor is not a tenant.

QUESTION 90:
The RFP references a code of conduct that we have not been able to locate. Could you provide a copy of this document or a link to it if it is available on-line.

ANSWER 90:
See CHANGES/MODIFICATIONS, items 11 and 12, which include task-specific versions of the current procedures. They living documents, subject to continuous improvement as

lessons are learned. It is the intention of the Authority and Users for the Procedures to remain amendable to continue growth and program improvement.

QUESTION 91:
Page 18 of RFP Section 1 states the following: "For the maintenance of the SMS equipment, the Proposer shall include a comprehensive preventive maintenance plan...which will include a plan for actively monitoring and reporting on system performance especially as it pertains to key points of failure."

a. We assume this maintenance plan does NOT include the equipment involved in the ASDE-X surveillance system at JFK. Can you please confirm that assumption?

ANSWER 91:
Yes. The assumption is correct.

QUESTION 92:
Will the Port Authority provide full, unfiltered JFK ASDE-X feed, including where available surveillance of the non-movement areas?

ANSWER 92:
Please see the response to question 26.

QUESTION 93:
Prerequisites (RFP Part 1, Section 3, page 9): If the PANYNJ will allow for JV proposers to jointly meet the prerequisite requirements, will they also allow for the experience of Proposer's team-subs (sub contractors) to qualify toward aggregate satisfaction of the prerequisites?

ANSWER 93:
No.

QUESTION 94:
Prerequisites (RFP Part 1, Section 3, page 9): One of the pre-requisites listed is "three (3) years of continuous experience immediately prior to the date of the submission of the its proposal in the development, installation, management, testing and operation of that is specifically tailored to the function of improving overall surface and airspace system efficiency and predictability while enhancing safety..." We assume that experience in providing aircraft metering, surface condition information (including runway status and availability), and collaboration and coordination services during deicing operations at several major airports counts towards the requirement of "improving overall surface ... system efficiency ..." Please confirm this assumption.

ANSWER 94:
As stated in Section 3 "Proposer Prerequisites" page 9, "Proposers who can demonstrate that they can comply with the following prerequisites should submit proposals, as only such proposals from such Proposers will be considered".

QUESTION 95:
Attachment B, Part III, Section 4 (Intellectual Property): It is our intention to provide preexisting software programs to satisfy the contract requirements. However, in some instances these software programs may

require modifications to meet the specific contract requirements. Would such modified software programs be considered preexisting under clause B or "prepared or compiled in connection with this Agreement" under clause A.

ANSWER 95:
Modifications to existing software programs to meet the specific contract requirements would be considered to be "prepared or compiled in connection with this Agreement" under clause A.

QUESTION 96:
Attachment B, Part III, Section 5 (Proprietary Rights): Does the Authority consider this Scope of Work to include "research, development, or consultative services" under this clause? If yes, specifically which of these services?

ANSWER 96:
The Scope of Work may include "research, development, or consultative services."

QUESTION 97:
(RE: same subsection as above) Please explain the term "not custom software" and its meaning under this clause.

ANSWER 97:
"Not custom software" is commercially available, off-the-shelf software or the vendor's standard software that was not specifically developed for this Contract.

QUESTION 98:
The RFP Management Proposal requires a Disaster Recovery Plan, yet it is also a deliverable per the SOW for the contractor. Please clarify the PANYNJ's expectation for both (proposal requirement vs. contract deliverable).

ANSWER 98:
The proposer should prepare a high-level version of the disaster recovery plan that is being proposed to be implemented, for evaluation, and would not include such details as people's telephone numbers. Once a contract is awarded, Contractor shall prepare a detailed disaster recovery plan that contains all of the information required to be included in the disaster recovery plan.

QUESTION 99:
At what point are the proposers expected to demonstrate the capabilities required in Phases A and B?

ANSWER 99:
The Proposers should demonstrate the capabilities within their proposal submission. If additional information is required, the Port Authority may request additional information.

QUESTION 100:
SOW Page 5 of 51: Section 2.B. Base Date of Operational Usage states: "The Base Date of Operational Usage is on or before January 15, 2011." We assume this was a typo and should be 2012?

ANSWER 100:
See Changes/Modifications #5

QUESTION 101:
Page 18 of 51, Attachment C: Alerts to User. The requirement to provide alerts for; "an aircraft enters a runway or taxiway that it is not planned to enter," "an aircraft enters a runway that it is not allowed to enter at this time," and "an aircraft deviates from its predicted path on the airport surface" could require coded-taxi routes or some other mechanism to automatically convey the planned route of movement on the surface for the aircraft/intent of the aircraft. Do you envision the use of any particular FAA system feed that would supplement or enable any of the above alerts?

ANSWER 101:
Currently there are no known coded taxi routes in use at JFK.

QUESTION 102:
Exhibit 5, Checklists, Page 15 of 19, Security Requirements, lists Oracle as the database. Is Oracle required or will any other appropriately capable database be acceptable?

ANSWER 102:
Oracle or another appropriately capable database may be acceptable

QUESTION 103:
SOW Page 33 of 51, Section 2, Training Coach, states: "Contractor shall provide an on-site coach to work at each of the 9 terminal facilities to work directly with the terminal operators and coach them in the use of the system. Coaching shall be conducted concurrently at each terminal facility for a minimum of three days and provide coverage for each of the 2 operational shifts." Please confirm that this means 9 x 3 days simultaneously over two shifts.

ANSWER 103:
9x 3 days is correct.

QUESTION 104:
If the anticipated contract-type is fixed price, what is the PA's interest in a SAS-70 Audit?

ANSWER 104:
To ensure that the system is designed and built to meet the Information Technology (IT) security requirements of the contract and to ensure that the Contractor actually follows the practices and policies for IT security.

QUESTION 105:
Are the work sites in construction areas or near hazardous materials?

ANSWER 105:
The work site is not in a construction area or near hazardous materials.

QUESTION 106:
What, if any, are the OSHA requirements associated with this RFP/contract?

ANSWER 106:
There are no known OSHA requirements associated with this RFP.

QUESTION 107:
Did the PA intend to state duplicative liquidated damages, stated in Attachment B, Sec. 16, subsections B and F.? Both subsections impose $200/day for late distribution of reports pursuant to SOW Section IV, C.

ANSWER 107:
See Change/Modification # 8

QUESTION 108:
Can you please advise if not bidding Phase A, but only a Phase B solution will disqualify or disadvantage an offerer?

ANSWER 108:
As stated in Attachment C, 9, IV, D, Phase B includes all requirements in Phase A in addition to the requirements in Phase B. If a contractor is capable of implementing the requirements of both Phases at one time, it should be presented.

This communication should be initialed by you and annexed to your proposal upon submission.

In case any Proposer fails to conform to these instructions, its proposal will nevertheless be construed as though this communication had been so physically annexed and initialed.

THE PORT AUTHORITY OF NY & NJ

KATHY LESLIE WHELAN, MANAGER
PURCHASING SERVICES DIVISON

PROPOSER'S FIRM NAME: Sensis Corporation

INITIALED: GW

DATE: 7/26/2011

QUESTIONS CONCERNING THIS ADDENDUM MAY BE ADDRESSED TO LESLEY BROWN, WHO CAN BE REACHED AT (212) 435-3969.

Exhibit 10

SURFACE FLOW METERING PROCEDURES

Surface Flow Metering Procedures will be in use during peak periods. Metering operations expand on current practices. The procedures are collaboratively designed to reduce ground congestion, reduce wait time at the runway for takeoff, reduce fuel burn and reduce the amount of time passengers will be held onboard the aircraft.

1. **Surface Flow Metering Procedure:**

   a. Obtain ATIS information. When procedures are in effect the ATIS broadcast will indicate:
   'Metering procedures are in effect.'

   b. After receiving ATC Clearance
      - Contact Ramp Control to obtain expected taxi time and metering location instructions.
      - Expect to hold either on your ramp or in a metering location within a movement or non-movement area of the airport.

NOTE: At this time if the departure delays are increasing, Ramp Control may issue an 'Expect Taxi Time.' This is the time to be at the top of the ramp and ready for taxi to the runway.

   1. Metering ON the gate: Ramp Control may issue an Estimated Taxi Time that is later than the regularly scheduled departure time along with instructions to hold at the gate. The Flight Crew must continue to monitor Ramp Control and coordinate pushback clearance to meet Expected Taxi Time. At the Estimated Taxi Time and upon completion of pushback, Flight Crews will be released by Ramp Control to request TAXI FOR DEPARTURE.

   2. Metering OFF the gate: Due to gate conflict or ramp congestion, Ramp Control may issue an Estimated Taxi Time and instruct the crew to request an off-ramp metering location from Ground Control. In this case the flight crew must request clearance from Ground Control for taxi to their 'Metering Location.' Once parked in the metering area, continue to monitor BOTH Ground and Ramp Control Frequencies. (Note: Due to the dynamics of the system, estimated taxi time may be amended. RAMP CONTROL will provide updated information to the flight crew; therefore, it is necessary to remain in radio contact as operationally feasible.) The flight crew will hold in the metering area and monitor Ramp Control until released to request TAXI FOR DEPARTURE.

NOTE: While holding in a metering or gated location, Flight Crews must monitor both Ground Control and Ramp Control. DO NOT request taxi for takeoff prior to your Estimated Taxi Time (ETT).

3. GENERAL INFORMATION

a. To ensure the integrity of the Surface Flow Metering Procedures, Flight Crews must coordinate to complete pushback and engine start to meet issued Expected Taxi Time.

b. When operationally advantageous, Ramp Control may issue an 'Expect Engine Start Time' to aid the flight crew in coordination of sequence and preparation of the aircraft for taxi.

c. As changes occur, Flight Crews can expect to receive updates from Ramp Control. Flight Crews shall monitor and maintain radio contact with Ramp Control at all times. Failure to respond to two (2) successive calls or the inability to taxi at the issued time will require the aircraft to be re-sequenced into the departure flow at a later time.

NOTE: *Failure to monitor Ramp Control after being instructed to remain on the frequency for any update/revision shall terminate 3rd Party/ATC liability for any delays incurred.*

d. Flight Crew of commuter/general aviation aircraft that cannot transmit/receive unless the engines are running, shall advise Ramp Control so that an alternative procedure can be arranged.

e. When Ramp Control advises the Flight Crew they are 'RELEASED TO REQUEST TAXI FOR DEPARTURE,' Flight Crew may call Ground Control and request 'TAXI FOR DEPARTURE.'

f. Every reasonable effort will be made to provide advance information on the implementation of these procedures.

g. Due to the ongoing testing and development of the system, changes to the procedures may occur.

h. Standard phraseology will be maintained between the 3rd Party, Terminal Operator and FAA during assignment of metering locations to Flight Crews.

4. DEFINITIONS

- *Expected Departure Clearance Time (EDCT): The runway release time assigned to an aircraft in a controlled arrival time program (terminal or airspace) and shown on the flight progress strip as and EDCT.

- Metering Location: A designated parking area that may be on a movement or non-movement area designed to synchronize surface movement with the current method of time-regulating arrival and departure flows through a terminal area so as not to exceed a predetermined terminal acceptance rate.

- Expected Taxi Time (ETT): The time an aircraft is expected to be first in line at the top of the ramp or metering location and ready for taxi to the runway. Expected taxi time is predicated on the following restrictions: Enroute (Miles in Trail), Local, Expected Departure Clearance Time (EDCT), Airport Conditions (Closures), Weather, Proposed Departure Time, First Fix Availability, Company-Specific Decision Processes.

- *Monitor: (When used with communication transfer) listen on a specific frequency and stand-by for instructions. Under normal circumstances, <u>do not</u> initiate communications.

*Definition used in accordance with the Pilot/Controller Glossary

Exhibit 11

Ramp Tower Guidance for Metering Procedures at JFK

This process is designed to reduce ground and ramp congestion at JFK. Ramp Control Centers are advised to familiarize their staff with this process. Utilization will improve communication, reduce delays, and reduce fuel burn on the surface of JFK.

1. All Ramp Control Centers must access and be logged into the JFK IROPSNET program.

2. All scheduled carriers will be listed in the IROPSNET program. Any changes or additions to the schedule must to be entered into IROPSNET by Ramp Control.

3. JFK Tower will advise the 3rd Party Vendor of the current departure rate for the runway combinations in use and any forecasted changes expected.

4. 3rd Party Vendor will enter the given rate into IROPSNET to generate the list of Estimated Taxi Times displayed in 15-minute buckets. Slot distribution numbers will be transmitted to Ramp Control electronically via IROPSNET.

5. Ramp Control will continuously review IROPSNET and update the planned taxi times for their aircraft. In the event that an aircraft cannot meet the assigned Estimated Taxi Time, Ramp Control may substitute an aircraft that will meet the time; a revised Estimated Taxi Time will be arranged for the delinquent aircraft. If the Airline or Terminal Operator does not have an aircraft for substitute, the slot must be offered back to the community in a timely fashion to ensure reallocation by the 3rd Party Vendor.

6. Ramp Control will advise the 3rd Party Vendor when an aircraft will require an off-ramp metering location. 3rd Party Vendor will assign the metering location to the Ramp Control, who will issue instructions to the pilot. The pilot will communicate the assigned metering location to Ground Control during their taxi request.

Example transmission from Ramp Control to aircraft after pushback is complete:
"Ramp Control: *Speed bird 101, your metering location is on PA short of Q. Continue to monitor me on your #2 for release. Contact Ground on 121.9 when ready for tax to metering location.*"

7. Ramp Control will contact metering aircraft shortly before Estimated Taxi Time to advise engine start and to release aircraft from their metering location. This is the point at which the Flight Crew may request to taxi for departure.

8. Ramp Control will advise 3rd Party Vendor when any situation arises that might disrupt flow of aircraft (i.e. gate conflicts), and when multiple metering locations will be required. This coordination should take place as far in advance as operationally feasible.

9. The 3rd Party Vendor will populate the flights for Unscheduled Carriers/GA aircraft. Any updates or changes to the proposed times must be called in to the 3rd Party Vendor by the Carrier's local operations personnel so that and Estimated Taxi Time can be assigned. Please note: if a delay of more than 5 minutes from the planned time is expected, the Unscheduled Carrier's local operations personnel must communicate the delay in a timely fashion, and prior to missing the time so the slot. The communication can take place via telephone or the IROPSNET chat function and will ensure the slot can be reallocated to the community.

10. In ensure integrity of the procedures set forth, open communication is encouraged between Ramp Control Centers, the 3rd Party Vendor and other partners on and off the field. IROPSNET and/or telephone hotlines will be utilized to enhance open dialogue.

THE PORT AUTHORITY OF NY & NJ

PROCUREMENT DEPARTMENT
ONE MADISON AVENUE 7TH FL.
NEW YORK, NY 10010

Date: August 3, 2011

ADDENDUM #3

To prospective Proposers on Request for Proposals #24997 for SURFACE MANAGEMENT SYSTEM AT JOHN F. KENNEDY INTERNATIONAL AIRPORT (JFK)

☒ **Proposals due back on August 8, 2011, no later than 2:00 PM**

☒ Proposals originally due on July 11, 2011, no later than 2:00 PM

CHANGES/MODIFICATIONS:

The following changes/modifications are hereby made to the solicitation documents:

1. Delete Attachment B, Part I, Section 3, "Duration" and replace with:

Section 3. Duration

(a) The term of the Contract (hereinafter called the "Base Term") is for three (3) year period and is estimated to commence on December 1, 2011 at 12:01 o'clock a.m. (said date and time hereinafter sometimes called "the Commencement Date") and unless sooner terminated or revoked or extended as provided in Paragraph (b) and (c) hereof shall expire on November 30, 2014 at 11:59 o'clock p.m. (said date and time hereinafter sometimes called the "Expiration Date"). The Base Term of the contract as described in Attachment C: Scope of Work, in detail, herein as described below.

- **Implementation Periods:**

  1. Phase A-Commencement Date: On or before February 15, 2012

  2. Phase B-Commencement Date: On or before August 1, 2012

- **Operational Usage:** Host, Operate, Administer and Maintain System - On or before February 15, 2012 at 12:01 o'clock a.m. - November 30, 2014 at 11:59 o'clock p.m., or as otherwise may be extended as set forth below.

(b) The Port Authority shall have the right to extend this Contract for three (3) additional one (1) year Option Periods to November 30, 2017 (hereinafter called the "Option Period") following the Expiration Date, upon the same terms and conditions If the Port Authority shall elect to exercise the Option(s) to extend this Contract, then, no later than thirty (30) days prior to the Expiration Date, the Port Authority shall send a notice that it is extending the Base Term of this Contract, and this Contract shall thereupon be extended for the applicable Option Period. If the Contract provides for more than one Option Period, the same procedure shall apply with regard to extending the term of this Contract for succeeding Option Periods.

(c) The Port Authority shall have the absolute right to extend the Base Term for an additional period of up to one hundred and twenty (120) days subsequent to the Expiration Date of the Base Term, or the Expiration Date of the final exercised Option Period (hereinafter called the "Extension Period"), subject to the same terms and conditions as the previous contract period. The prices quoted by the Contractor for the previous contract period shall remain in effect during this Extension Period without adjustment. If it so elects to extend this Contract, the Port Authority will advise the Contractor, in writing, that the term is so extended, and stipulate the length of the extended term, at least thirty (30) days prior to the expiration date of the previous contract period.

This communication should be initialed by you and annexed to your proposal upon submission.

In case any Proposer fails to conform to these instructions, its proposal will nevertheless be construed as though this communication had been so physically annexed and initialed.

THE PORT AUTHORITY OF NY & NJ

KATHY LESLIE WHELAN, MANAGER
PURCHASING SERVICES DIVISON

PROPOSER'S FIRM NAME: Sensis Corporation

INITIALED: GW

DATE: 8/3/2011

QUESTIONS CONCERNING THIS ADDENDUM MAY BE ADDRESSED TO LESLEY BROWN, WHO CAN BE REACHED AT (212) 435-3969.

Sensis

Detect the Difference

August 2, 2011
KAS:11-630

Ms. Lesley Brown
The Port Authority of NY & NJ
Procurement Department
1 Madison Avenue, 7th Floor
New York, NY 10010

Subject: **C. Agreement on Terms and Discussions**

RFP No.: **24997**

Reference: Sensis Proposal dated August 8, 2011

Enclosure: **Exceptions: Attachment B: Part III – General Contract Provisions**

Dear Ms. Brown:

Pursuant to the Proposal Submission Requirements at Paragraph C – Agreement on Terms and Discussion, Sensis hereby submits the following for additional discussions and negotiations prior to a potential Contract Award:

Attachment B: Part I - Contract Specific Terms and Conditions

Section	Sensis Comment
5 - Insurance Procured by the Contractor	Sensis requests a discussion regarding the specific terms.
16 – Liquidate Damages	Sensis requests a discussion regarding the specific terms.

*Attachment B: Part III – General Contract Provisions**

**The below tables include the portions of actual language taken from the above referenced RFP section. Sensis has underlined certain language that we would like to discuss for clarification and/or alternative language. For those clauses without specific underlined language, Sensis seeks clarification in writing prior to acceptance.*

If the Port Authority has any interim questions regarding these exceptions, please feel free to contact me directly. It is Sensis' opinion that mutually agreeable terms and conditions are achievable with minimal negotiation.

5717 Enterprise Parkway, East Syracuse, NY 13057 Phone: 315-445-0550 Fax: 315-446-2209
www.sensis.com

Sincerely,

Kathy Selmser
Manager, ATS Contracts
Sensis Corporation

5717 Enterprise Parkway, East Syracuse, NY 13057 Phone: 315-445-5076 Fax: 315-446-2209
www.sensis.com

Section	Heading
	1 GENERAL AGREEMENT
	The undersigned (hereinafter referred to as the "Contractor" or "you") agrees to provide, and The Port Authority of New York and New Jersey (hereinafter referred to as the "Authority") agrees to provide the surface management services, as more fully set forth in the Scope of Work attached hereto and made a part hereof The Scope of Work requires the doing of all things necessary or proper for or incidental to the requirements as set forth in the Scope of Work. All things not expressly mentioned in the Scope of Work but involved in carrying out their intent are required by the Scope of Work and the Contractor shall perform the same as though they were specifically mentioned, described and delineated.
	4 INTELLECTUAL PROPERTY
A	Except as provided below: as between the Port Authority and the Contractor all process flows, codes including, but not limited to scripts, programs, routines, processes, procedures, documentation, estimates, reports, records, data, charts, documents, models, designs, renderings, drawings, specifications, photographs, computations, computer tapes or discs, and other documentation of any type whatsoever, whether electronic or in the form of writing, figures or delineations, which are prepared or compiled in connection with this Agreement, shall become the exclusive property of the Authority, and the Authority shall have the exclusive right to use or permit the use of them and any ideas or methods represented by them for any purpose and at any time without other compensation than that specifically provided for herein. *With regard to training manuals or any other knowledge transfer documentation, communication or presentation prepared under this Agreement the Authority shall expressly have the right to use,* alter and reproduce including electronically, said manuals for its internal business purposes. The Contractor hereby warrants and represents that the Authority will have at all times the ownership and rights provided for in the immediately preceding sentence free and clear of all claims of third persons whether presently existing or arising in the future and whether presently known to either of the parties to this Agreement or not. Any information given to the Port Authority before, with or after submission of the Agreement on Terms of Discussion, either orally or in writing, is not given in confidence and may be used, or disclosed to others, for any purpose at any time without obligation or compensation and without liability of any kind whatsoever *except as otherwise set forth in the Agreement On Terms Of Discussion*
	3 GENERAL PROVISIONS
B	Any services performed for the benefit of the Authority at any time by you or on your behalf, even if expressly and duly authorized by the Authority, shall be deemed to be rendered under and subject to this Agreement (unless referable to another expressly written, duly executed agreement by the same parties), whether such additional services are performed prior to, during or subsequent to the services described herein, and no rights or obligations shall arise out of such additional services except as provided under this Agreement.
	5 PROPRIETY RIGHTS IN SUBJECT MATTER NOT WITHIN THE INTELLECTUAL PROPERTY CLAUSE
	If in accordance with this Contract the Contractor furnishes research, development or consultative services in connection with the performance of the Work and if in the course of such research, development, or consultation patentable or copyrightable subject matter or trade secrets or other proprietary matter is produced by the Contractor, its officers, agents, employees, subcontractors, or suppliers, not custom software, and not covered under clause 6 entitled Intellectual Property, the Authority shall have, without cost or expense to it, an irrevocable, non-exclusive, royalty-free license to make, have made, and use, either itself or by anyone on its behalf, such subject matter in connection with any activity now or hereafter engaged in or permitted by the Authority. Promptly upon request by the Authority, the Contractor shall furnish or obtain from the appropriate person a form of license satisfactory to the Authority, but it is expressly understood and agreed that as between the Contractor and the Authority the license herein provided for shall nevertheless arise for the benefit of the Authority immediately upon the production of said subject matter and shall not await formal exemplification in a written license agreement as provided for above. Such license may be transferred by the Authority to its successors, immediate or otherwise, in the operations of or ownership of any facility now or hereafter operated by the Authority or the Authority but such license shall not be otherwise transferable. The right of the Authority as well as the Contractor to use all patented material, compositions of matter, manufactures, apparatus, appliances, processes of manufacture or types of construction as well as any copyrightable matter, trade secrets or other proprietary matters, shall be obtained by the Contractor without separate or additional compensation whether the same is patented or copyrighted before, during or after the performance of the Work.

6 INDEMNITY IN REGARD TO INFRINGEMENT MATTER

The Contractor shall indemnify the Authority against and save it harmless from all loss and expense incurred in the defense, settlement or satisfaction of any claims in the nature of patent, copyright, or other proprietary rights infringement arising out of or in connection with the Authority's use, in accordance with the preceding clause of such patentable subject matter or patented material, compositions of matter, manufactures, apparatus, appliances, processes of manufacture or types of construction, or copyrighted matter or other matter protected as intellectual property. If requested by the Authority and if notified promptly in writing of any such claims, the Contractor shall conduct all negotiations with respect to and defend such claim without expense to the Authority. If the Authority be enjoined from using any of the facilities which form the subject matter of this Contract, and as to which the Contractor is to indemnify the Authority against proprietary rights claims, the Authority may, at its option and without thereby limiting any other right it may have hereunder or at law or in equity, require the Contractor to supply, temporarily or permanently, facilities not subject to such injunction and not infringing any proprietary rights and if the Contractor shall fail to do so, the Contractor shall, at its expense, remove all such facilities and refund the cost thereof to the Authority and otherwise equitably adjust compensation and take such steps as may be necessary to ensure compliance by the Authority with such injunction, to the satisfaction of the Authority.

The Contractor shall promptly and fully inform the Director of any claims or disputes for infringement or otherwise, whether existing or potential, of which it has knowledge relating to any Intellectual Property used, developed or licensed in connection with the performance of the Work or otherwise in connection with this Contract.

	9	FINAL PAYMENT
		The acceptance by the Contractor, or by anyone claiming by or through him, of the Final Payment shall be and shall operate as a release to the Authority of all claims and of all liability to the Contractor for all things done or furnished in connection with this contract and for *every act and neglect of the Authority* and others relating to or arising out of the this contract, including claims arising out of breach of the contract and claims based on claims of third persons.
	10	DEFAULT, REVOCATION OR SUSPENSION OF CONTRACT
A		If one or more of the following events shall occur:
	5	If one or more of the following... The Contractor, if a corporation, shall, without the prior written approval of the Port Authority, become a surviving or merged corporation in a merger, a constituent corporation in a consolidation, or a corporation in dissolution; or
D		If any of the events enumerated in this Section (Default, Revocation or Suspension of Contract) shall occur prior to commencement date of this Contract the Port Authority upon the occurrence of any such event or any time thereafter during the continuance thereof by twenty-four (24) hours notice may terminate or suspend this Contract and the rights of the Contractor hereunder, such termination or suspension to be effective upon the date specified in such notice.
H		If (1) the Contractor fails to perform any of its obligations under this Contract or any other agreement between the Port Authority and the Contractor (including its obligation to the Port Authority to pay any claim lawfully made against it by any supplier, subcontractor or worker or other person which arises out of or in connection with the performance of this Contract or any other agreement with the Port Authority) or
		(2) any claim (just or unjust) which arises out of or in connection with this Contract or any other agreement between the Port Authority and the Contractor is made against the Port Authority or
		3) any subcontractor under this Contract or any other agreement between the Port Authority and the Contractor fails to pay any claims lawfully made against it by any supplier, subcontractor, worker or other third person which arises out of or in connection with this Contract or any other agreement between the Port Authority and the Contractor or if in the *opinion of the Port Authority any of the aforesaid contingencies is likely to arise, then the Port Authority shall have the right, in its discretion, to withhold out of any payment (final or otherwise) such sums as the Port Authority may deem ample to protect it against delay or loss or to assure the payment of just claims of third persons,* and to apply such sums in such manner as the Port Authority may deem proper to secure such protection or satisfy such claims.
	11	WITHHOLDING OF PAYMENT
		If (1) the Contractor fails to perform any of its obligations under this Contract or any other agreement between the Authority and the Contractor (including his obligation to the Authority to pay any claim lawfully made against him by any materialman, subcontractor or workman or other person which arises out of or in connection with the performance of this Contract or any other agreement with the Authority) or
		(2) any claim (just or unjust) which arises out of or in connection with this Contract or any other agreement between the Authority and the Contractor is made against the Authority or
		(3) any subcontractor under this Contract or any other agreement between the Authority and the Contractor fails to pay any claims lawfully made against him by any materialman, subcontractor, workman or other third person which arises out of on in connection with this Contract or any other agreement between the Authority and the Contractor *or if in the opinion of the Authority any of the aforesaid contingencies is likely to arise, then the Authority shall have the right, in its discretion, to withhold out of any payment (final or otherwise and even though such payment has already been certified as due) such sums as the Authority may deem ample to protect it against delay or loss or to assure the payment of just claims of third persons, and to apply such sums in such manner as the Port Authority may deem proper to protect it against delay or loss or to satisfy such claims.*

	16 CERTAIN CONTRACTOR'S WARRANTIES The Contractor represents and warrants:
E	That, except only for those representations, statements or promises expressly contained in this Contract, no representation, statement or promise, oral or in writing, of any kind whatsoever by the Authority, its Commissioners, officers, agents, employees or consultants has induced the Contractor to enter into this Contract or has been relied upon by the Contractor, including any with reference to: (1) the meaning, correctness, suitability or completeness of any provisions or requirements of this Contract; (2) the nature, existence or location of materials, structures, obstructions, utilities or conditions, which may be encountered at the installation sites; (3) the nature, quantity, quality or size of the materials, equipment, labor and other facilities needed for the performance of this Contract; (4) the general or local conditions which may in any way affect this Contract or its performance; (5) the price of the Contract; or (6) any other matters, whether similar to or different from those referred to in (1) through (5) immediately above, affecting or having any connection with this Contract, the bidding thereon, any discussions thereof, the performance thereof or those employed therein or connected or concerned therewith.
F	That, notwithstanding any requirements of this Contract, any inspection or approval of the Contractor's services by the Authority, or the existence of any patent or trade name, the Contractor nevertheless warrants and represents that the services and any intellectual property supplied to the Authority hereunder shall be of the best quality and shall be fully fit for the purpose for which they are to be used. The Contractor unconditionally guarantees against defects or failures of any kind, including defects or failures in design, workmanship and materials, excepting solely defects or failures which the Contractor demonstrates to the satisfaction of the Authority have arisen solely from accident, abuse or fault of the Authority occurring after issuance of Final Payment hereunder and not due to fault on the Contractor's part. In the event of defects or failures in said services, or any part thereof, then upon receipt of notice thereof from the Authority, the Contractor shall correct such defects or failures as may be necessary or desirable, in the sole opinion of the Authority, to comply with the above guaranty.
	Moreover, the Contractor accepts the conditions at the sites of work as they may eventually be found to exist and warrants and represents that it can and will perform the Contract under such conditions and that all materials, equipment, labor and other facilities required because of any unforeseen conditions (physical or otherwise) shall be wholly at its own cost and expense, anything in this Contract to the contrary notwithstanding.
	Nothing in the Scope of Work or any other part of the Contract is intended as or shall constitute a representation by the Authority as to the feasibility of performance of this Contract or any part thereof. Moreover, the Authority does not warrant or represent either by issuance of the Scope of Work or by any provision of this Contract as to time for performance or completion or otherwise that the Contract may be performed or completed by the times required herein or by any other times,

17 RIGHTS AND REMEDIES OF THE AUTHORITY

The Authority shall have the following rights in the event the Director shall deem the Contractor guilty of a breach of any term whatsoever of this contract:

a) The right to take over and complete the Work or any part thereof as agent for and at the expense of the Contractor, either directly or through other Contractors;
b) The right to cancel this Contract as to any or all of the Work yet to be performed;
c) The right to specific performance, an injunction or any other appropriate equitable remedy;
d) The right to money damages.

For the purpose of this Contract, breach shall include but not be limited to the following, whether or not the time has yet arrived for performance of an obligation under this Contract: a statement by the Contractor to any representative of The Authority indicating that he cannot or will not perform any one or more of his obligations under this Contract; any act or omission of the Contractor or any other occurrence which makes it improbable at the time that he will be able to perform any one or more of his obligations under this Contract; any suspension of or failure to proceed with any part of the Work by the Contractor which makes it improbable at the time that he will be able to perform any one or more of his obligations under this Contract; any false certification at any time by the Contractor as to any material item certified pursuant to the clauses hereof entitled "Certification of No Investigation (Criminal or Civil Anti-Trust), Indictment, Conviction, Debarment, Suspension, Disqualification and Disclosure of Other Required Information" and "Non-Collusive Bidding and Code of Ethics Certification; Certification of No Solicitation Based on Commission, Percentage, Brokerage, Contingent or Other Fee", or the willful or fraudulent submission of any signed statement pursuant to such clauses which is false in any material respect; or the Contractor's incomplete or inaccurate representation of its status with respect to the circumstances provided for in such clauses.

Neither the acceptance of the work or any part thereof, nor any payment therefor, nor any order or certificate issued under this Agreement or otherwise issued by the Authority, or any officer, agent or employee of the Authority, nor any permission or direction to continue with the performance or work, nor any performance by the authority of any of the Contractor's duties or obligations, nor any aid provided to the Contractor by the Authority in his performance of such duties or obligations, nor any other thing done or omitted to be done by the Authority, its Commissioners, officers, agents or employees shall be deemed to be a waiver of any provision of this agreement or of any rights or remedies to which the Authority may be entitled because of any breach hereof, excepting only a resolution of its Commissioners, providing expressly for such waiver. No cancellation, rescission or annulment hereof, in whole or as to any part of the work, because of any breach hereof, shall be deemed a waiver of any money damagesure of Other Required Information" and "Non-Collusive Bidding and Code of Ethics Certification; Certification of No Solicitation Based on Commission, Percentage, Brokerage, Contingent or Other Fee", or

18 RIGHTS AND REMEDIES OF THE CONTRACTOR

Inasmuch as the Contractor can be adequately compensated by money damages for any breach of this Contract which may be committed by the Authority, the Contractor expressly agrees that no default, act or omission of the Authority shall constitute a material breach of this Contract, entitling him to cancel or rescind it or (unless the Director shall so direct) to suspend or abandon performance.

24 INDEMNIFICATION AND RISKS ASSUMED BY THE CONTRACTOR

To the extent permitted by law, the Contractor shall indemnify and hold harmless the Port Authority, its Commissioners, officers, representatives and employees from and against all claims and demands, just or unjust, of third persons (including Contractor's employees, employees, officers, and agents of the Port Authority) arising out of or in any way connected or alleged to arise out of or alleged to be in any way connected with the Contract and all other services and activities of the Contractor under this Contract and for all expenses incurred by it and by them in the defense, settlement or satisfaction thereof, including without limitation thereto, claims and demands for death, for personal injury or for property damage, direct or consequential, *whether they arise from the acts or omissions of* the Contractor, *the Port Authority, third persons* (including Contractor's employees, employees, officers, and agents of the Port Authority), or from the acts of God or the public enemy, or otherwise, including claims and demands of any local jurisdiction against the Port Authority in connection with this Contract.

The Contractor assumes the following risks, whether such risks arise from acts or omissions (negligent or not) of the Contractor, the Port Authority or third persons (including Contractor's employees, employees, officers, and agents of the Port Authority)or from any other cause, *excepting only risks occasioned solely by affirmative willful acts of the Port Authority done subsequent to the opening of proposals on this Contract*, and shall to the extent permitted by law indemnify the Port Authority for all loss or damage incurred in connection with such risks:

If so directed, the Contractor shall at its own expense defend any suit based upon any such claim or demand, even if such suit, claim or demand is groundless, false or fraudulent, and in handling such shall not, without obtaining express advance permission from the General Counsel of the Port Authority, raise any defense involving in any way the jurisdiction of the tribunal over the person of the Port Authority, the immunity of the Port Authority, its Commissioners, officers, agents or employees, the governmental nature of the Port Authority or the provision of any statutes respecting suits against the Port Authority.

26 AUTHORITY OF THE DIRECTOR

Inasmuch as the public interest requires that the Project to which this Contract relates shall be performed in the manner which the Authority, acting through the Director deems best, the Director shall have absolute authority to determine what is or is not necessary or proper for or incidental thereto and the Specifications shall be deemed merely the Director's present determination on this point. In the exercise of this authority, the Director shall have power to alter the Specifications, to require the performance of Work not required by them in their present form, even though of a totally different character from that not required, and to vary, increase and diminish the character, quantity and quality of; or to countermand any Work now or hereafter required. If at any time it shall be, from the viewpoint of the Authority, impracticable or undesirable in the judgment of the Director to proceed with or continue the performance of the Contract or any part thereof, whether or not for reasons beyond the control of the Authority, the Director shall have authority to suspend performance of any part or all of the Contract until such time as the Director may deem it practicable or desirable to proceed. Moreover, if at any time it shall be, from the viewpoint of the Authority impracticable or undesirable in the judgment of the Director to proceed with or continue the performance of the Contract or any part thereof for reasons within or beyond the control of the Authority, the Director shall have authority to cancel this Contract as to any or all portions not yet performed and as to any materials not yet installed even though delivered. Such cancellation shall be without prejudice to the rights and obligations of the parties arising out of portions already satisfactorily performed, but no allowance shall be made for anticipated profits. To resolve all disputes, the parties to this Contract authorize the Director to decide all questions of any nature whatsoever arising out of; under, or in connection with, or in any way related to or on account of; this Contract (*including claims in the nature of breach of contract or fraud or misrepresentation before or subsequent to acceptance of the Contractor's Proposal and claims of a type which are barred by the provisions of this Contract*) and such decision shall be conclusive, final and binding on the parties. The Director's decision may be based on such assistance as she may find desirable. The effect of the decision shall not be impaired or waived by any negotiation or settlement offers in connection with the question decided, whether or not she participated therein, or by any prior decision of her or others, which prior decisions shall be deemed subject to review, or by any termination or cancellation of this Contract.

All such questions shall be submitted in writing by the Contractor to the Director for a decision together with all evidence and other pertinent information in regard to such questions, in order that a fair and impartial decision may be made.

In the performance of the Contract, the Contractor shall conform to all orders, directions and requirements of the Director and shall perform the Contract to her satisfaction at such times and places, by such methods and such manner and sequence as she may require, and the Contract shall at all stages be subject to her inspection. The Contractor shall employ no equipment, materials, methods or men to which she objects, and shall remove no materials, equipment or other facilities from the Authority site without permission. Upon request, she shall confirm in writing any oral order, direction, requirements or determination.

The enumeration herein or elsewhere of particular instances in which the opinion, judgment, discretion or determination of the Director shall control or in which the Contract shall be performed to her satisfaction or subject to her inspection, shall not imply that only the matters of a nature similar to those enumerated shall be so governed and performed, but without exception the entire Contract shall be so governed and performed.

This provision shall be construed in accordance with the laws of the State of New York excluding its conflict of law provisions.

28 CONTRACT REVIEW AND COMPLIANCE AUDITS

The Contractor, and any subcontractors, shall provide system access and reasonable assistance to the Authority's External and Internal Audit staff or its consultants in their performance of work under the contract, including producing specific requested information, extraction of data and reports. The Contractor, and any subcontractors, shall support requests related to audits of the agreement and administration tasks and functions covered by this Contract.

The Authority reserves the right to use and load security and system software to evaluate the level of security and vulnerabilities in all systems which control, collect, dispense, contain, manage, administer, or monitor revenue "owned" by the Port Authority.

32 CONTRACTOR'S INTEGRITY PROVISIONS

During the term of this Contract, the Contractor shall not participate in any way in the preparation, negotiation or award of any contract (other than a contract for its own services to the Authority) to which it is contemplated the Port Authority may become a party, or participate in any way in the review or resolution of a claim in connection with such a contract if the Contractor has a substantial financial interest in the contractor or potential contractor of the Port Authority or if the Contractor has an arrangement for future employment or for any other business relationship with said contractor or potential contractor, nor shall the Contractor at any time take any other action which might be viewed as or give the appearance of conflict of interest on its part. If the possibility of such an arrangement for future employment or for another business arrangement has been or is the subject of a previous or current discussion, or if the Contractor has reason to believe such an arrangement may be the subject of future discussion, or if the Contractor has any financial interest, substantial or not, in a contractor or potential contractor of the Authority, and the Contractor's participation in the preparation, negotiation or award of any contract with such a contractor or the review or resolution of a claim in connection with such a contract is contemplated or if the Contractor has reason to believe that any other situation exists which might be viewed as or give the appearance of a conflict of interest, the Contractor shall immediately inform the Director in writing of such situation giving the full details thereof. Unless the Contractor receives the specific written approval of the Director, the Contractor shall not take the contemplated action which might be viewed as or give the appearance of a conflict of interest.

29 AUTHORITY ACCESS TO RECORDS

The Authority shall have access during normal business hours to all records and documents of the Contractor relating to any service provided under this Agreement, amounts for which it has been compensated, or claims he should be compensated, by The Authority above those included in the lump sum compensation set forth elsewhere herein. All Contractor records shall be kept in the Port District. The Contractor shall obtain for The Authority similar access to similar records and documents of subcontractors. Such access shall be given or obtained both before and within a period of three (3) years after Final Payment to the Contractor, provided, however, that if within the aforesaid one year period The Authority has notified the Contractor in writing of a pending claim by The Authority under or in connection with this Contract to which any of the aforesaid records and documents of the Contractor or of his subcontractors relate either directly or indirectly, then the period of such right of access shall be extended to the expiration of six (6) years from the date of Final Payment with respect to the records and documents involved.

Upon request of the Port Authority, the Contractor shall furnish or provide access to the federal Form 1-9 (Employment Eligibility Verification) for each individual performing work under this Contract. This includes citizens and noncitizens.

The Contractor shall provide, at no cost to the Authority, access for and reasonable assistance to such auditors from the Authority or the Authority's external auditors that may, from time to time, be designated to audit detail records which support Contractor charges to the Authority. The Authority shall have access to the detail records that support Contractor charges to the Authority for up to three (3) years following the termination of the Contract.

No provision in this Contract giving The Authority a right of access to records and documents is intended to impair or affect any right of access to records and documents that The Authority would have in the absence of such provision.

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1. M/WBE PLAN 1

1. M/WBE Plan

As a small business, Sensis is committed to furthering small, minority and women-owned businesses. As such, we make concerted efforts to subcontract with small businesses where possible.

The scope of the solution for this RFP offers some limited opportunities, but is restricted in part by the fact that Aerobahn is an existing software platform developed by Sensis Corporation. As such, the opportunities for subcontracting cannot meet the Port's goals, but our plans do reflect an effort to subcontract to M/WBE contractors.

The following table identifies the opportunities for subcontracting and the Sensis approach.

Scope	Company	Designation
Concept of operations refinement and coordinating such concepts with stakeholders at Kennedy to ensure maximum participation and acceptance	ANSA	MBE, in process of registering
Office Equipment	TBD	Sensis utilizes a number of equipment vendors and will work with the Port to identify a qualified M/WBE in this area.
Live and archived ATC Radio streams for seamless integration into the Aerobahn SMS.	LiveATC.net	LiveATC.net is a small business but does not fall into a W/MBE category.
On-site departure metering coordination staff for all SMS Operators, including recruitment, training, and personnel management.	Robinson Aviation	Sensis received an affirmative statement from Robinson that they will utilize certified M/WBEs where available
Data center and telecommunications services.	Digital Edge	Sensis solicited quotes from multiple subcontractors, but was unable to find a

		qualified M/WBE

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1. SUBCONTRACTORS 1

1. Subcontractors

Sensis intends to use the following subcontractors as part of the SMS solution for JFK.

Company	Contributions
Robinson Aviation	On-site departure metering coordination staff for all SMS Operators, including recruitment, training, and personnel management.
ANSA	Extensive subject matter expertise to be used in all concept of operations refinement and in coordinating such concepts with stakeholders at Kennedy to ensure maximum participation and acceptance,
LiveATC.net	Live and archived ATC Radio streams for seamless integration into the Aerobahn SMS.
Digital Edge	Data center and telecommunications services.

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1. CONFLICT OF INTEREST 1

1. Conflict of Interest

Sensis affirms that no conflicts of interest exist that would preclude a contract award for Sensis Aerobahn. However, the Aerobahn system is currently deployed at JFK. Sensis takes exception to the inclusion of language noting any scenario that "may give the appearance of a possible conflict of interest." Given the subjectivity of this term, Sensis cannot adequately define what appearances other contracts for Aerobahn at JFK may provide, although the deployment and use of Sensis Aerobahn at JFK does not represent a true conflict of interest.

Proposal for

Surface Management System at John F. Kennedy International Airport (JFK)

8 August 2011

Vendor Number RAYTHEO 01752

In Response to

RFP Number 24997

This proposal includes data that shall not be disclosed outside the PANYNJ and shall not be duplicated, used, or disclosed – in whole or in part – for any purpose other than to evaluate this proposal. If, however, a contract is awarded to this offeror as a result of – or in connection with – the submission of this data, the PANYNJ shall have the right to duplicate, use, or disclose the data to the extent provided in the resulting contract. This restriction does not limit the PANYNJ's right to use information contained in this data if it is obtained from another source without restriction. The data subject to this restriction are contained in all pages of this volume.

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Prepared for

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LIST OF ACRONYMS

Acronym	Definition
AATT	Advanced Air Transportation Technologies
ACARS	Aircraft Communications Addressing and Reporting System
ACC	Area Control Center
ACO	Administrative Contracting Officer
ADAS	AWOS Data Acquisition System
ADL	Aggregate Demand List
A/DMT	Arrival/Departure Management Tool
ADS-B	Automatic Dependent Surveillance – Broadcast
ADT	Airspace Design Tool
AFP	Airspace Flow Program
AFSAT	Air Force Satellite
ANSP	Air Navigation Service Provider
AOC	Airline Operations Center
ARTCC	Air Route Traffic Control Center
AS	Application Server
ASA	Adaptive Security Appliance
ASDE-X	Airport Surface Detection Equipment – Model X
ASDI	Aircraft Situation Display to Industry
ATC	Air Traffic Control
ATCAS	Air Traffic Control Automation System
ATCOTS	Air Traffic Control Optimal Training Solution
ATCSCC	Air Traffic Control Strategic Command Center
ATCT	Air Traffic Control Tower
ATFM	Air Traffic Flow Management
ATM	Air Traffic Management
ATMSDI	Air Traffic Management System Development and Integration
ATNS	Air Traffic Navigation Services
AWOS	Aviation Weather Observation System
BOM	Bill of Material
BRP	Business Resumption Plan
C-ATFM	Collaborative Air Traffic Flow Management
CCB	Configuration Control Board
CCTV	Closed Captioned Television
CDM	Collaborative Decision Making
CDQM	Collaborative Departure Queue Management
CDRL	Contract Data Requirement List
CD-ROM	Compact Disk – Read Only Memory
CERAP	Combined En Route Radar Approach Control
CFE	Customer Furnished Equipment
CFT	Call for Taxi
CLIN	Contract Line Item Number
CMMI	Capability Maturity Model Integrated
CNS	Communication, Navigation, Surveillance
ConOps	Concept of Operations
COTS	Commercial Off-the-Shelf
CPAR	Customer Performance Assessment Report

Acronym	Definition
CSV	Comma Separated Values
CTOT	Calculated Takeoff Times
DASR	Digital Airport Surveillance Radar
DC	Data Center
DC	District of Columbia
DDU	Data Distribution Unit
DFM	Departure Flow Management
DHTML	Dynamic Hypertext Markup Language
DISA	Defense Information Systems Agency
DoD	Department of Defense
DRP	Disaster Recovery Plan
DSP	Departure Spacing Program
DST	Decision Support Tool
EDCT	Estimated Departure Clearance Time
EFSTS	Electronic Flight Strip Transfer System
EIS	Environmental Impact Statement
EOBT	Estimated Off Block Time
ERAM	En Route Automation Modernization
ESM	Enhanced Substitution Module
ETA	Estimated Time of Arrival
ETD	Estimated Time of Departure
ETMS	Enhanced Traffic Management System
EWR	Newark Liberty International Airport
FAA	Federal Aviation Administration
FAT	Factory Acceptance Testing
FDM	Flight Data Management
FIR	Flight Information Region
FSM	Flight Schedule Monitor
FTI	FAA Telecommunication Infrastructure
GBSAA	Ground Based Sense and Avoid
GDP	Ground Delay Program
GPS	Global Positioning System
GS	Ground Stop
GUI	Graphical User Interface
HTML	Hypertext Markup Language
HTTPS	Hypertext Markup Language Secure
IA	Information Assurance
IBT	In Block Time
ICAO	International Civil Aviation Organization
ICW	Integrated Controller Workstation
IDAC	Integrated Departure/Arrival Capability
IMS	Integrated Master Schedule
IP	Internet Protocol
IRAD	Independent Research and Development
IROPS	Irregular Operations
ISD	Instructional Systems Development

Acronym	Definition
ISP	Internet Service Provider
ISSE	Information System Security Engineering
IT	Information Technology
ITWS	Integrated Terminal Weather System
JFK	John F. Kennedy International Airport
JMS	Java Messaging Service
LAN	Local Area Network
LDAP	Lightweight Directory Access Protocol
LGA	LaGuardia Airport
LMS	Learning Management System
LRR	Long Range Radar
MA	Massachusetts
MBE	Minority Business Enterprise
MEM	Memphis International Airport
METAR	Meteorological Aviation Report
MINIT	Minutes in Trail
MIT	Massachusetts Institute of Technology
MIT	Miles in Trail
MLAT	Multilateration
MLDT	Mean Logistic Delay Time
MOU	Memorandum of Understanding
MPEG	Moving Picture Experts Group
MTTR	Mean Time to Repair
M/WBE	Minority/Women-Owned Business
N90	New York Terminal Radar Approach Control
NA	Not Applicable
NAS	National Airspace System
NASA	National Aeronautics and Space Administration
NAT	Network Address Translation
NEO	Network Enabled Operations
NIRS	Noise Integrated Routing System
NJ	New Jersey
NOC	National Operations Center
NOTAM	Notice to Airmen
NTML	National Traffic Management Log
NTP	Network Timing Protocol
NTZ	Non-Transgression Zone
NWS	National Weather Service
NY	New York
OBT	Off Block Time
OC	Operations Center
OK	Oklahoma
OEM	Original Equipment Manufacturer
PA	Port Authority
PANYNJ	Port Authority of NY & NJ
PIDS	Perimeter Intrusion Detection System

Acronym	Definition
POC	Point of Contact
PQT	Preliminary Qualification Test
PRM	Precision Runway Monitor
PS	Playback Server
PSAT	Preliminary Site Acceptance Test
QA	Quality Assurance
QE	Quality Engineering
RAC	Real Application Cluster
RAPCON	Radar Approach Control
RAPT	Route and Airspace Planning Tool
RBI	Results-Based Incentive
RBS	Ration by Schedule
RDBMS	Relational Database Management System
RFP	Request for Proposal
RNAV	Area Navigation
RNP	Required Navigation Performance
ROI	Region of Interest
RTSC	Raytheon Technical Services Company
RVR	Runway Visual Range
SAN	Storage Area Network
SAT	Site Acceptance Testing
SDD	Situation Data Display
SIP	System Wide Information Management Implementing Program
SMGCS	Surface Management and Ground Control System
SMS	Surface Management System
SOA	Service Oriented Architecture
SOAP	SOAP Protocol
SOW	Statement of Work
SSL	Secure Socket Layer
STARS	Standard Terminal Automation Replacement System
STCA	Short-Term Conflict Alert
STDDS	SWIM Terminal Data Distribution System
STIG	Security Technical Implementation Group
SWAC	Secured Workers Access Consortium
SWIM	System Wide Information Management
SWIT	Software Integration and Test
TAF	Terminal Area Forecast
TAM	Terminal Area Multilateration
TAMR	Terminal Automation Modernization/Replacement
TBFM	Time Based Flow Management
TBM	Time Based Metering
TCP	Transport Control Protocol
TDDS	Terminal Data Distribution System
TDLS	Tower Data Link Service
TDLS-PDC	Tower Data Link Service Predeparture Clearance
TEB	Teterboro Airport
TFDM	Tower Flight Data Manager

Acronym	Definition
TFM	Traffic Flow Management
TFMM	Traffic Flow Management Modernization
TFMS	Traffic Flow Management System
TLS	Transport Layer Security
TMA	Traffic Management Advisor
TMI	Traffic Management Initiative
TRACON	Terminal Radar Approach Control
TRR	Test Readiness Review
UAV	Unmanned Aerial Vehicle
UPS	Uninterruptible Power Supply
U.S.	United States
USA	United States of America
VPN	Virtual Private Network
WAN	Wide Area Network
WJHTC	William J. Hughes Technical Center
XML	Extensible Markup Language
ZNY	New York Air Route Traffic Control Center

Raytheon

Raytheon Company
Network Centric Systems
1001 Boston Post Road East
Marlborough, MA
01752-3789, USA
508.490.1618
508.490.3377 fax

A. LETTER OF TRANSMITTAL

8 August 2011

The Port Authority of NY & NJ
Purchasing Services Division
1 Madison Avenue, 7th Floor
New York, NY 10010
USA

Attention: Lesley Brown, Contract Specialist

Subject: Raytheon Company Surface Management System at John F. Kennedy International Airport (JFK) Proposal

References:
(a) Request for Proposals (RFP) Number 24997
(b) RFP Number 24997, Addendum 1, dated 7 July 2011
(c) RFP Number 24997, Addendum 2, dated 25 July 2011
(d) RFP Number 24997, Addendum 3, dated 3 August 2011

Attachment: (A1) Certificate of Incorporation with Written Declaration

Enclosures:
(1) Raytheon Company Surface Management System at John F. Kennedy International Airpc (JFK) Proposal, 1 original and 10 hard copies
(2) Raytheon Company Surface Management System at John F. Kennedy International Airpc (JFK) Proposal, 1 CD-ROM

Dear Ms. Brown,

Raytheon Company is pleased to submit its Firm Fixed Price (FFP) proposal in response to the Reference (a to (d) Request for Proposals (RFP), consisting of one original and 10 hard copies, and one CD-ROM, via Enclosures (1) and (2), for the Surface Management System at John F. Kennedy International Airport (JFK) Program. As requested, our proposal is prepared in accordance with the RFP and is valid for 180 days from the date of submission.

- Name and address of proposer:

Raytheon Company
Network Centric Systems
1001 Boston Post Road East
Marlborough, MA 01752-3789
USA

- Contact information for authorized negotiators:

Ellen K. Kelley
Contracts Manager
Telephone Number: 508.490.1618
Fax Number: 508.490.3377
Email Address: Ellen_K_Kelley@raytheon.com

Christopher S. Graham
Senior Contracts Manager
Telephone Number: 508.490.3638
Fax Number: 508.490.3377
Email Address: graham@raytheon.com

- Contact information for persons Port Authority can contact with questions/issues:

Ellen K. Kelley
Contracts Manager
Telephone Number: 508.490.1618
Fax Number: 508.490.3377
Email Address: Ellen_K_Kelley@raytheon.com

Christopher S. Graham
Senior Contracts Manager
Telephone Number: 508.490.3638
Fax Number: 508.490.3377
Email Address: graham@raytheon.com

- Name and address of proposed subcontractors:

Metron Aviation
45300 Catalina Court, Suite 101
Dulles, VA 20166

Christopher Forshier
Director, Business Development for Global Airline Operations
Telephone Number: 703.563.5184
Fax Number: 703.456.0133
Email Address: forshier@metronaviation.com

- As a corporation:
  - Names and residences of corporate officers:

Daniel J. Crowley
Ex. 1

Lynn A. Dugle
Ex. 1

Richard A. Goglia

John D. Harris II

Thomas A. Kennedy
Ex. 1

Taylor W. Lawrence
Ex. 1

Keith J. Peden
Ex. 1

Jay B. Stephens
Ex. 1

William H. Swanson
Ex. 1

David C. Wajsgras
Ex. 1

Michael J. Wood
Ex. 1

Richard R. Yuse
Ex. 1

- Copy of Certificate of Incorporation with Written Declaration – A copy of Raytheon's Certificate of Incorporation with Written Declaration is included in Attachment A1.

We look forward to hearing from you on this important initiative. Should you have any questions, please telephone me at 508.490.1618 or 508.838.4290, or e-mail me at ellen_k_kelley@raytheon.com.

Very truly yours,

RAYTHEON COMPANY

Ellen K. Kelley

Ellen K. Kelley
Manager, Contracts

ATTACHMENT A1. CERTIFICATE OF INCORPORATION WITH WRITTEN DECLARATION

RAYTHEON COMPANY

Assistant Secretary's Certificate

The undersigned, Brooke M. Bartleson, being a duly appointed, qualified and acting Assistant Secretary of Raytheon Company, a Delaware corporation (the "Corporation"), on behalf of the Corporation does hereby certify as follows:

Attached hereto as Exhibit A is a true, correct and complete copy of the Restated Certificate of Incorporation, with all amendments, of the Corporation, as in effect on the date hereof.

IN WITNESS WHEREOF, I have hereunto set my hand this 7th day of July, 2011.

Raytheon Company

By: Brooke M. Bartleson
Brooke M. Bartleson
Assistant Secretary

RAYTHEON COMPANY INCORPORATED 1953 DELAWARE

Delaware

PAGE 1

The First State

I, JEFFREY W. BULLOCK, SECRETARY OF STATE OF THE STATE OF DELAWARE, DO HEREBY CERTIFY THE ATTACHED IS A TRUE AND CORRECT COPY OF THE RESTATED CERTIFICATE OF "RAYTHEON COMPANY", FILED IN THIS OFFICE ON THE SECOND DAY OF APRIL, A.D. 2002, AT 2 O'CLOCK P.M.

0472015 8100

110455950

You may verify this certificate online at corp.delaware.gov/authver.shtml

Jeffrey W. Bullock, Secretary of State

AUTHENTICATION: 8717619

DATE: 04-26-11

STATE OF DELAWARE
SECRETARY OF STATE
DIVISION OF CORPORATIONS
FILED 02:00 PM 04/02/2002
020210881 - 0472015

RESTATED CERTIFICATE OF INCORPORATION
OF
RAYTHEON COMPANY

Raytheon Company (the "Corporation"), a corporation organized and existing under the General Corporation Law of the State of Delaware, does hereby state as follows:

1. The present name of the Corporation is Raytheon Company. The Corporation was originally incorporated under the name "Hughes Aircraft Company" and its original Certificate of Incorporation was filed with the Secretary of State on December 17, 1953.

2. This Restated Certificate of Incorporation was duly adopted by the Board of Directors of the Corporation in accordance with the provisions of Section 245 of the Delaware General Corporation Law.

3. This Restated Certificate of Incorporation only restates and integrates the provisions of the Corporation's Certificate of Incorporation and does not further amend the provisions of the Corporation's Certificate of Incorporation as heretofore amended or supplemented, and there is no discrepancy between those provisions and the provisions of this Restated Certificate.

Article I.
Name

The name of the corporation (which is hereinafter referred to as the "Corporation") is: "Raytheon Company"

Article II.
Registered Agent

The address of the Corporation's registered office in the State of Delaware is The Corporation Trust Center, 1209 Orange Street in the City of Wilmington, County of New Castle. The name of the Corporation's registered agent at such address is The Corporation Trust Company.

Article III.
Purpose

The purpose of the Corporation shall be to engage in any lawful act or activity for which corporations may be organized and incorporated under the General Corporation Law of the State of Delaware (the "DGCL").

Article IV.
Capital Stock

Section 1. The Corporation is authorized to issue 1,650,000,000 shares of capital stock of which (a) 1,450,000,000 shares shall be shares of Common Stock $.01 par value per share ("Common Stock"), and (b) 200,000,000 shares shall be shares of Preferred Stock $.01 par value per share ("Preferred Stock").

Section 2. Common Stock. Except as provided herein, as otherwise provided by law or by the resolution or resolutions adopted by the Board designating the rights, powers and preferences of any series of Preferred Stock, the Common Stock shall have the exclusive right to vote for the election of directors and for all other purposes, in each case acting by such vote as required under applicable law (or by such greater vote than would be required under applicable law as may be set forth herein or in the By-laws of the Corporation). Each share of Common Stock shall have one vote, and the Common Stock shall vote together as a single class on all matters to be voted on by the Corporation's stockholders.

Subject to the rights of the holders of any class or series of outstanding Preferred Stock and subject to any other provisions hereof and applicable law, holders of Common Stock will be entitled to dividends and such other distributions in cash, securities or property of the Corporation as may be declared thereon by the Corporation's Board of Directors, out of funds legally available therefor, whether payable in cash, property or securities of the Corporation.

Section 3. Preferred Stock. The Preferred Stock may be issued from time to time in one or more series. The Board is hereby authorized to provide by resolution from time to time for the issuance of shares of Preferred Stock in series and, by filing a certificate pursuant to the DGCL (hereinafter referred to as a "Preferred Stock Designation"), to establish from time to time the number of shares to be included in each such series, and to fix the designation, powers, privileges, preferences and rights of the shares of each such series and the qualifications, limitations and restrictions thereof. The authority of the Board with respect to each series shall include, but not be limited to, determination of the following:

(a) the designation of the series, which may be by distinguishing number, letter or title;

(b) the number of shares of the series, which number the Board may thereafter (except where otherwise provided in the Preferred Stock Designation) increase or decrease (but not below the number of shares thereof then outstanding);

(c) whether dividends, if any, shall be cumulative or noncumulative, and, in the case of shares of any series having cumulative dividend rights, the date or dates or method of determining the date or dates from which dividends on the shares of such series shall be cumulative;

(d) the rate of any dividends (or method of determining such dividends) payable to the holders of the shares of such series, any conditions upon which such dividends

Raytheon Competition Sensitive/Raytheon Proprietary
Export-Restricted Data
1106-1002

Use or disclosure of data contained on this sheet is subject to the restriction on the title page of this proposal.

shall be paid and the date or dates or the method of determining the date or dates upon which such dividends shall be payable;

(e) the price or prices (or method of determining such price or prices) at which, the form of payment of such price or prices (which may be cash, property or rights, including securities of the same or another corporation or other entity) for which, the period or periods within which and the terms and conditions upon which the shares of such series may be redeemed, in whole or in part, at the option of the Corporation or at the option of the holder or holders thereof or upon the happening of a specified event or events, if any;

(f) the obligation, if any, of the Corporation to purchase or redeem shares of such series pursuant to a sinking fund or otherwise and the price or prices at which, the form of payment of such price or prices (which may be cash, property or rights, including securities of the same or another corporation or other entity) for which, the period or periods within which and the terms and conditions upon which the shares of such series shall be redeemed or purchased, in whole or in part, pursuant to such obligation;

(g) the amount payable out of the assets of the Corporation to the holders of shares of the series in the event of any voluntary or involuntary liquidation, dissolution or winding up of the affairs of the Corporation;

(h) provisions, if any, for the conversion or exchange of the shares of such series, at any time or times at the option of the holder or holders thereof or at the option of the Corporation or upon the happening of a specified event or events, into shares of any other class or classes or any other series of the same or any other class or classes of stock, or any other security, of the Corporation, or any other corporation or other entity, and the price or prices or rate or rates of conversion or exchange and any adjustments applicable thereto, and all other terms and conditions upon which such conversion or exchange may be made;

(i) restrictions on the issuance of shares of the same series or of any other class or series, if any; and

(j) the voting rights, if any, of the holders of shares of the series.

Section 4. Series A Junior Participating Preferred Stock. The Board hereby authorizes the issuance of the Series A Junior Participating Preferred Stock as follows:

(a) Designation and Amount. The shares of such series shall be designated as "Series A Junior Participating Preferred Stock" (the "Series A Preferred Stock") and the number of shares constituting the Series A Preferred Stock shall be 4,000,000. Such number of shares may be increased or decreased by resolution of the Board of Directors; provided, that no decrease shall reduce the number of shares of Series A Preferred Stock to a number less than the number of shares then outstanding plus the number of shares reserved for issuance upon the exercise of outstanding options, rights or warrants or upon the conversion of any outstanding securities issued by the Corporation convertible into Series A Preferred Stock.

Raytheon Competition Sensitive/Raytheon Proprietary
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(b) Dividends and Distributions.

(i) Subject to the rights of the holders of any shares of any series of Preferred Stock (or any similar stock) ranking prior and superior to the Series A Preferred Stock with respect to dividends, the holders of shares of Series A Preferred Stock, in preference to the holders of shares of Class A Common Stock and Class B Common Stock of the Corporation, and of any other junior stock shall be entitled to receive, when, as and if declared by the Board of Directors out of funds legally available for the purpose, quarterly dividends payable in cash on the first day of March, June, September and December in each year (each such date being referred to herein as a "Quarterly Dividend Payment Date"), commencing on the first Quarterly Dividend Payment Date after the first issuance of a share or fraction of a share of Series A Preferred Stock in an amount per share (rounded to the nearest cent) equal to the greater of (A) $1 or (B) subject to the provision for adjustment hereinafter set forth, 100 times the aggregate per share amount of all cash dividends, and 100 times the aggregate per share amount (payable in kind) of all non-cash dividends or other distributions, other than a dividend payable in shares of Common Stock or a subdivision of the outstanding shares of Common Stock (by reclassification or otherwise), declared on the Common Stock since the immediately preceding Quarterly Dividend Payment Date or, with respect to the first Quarterly Dividend Payment Date, since the first issuance of any share or fraction of a share of Series A Preferred Stock. In the event the Corporation shall at any time declare or pay any dividend on the Common Stock payable in shares of Common Stock, or effect a subdivision or combination or consolidation of the outstanding shares of Common Stock (by reclassification or otherwise than by payment of a dividend in shares of Common Stock) into a greater or lesser number of shares of Common Stock, then in each such case the amount to which holders of shares of Series A Preferred Stock were entitled immediately prior to such event under clause (B) of the preceding sentence shall be adjusted by multiplying such amount by a fraction, the numerator of which is the number of shares of Common Stock outstanding immediately after such event and the denominator of which is the number of shares of Common Stock that were outstanding immediately prior to such event.

(ii) The Corporation shall declare a dividend or distribution on the Series A Preferred Stock as provided in paragraph (i) of this subsection immediately after it declares a dividend or distribution on the Common Stock (other than a dividend payable in shares of Common Stock); provided that, in the event no dividend or distribution shall have been declared on the Common Stock during the period between any Quarterly Dividend Payment Date and the next subsequent Quarterly Dividend Payment Date, a dividend of $1 per share on the Series A Preferred Stock shall nevertheless be payable on such subsequent Quarterly Dividend Payment Date.

(iii) Dividends shall begin to accrue and be cumulative on outstanding shares of Series A Preferred Stock from the Quarterly Dividend Payment Date next preceding the date of issue of such shares, unless the date of issue of such shares is prior to the record date for the first Quarterly Dividend Payment Date, in which case dividends on such shares shall begin to accrue from the date of issue of such shares, or unless the date of issue is a Quarterly Dividend Payment Date or is a date after the record date for the determination of holders of shares of Series A Preferred Stock entitled to receive a quarterly dividend and before such Quarterly

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Dividend Payment Date, in either of which events such dividends shall begin to accrue and be cumulative from such Quarterly Dividend Payment Date. Accrued but unpaid dividends shall not bear interest. Dividends paid on the shares of Series A Preferred Stock in an amount less than the total amount of such dividends at the time accrued and payable on such shares shall be allocated pro rata on a share-by-share basis among all such shares at the time outstanding. The Board of Directors may fix a record date for the determination of holders of shares of Series A Preferred Stock entitled to receive payment of a dividend or distribution declared thereon, which record date shall be not more than 60 days prior to the date fixed for the payment thereof.

(c) Voting Rights. The holders of shares of Series A Preferred Stock shall have the following voting rights:

(i) Subject to the provision for adjustment hereinafter set forth, each share of Series A Preferred Stock shall entitle the holder thereof to 100 votes on all matters submitted to a vote of the stockholders of the Corporation. In the event the Corporation shall at any time declare or pay any dividend on the Common Stock payable in shares of Common Stock, or effect a subdivision or combination or consolidation of the outstanding shares of Common Stock (by reclassification or otherwise than by payment of a dividend in shares of Common Stock) into a greater or lesser number of shares of Common Stock, then in each such case the number of votes per share to which holders of shares of Series A Preferred Stock were entitled immediately prior to such event shall be adjusted by multiplying such number by a fraction, the numerator of which is the number of shares of Common Stock outstanding immediately after such event and the denominator of which is the number of shares of Common Stock that were outstanding immediately prior to such event.

(ii) Except as otherwise provided herein, in any other Certificate of Designations creating a series of Preferred Stock or any similar stock or by law, the holders of shares of Series A Preferred Stock and the holders of shares of Class B Common Stock shall vote together as one class on all matters submitted to a vote of stockholders of the Corporation.

(iii) Except as set forth herein, or as otherwise provided by law, holders of Series A Preferred Stock shall have no special voting rights and their consent shall not be required (except to the extent they are entitled to vote with holders of Common Stock as set forth herein) for taking any corporate action.

(d) Certain Restrictions.

(i) Whenever quarterly dividends or other dividends or distributions payable on the Series A Preferred Stock as provided in Section 4(b) are in arrears, thereafter and until all accrued and unpaid dividends and distributions, whether or not declared, on shares of Series A Preferred Stock outstanding shall have been paid in full, the Corporation shall not:

(A) declare or pay dividends, or make any other distributions, on any shares of stock ranking junior (either as to dividends or upon liquidation, dissolution or winding up) to the Series A Preferred Stock;

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(B) declare or pay dividends, or make any other distributions, on any shares of stock ranking on a parity (either as to dividends or upon liquidation, dissolution or winding up) with the Series A Preferred Stock except dividends paid ratably on the Series A Preferred Stock and all such parity stock on which dividends are payable or in arrears in proportion to the total amounts to which the holders of all such shares are then entitled;

(C) redeem or purchase or otherwise acquire for consideration shares of any stock ranking junior (either as to dividends or upon liquidation, dissolution or winding up) to the Series A Preferred Stock provided that the Corporation may at any time redeem, purchase or otherwise acquire shares of any such junior stock in exchange for shares of any stock of the Corporation ranking junior (either as to dividends or upon dissolution, liquidation or winding up) to the Series A Preferred Stock; or

(D) redeem or purchase or otherwise acquire for consideration any shares of Series A Preferred Stock or any shares of stock ranking on a parity with the Series A Preferred Stock except in accordance with a purchase offer made in writing or by publication (as determined by the Board of Directors) to all holders of such shares upon such terms as the Board of Directors, after consideration of the respective annual dividend rates and other relative rights and preferences of the respective series and classes, shall determine in good faith will result in fair and equitable treatment among the respective series or classes.

(ii) The Corporation shall not permit any subsidiary of the Corporation to purchase or otherwise acquire for consideration any shares of stock of the Corporation unless the Corporation could, under paragraph (i) of this Section 4(d), purchase or otherwise acquire such shares at such time and in such manner.

(e) Reacquired Shares. Any shares of Series A Preferred Stock purchased or otherwise acquired by the Corporation in any manner whatsoever shall be retired and canceled promptly after the acquisition thereof. All such shares shall upon their cancellation become authorized but unissued shares of Preferred Stock and may be reissued as part of a new series of Preferred Stock subject to the conditions and restrictions on issuance set forth herein, in the Certificate of Incorporation, or in any other Certificate of Designations creating a series of Preferred Stock or any similar stock or as otherwise required by law.

(f) Liquidation, Dissolution or Winding Up. Upon any liquidation, dissolution or winding up of the Corporation, no distribution shall be made (1) to the holders of shares of stock ranking junior (either as to dividends or upon liquidation, dissolution or winding up) to the Series A Preferred Stock unless, prior thereto, the holders of shares of Series A Preferred Stock shall have received $100 per share, plus an amount equal to accrued and unpaid dividends and distributions thereon, whether or not declared, to the date of such payment, provided that the holders of shares of Series A Preferred Stock shall be entitled to receive an aggregate amount per share, subject to the provision for adjustment hereinafter set forth, equal to 100 times the aggregate amount to be distributed per share to holders of shares of Common Stock or (2) to the holders of shares of stock ranking on a parity (either as to dividends or upon liquidation, dissolution or winding up) with the Series A Preferred Stock except distributions made ratably on the Series A Preferred Stock and all such parity stock in proportion to the total amounts to

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which the holders of all such shares are entitled upon such liquidation, dissolution or winding up. In the event the Corporation shall at any time declare or pay any dividend on the Common Stock payable in shares of Common Stock, or effect a subdivision or combination or consolidation of the outstanding shares of Common Stock (by reclassification or otherwise than by payment of a dividend in shares of Common Stock) into a greater or lesser number of shares of Common Stock then in each such case the aggregate amount to which holders of shares of Series A Preferred Stock were entitled immediately prior to such event under the proviso in clause (1) of the preceding sentence shall be adjusted by multiplying such amount by a fraction the numerator of which is the number of shares of Common Stock outstanding immediately after such event and the denominator of which is the number of shares of Common Stock that were outstanding immediately prior to such event.

(g) Consolidation, Merger, etc. In case the Corporation shall enter into any consolidation, merger, other than the merger of Raytheon Company with and into the Corporation, combination or other transaction in which the shares of Common Stock are exchanged for or changed into other stock or securities, cash and/or any other property, then in any such case each share of Series A Preferred Stock shall at the same time be similarly exchanged or changed into an amount per share, subject to the provision for adjustment hereinafter set forth, equal to 100 times the aggregate amount of stock securities, cash and/or any other property (payable in kind), as the case may be, into which or for which each share of Common Stock is changed or exchanged. In the event the Corporation shall at any time declare or pay any dividend on the Common Stock payable in shares of Common Stock or effect a subdivision or combination or consolidation of the outstanding shares of Common Stock (by reclassification or otherwise than by payment of a dividend in shares of Common Stock) into a greater or lesser number of shares of Common Stock then in each such case the amount set forth in the preceding sentence with respect to the exchange or change of shares of Series A Preferred Stock shall be adjusted by multiplying such amount by a fraction, the numerator of which is the number of shares of Common Stock outstanding immediately after such event and the denominator of which is the number of shares of Common Stock that were outstanding immediately prior to such event.

(h) No Redemption. The shares of Series A Preferred Stock shall not be redeemable.

(i) Rank. The Series A Preferred Stock shall rank, with respect to the payment of dividends and the distribution of assets, junior to all series of any other class of the Corporation's Preferred Stock.

(j) Amendment. The Certificate of Incorporation of the Corporation shall not be amended in any manner which would materially alter or change the powers, preferences or special rights of the Series A Preferred Stock so as to affect them adversely without the affirmative vote of the holders of at least two-thirds of the outstanding shares of Series A Preferred Stock voting together as a single class.

Section 5. General. The Common Stock shall be subject to the express terms of the Preferred Stock and any series thereof. Except as otherwise provided by law or by the

resolution or resolutions adopted by the Board designating the rights, powers and preferences of any series of Preferred Stock the Common Stock shall have the exclusive right to vote for the election of directors and for all other purposes, and holders of Preferred Stock shall not be entitled to receive notice of any meeting of stockholders at which they are not entitled to vote. The Corporation shall be entitled to treat the person in whose name any share of its stock is registered as the owner thereof for all purposes and shall not be bound to recognize any equitable or other claim to, or interest in, such share on the part of any other person, whether or not the Corporation shall have notice thereof, except as expressly provided by applicable law.

Article V.
Stockholder Action

Any action required or permitted to be taken by the stockholders of the Corporation must be effected at a duly called annual or special meeting of such holders and may not be effected by any consent in writing by such holders. Except as otherwise required by law and subject to the rights of the holders of any class or series of stock having a preference over the Common Stock as to dividends or upon liquidation, special meetings of stockholders of the Corporation for any purpose or purposes may be called only by the Board pursuant to a resolution stating the purpose or purposes thereof approved by a majority of the total number of directors which the Corporation would have if there were no vacancies (the "Whole Board") or by the Chairman of the Board and any power of stockholders to call a special meeting is specifically denied. No business other than that stated in the notice shall be transacted at any special meeting.

Article VI.
Board of Directors

Section 1. Number, election and terms. The number of directors of the Corporation shall be, except as otherwise fixed by or pursuant to the provisions of Article IV relating to the rights of the holders of any class or series of stock having a preference over the Common Stock as to dividends or upon liquidation to elect additional directors under specified circumstances, fixed from time to time exclusively pursuant to a resolution adopted by a majority of the Whole Board (but shall not be less than three). The directors, other than those who may be elected by the holders of any class or series of stock having a preference over the Common Stock as to dividends or upon liquidation, shall be classified, with respect to the time for which they severally hold office, into three classes, as nearly equal in number as possible, one class to be originally elected for a term expiring at the annual meeting of stockholders to be held in 1998, another class to be originally elected for a term expiring at the annual meeting of stockholders to be held in 1999, and another class to be originally elected for a term expiring at the annual meeting of stockholders to be held in 2000, with each director to hold office until such person's successor is duly elected and qualified. At each succeeding annual meeting of stockholders, directors elected to succeed those directors whose terms then expire shall be elected for a term of office to expire at the third succeeding annual meeting of stockholders after their election, with each director to hold office until such person's successor shall have been duly elected and qualified.

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Section 2. Stockholder nomination of director candidates; Stockholder Proposal of Business. Advance notice of stockholder nominations for the election of directors and of the proposal of business by stockholders shall be given in the manner provided in the By-Laws of the Corporation, as amended and in effect from time to time.

Section 3. Vacancies and newly created directorships. Except as otherwise provided for or fixed by or pursuant to the provisions of Article IV relating to the rights of the holders of any class or series of stock having a preference over the Common Stock as to dividends or upon liquidation to elect directors under specified circumstances, (i) vacancies on the Board resulting from death, resignation, disqualification, removal or other cause shall be filled by the affirmative vote of a majority of the remaining directors then in office, even though less than a quorum of the Board, and not by the stockholders and (ii) newly created directorships resulting from any increase in the number of directors after the adoption of a resolution by a majority of the Whole Board in accordance with Section 1 of this Article VI shall be filled by the affirmative vote of the holders of Common Stock, voting in accordance with the provisions of Section 2 of Article IV.

Any director appointed in accordance with clause (i) of the preceding sentence shall hold office until the next annual or special meeting of stockholders and until such director's successor shall have been duly elected and qualified. Any director elected in accordance with clause (ii) of the preceding sentence shall hold office for the remainder of the full term of the class of director in which the new directorship was created and until such director's successor shall have been duly elected and qualified. No decrease in the number of directors constituting the Board shall shorten the term of any incumbent director.

Section 4. Removal. Subject to the rights of any class or series of stock having a preference over the Common Stock as to dividends or upon liquidation to elect directors under specified circumstances, any director may be removed from office only for cause by the affirmative vote of the holders of the shares of Common Stock, voting in accordance with the provisions of Section 2 of Article IV.

Article VII.
By-Laws

The By-Laws may be altered or repealed and new By-Laws may be adopted (1) at any annual or special meeting of stockholders, by the affirmative vote of the holders of the shares of Common Stock voting in accordance with Section 2 of Article IV; provided, however, that in the case of any such stockholder action at a special meeting of stockholders, notice of the proposed alteration, repeal or adoption of the new By-Law or By-Laws must be contained in the notice of such special meeting, or (2) by the affirmative vote of a majority of the Whole Board.

Article VIII.
Amendment of Certificate of Incorporation

The Corporation reserves the right at any time from time to time to amend, alter, change or repeal any provision contained in this Certificate of Incorporation, and any other

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provisions authorized by the laws of the State of Delaware at the time in force may be added or inserted, in the manner now or hereafter prescribed by law; and, except as set forth in Article X all rights, preferences and privileges of whatsoever nature conferred upon stockholders, directors or any other persons whomsoever by and pursuant to this Certificate of Incorporation in its present form or as hereafter amended are granted subject to the right reserved in this Article.

Article IX.
Corporate Action

In addition to any other considerations which the Board may lawfully take into account, in determining whether to take or to refrain from taking corporate action on any matter, including making or declining to make any recommendation to the stockholders of the Corporation, the Board may in its discretion consider the long-term as well as short-term best interests of the Corporation (including the possibility that these interests may be best served by the continued independence of the Corporation), taking into account, and weighing as the directors deem appropriate, the effects of such action on employees, suppliers and customers of the Corporation and its subsidiaries and the effect upon communities in which offices or other facilities of the Corporation are located, and any other factors the directors consider pertinent.

Article X.
Limited Liability; Indemnification

Section 1. Limited Liability of Directors. A director of the Corporation shall not be personally liable to the Corporation or its stockholders for monetary damages for breach of fiduciary duty as a director, except to the extent such exemption from liability or limitation thereof is not permitted under the DGCL as the same exists or may hereafter be amended. Neither the amendment nor repeal of Section 1 of this Article X shall eliminate or reduce the effect of Section 1 of this Article X in respect of any matter occurring, or any cause of action, suit or claim that, but for Section 1 of this Article X would accrue or arise, prior to such amendment or repeal.

Section 2. Indemnification and Insurance.

(a) Right to Indemnification. Each person who was or is made a party or is threatened to be made a party to or is involved in any action, suit or proceeding, whether civil, criminal, administrative or investigative (hereinafter a "proceeding"), by reason of the fact that such person, or a person of whom such person is the legal representative, is or was a director or officer of the Corporation or is or was serving at the request of the Corporation as a director or officer of another corporation or of a partnership, joint venture, trust or other enterprise, including service with respect to employee benefit plans, whether the basis of such proceeding is alleged action in an official capacity as a director or officer or in any other capacity while serving as a director or officer shall be indemnified and held harmless by the Corporation to the fullest extent authorized by the DGCL, as the same exists or may hereafter be amended (but, in the case of any such amendment, to the fullest extent permitted by law, only to the extent that such amendment permits the Corporation to provide broader indemnification rights than said law

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permitted the Corporation to provide prior to such amendment), against all expense, liability and loss (including attorneys' fees, judgment, fines, amounts paid or to be paid in settlement, and excise taxes or penalties arising under the Employee Retirement Income Security Act of 1974, as in effect from time to time) reasonably incurred or suffered by such person in connection therewith and such indemnification shall continue as to a person who has ceased to be a director or officer, and shall inure to the benefit of such person's heirs, executors and administrators; provided, however, that, except as provided in paragraph (b) of this Section, the Corporation shall indemnify any such person seeking indemnification in connection with a proceeding (or part thereof) initiated by such person only if such proceeding (or part thereof) was authorized by the Board. The right to indemnification conferred in this Section shall be a contract right and shall include the right to have the Corporation pay the expenses incurred in defending any such proceeding in advance of its final disposition; any advance payments to be paid by the Corporation within 20 calendar days after the receipt by the Corporation of a statement or statements from the claimant requesting such advance or advances from time to time; provided, however, that, if and to the extent the DGCL requires, the payment of such expenses incurred by a director or officer in such person's capacity as a director or officer (and not in any other capacity in which service was or is rendered by such person while a director or officer, including, without limitation, service to an employee benefit plan) in advance of the final disposition of a proceeding, shall be made only upon delivery to the Corporation of an undertaking, by or on behalf of such director or officer, to repay all amounts so advanced if it shall ultimately be determined that such director or officer is not entitled to be indemnified under this Section or otherwise. The Corporation may, to the extent authorized from time to time by the Board, grant rights to indemnification, and rights to have the Corporation pay the expenses incurred in defending any proceeding in advance of its final disposition, to any employee or agent of the Corporation to the fullest extent of the provisions of this Article with respect to the indemnification and advancement of expenses of directors and officers of the Corporation.

(b) Right of Claimant to Bring Suit. If a claim under paragraph (a) of this Section is not paid in full by the Corporation within 30 calendar days after a written claim has been received by the Corporation, the claimant may at any time thereafter bring suit against the Corporation to recover the unpaid amount of the claim and, if successful in whole or in part, the claimant shall be entitled to be paid also the expense of prosecuting such claim. It shall be a defense to any such action (other than an action brought to enforce a claim for expenses incurred in defending any proceeding in advance of its final disposition where the required undertaking, if any is required, has been tendered to the Corporation) that the claimant has not met the standard of conduct which makes it permissible under the DGCL for the Corporation to indemnify the claimant for the amount claimed, but the burden of proving such defense shall be on the Corporation. Neither the failure of the Corporation (including its Board of Directors, independent legal counsel, or its stockholders) to have made a determination prior to the commencement of such action that indemnification of the claimant is proper in the circumstances because the claimant has met the applicable standard of conduct set forth in the DGCL, nor an actual determination by the Corporation (including its Board, independent legal counsel, or its stockholders) that the claimant has not met such applicable standard of conduct, shall be a defense to the action or create a presumption that the claimant has not met the applicable standard of conduct.

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(c) Non-Exclusivity of Rights. The right to indemnification and the payment of expenses incurred in defending a proceeding in advance of its final disposition conferred in this Section shall not be exclusive of any other right which any person (including, without limitation, any person other than an officer or director of the Corporation) may have or hereafter acquire under any statute, provision of the Certificate of Incorporation, By-Laws, agreement, vote of stockholders or disinterested directors or otherwise. No repeal or modification of this Article shall in any way diminish or adversely affect the rights of any director or officer of the Corporation hereunder in respect of any occurrence or matter arising prior to any such repeal or modification.

(d) Insurance. The Corporation may maintain insurance, at its expense, to protect itself and any director, officer, employee or agent of the Corporation or another corporation, partnership, joint venture, trust or other enterprise against any such expense, liability or loss, whether or not the Corporation would have the power to indemnify such person against such expense, liability or loss under the DGCL.

(e) Severability. If any provision or provisions of this Article X shall be held to be invalid, illegal or unenforceable for any reason whatsoever: (1) the validity, legality and enforceability of the remaining provisions of this Article X (including, without limitation, each portion of any paragraph of this Article X containing any such provision held to be invalid, illegal or unenforceable, that is not itself held to be invalid, illegal or unenforceable) shall not in any way be affected or impaired thereby, and (2) to the fullest extent possible, the provisions of this Article X (including, without limitation, each such portion of any paragraph of this Article X containing any such provision held to be invalid, illegal or unenforceable) shall be construed so as to give effect to the intent manifested by the provision held invalid, illegal or unenforceable.

IN WITNESS WHEREOF, the Corporation has caused this Restated Certificate of Incorporation to be duly executed this 1st day of April, 2002.

RAYTHEON COMPANY

By: John W. Kapples /s/
John W. Kapples
Vice President and Secretary

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Delaware

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The First State

I, JEFFREY W. BULLOCK, SECRETARY OF STATE OF THE STATE OF DELAWARE, DO HEREBY CERTIFY THE ATTACHED IS A TRUE AND CORRECT COPY OF THE CERTIFICATE OF DESIGNATION OF "RAYTHEON COMPANY", FILED IN THIS OFFICE ON THE SECOND DAY OF APRIL, A.D. 2002, AT 2:01 O'CLOCK P.M.

0472015 8100

110455950

You may verify this certificate online at corp.delaware.gov/authver.shtml

Jeffrey W. Bullock, Secretary of State

AUTHENTICATION: 8717620

DATE: 04-26-11

STATE OF DELAWARE
SECRETARY OF STATE
DIVISION OF CORPORATIONS
FILED 02:01 PM 04/02/2002
020210887 - 0472015

CERTIFICATE OF DESIGNATION OF

PREFERENCES AND RIGHTS OF

RAYTHEON COMPANY

SERIES B JUNIOR PARTICIPATING

PREFERRED STOCK

Raytheon Company, a Delaware corporation (hereinafter called, the "Corporation"), pursuant to Section 151 of the General Corporation Law of the State of Delaware, does hereby make this Certificate of Designation and does hereby state and certify that pursuant to the authority expressly vested in the Board of Directors of the Corporation by the Restated Certificate of Incorporation of the Corporation (the "Restated Certificate"), the Board of Directors of the Corporation duly adopted the following resolutions:

RESOLVED, that pursuant to Article IV of the Restated Certificate (which authorizes 200,000,000 shares of preferred stock, $.01 par value), the Board of Directors of the Corporation hereby fixes the voting powers, designations and preferences and the relative, participating, optional and other special rights, and the qualifications, limitations and restrictions thereof, of the Series B Junior Participating Preferred Stock.

RESOLVED, that each share of the Series B Junior Participating Preferred Stock shall rank equally in all respects and shall be subject to the following provisions:

SECTION 1. Designation and Amount. The shares of such series shall be designated as "Series B Junior Participating Preferred Stock" (the "Series B Preferred Stock") and the number of shares constituting the Series B Preferred Stock shall be 6,000,000. Such number of shares may be increased or decreased by resolution of the Board of Directors; provided, that no decrease shall reduce the number of shares of Series B Preferred Stock to a number less than the number of shares then outstanding plus the number of shares reserved for issuance upon the exercise of outstanding options, rights or warrants or upon the conversion of any outstanding securities issued by the Corporation convertible into Series B Preferred Stock.

SECTION 2. Dividends and Distributions.

(a) Subject to the rights of the holders of any shares of any series of Preferred Stock (or any similar stock) ranking prior and superior to the Series B Preferred Stock with respect to dividends, the holders of shares of Series B Preferred Stock, in preference to the holders of shares of common stock, $0.01 par value, of the Corporation ("Common Stock"), and of any other junior stock shall be entitled to receive, when, as and if declared by the Board of Directors out of funds legally available for the purpose, quarterly dividends payable in cash on the first day of March, June, September and December in each year (each such date being referred to herein as a "Quarterly Dividend Payment Date"), commencing on the first Quarterly Dividend Payment Date after the first issuance of a share or fraction of a share of Series B

Preferred Stock in an amount per share (rounded to the nearest cent) equal to the greater of (A) $1 or (B) subject to the provision for adjustment hereinafter set forth, 100 times the aggregate per share amount of all cash dividends, and 100 times the aggregate per share amount (payable in kind) of all non-cash dividends or other distributions, other than a dividend payable in shares of Common Stock or a subdivision of the outstanding shares of Common Stock (by reclassification or otherwise), declared on the Common Stock since the immediately preceding Quarterly Dividend Payment Date or, with respect to the first Quarterly Dividend Payment Date, since the first issuance of any share or fraction of a share of Series B Preferred Stock. In the event the Corporation shall at any time declare or pay any dividend on the Common Stock payable in shares of Common Stock, or effect a subdivision or combination or consolidation of the outstanding shares of Common Stock (by reclassification or otherwise than by payment of a dividend in shares of Common Stock) into a greater or lesser number of shares of Common Stock, then in each such case the amount to which holders of shares of Series B Preferred Stock were entitled immediately prior to such event under clause (B) of the preceding sentence shall be adjusted by multiplying such amount by a fraction, the numerator of which is the number of shares of Common Stock outstanding immediately after such event and the denominator of which is the number of shares of Common Stock that were outstanding immediately prior to such event.

(b) The Corporation shall declare a dividend or distribution on the Series B Preferred Stock as provided in paragraph (a) of this section immediately after it declares a dividend or distribution on the Common Stock (other than a dividend payable in shares of Common Stock); provided that, in the event no dividend or distribution shall have been declared on the Common Stock during the period between any Quarterly Dividend Payment Date and the next subsequent Quarterly Dividend Payment Date, a dividend of $1 per share on the Series B Preferred Stock shall nevertheless be payable on such subsequent Quarterly Dividend Payment Date.

(c) Dividends shall begin to accrue and be cumulative on outstanding shares of Series B Preferred Stock from the Quarterly Dividend Payment Date next preceding the date of issue of such shares, unless the date of issue of such shares is prior to the record date for the first Quarterly Dividend Payment Date, in which case dividends on such shares shall begin to accrue from the date of issue of such shares, or unless the date of issue is a Quarterly Dividend Payment Date or is a date after the record date for the determination of holders of shares of Series B Preferred Stock entitled to receive a quarterly dividend and before such Quarterly Dividend Payment Date, in either of which events such dividends shall begin to accrue and be cumulative from such Quarterly Dividend Payment Date. Accrued but unpaid dividends shall not bear interest. Dividends paid on the shares of Series B Preferred Stock in an amount less than the total amount of such dividends at the time accrued and payable on such shares shall be allocated pro rata on a share-by-share basis among all such shares at the time outstanding. The Board of Directors may fix a record date for the determination of holders of shares of Series B Preferred Stock entitled to receive payment of a dividend or distribution declared thereon, which record date shall be not more than 60 days prior to the date fixed for the payment thereof.

SECTION 3. Voting Rights. The holders of shares of Series B Preferred Stock shall have the following voting rights:

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(a) Subject to the provision for adjustment hereinafter set forth, each share of Series B Preferred Stock shall entitle the holder thereof to 100 votes on all matters submitted to a vote of the stockholders of the Corporation. In the event the Corporation shall at any time declare or pay any dividend on the Common Stock payable in shares of Common Stock, or effect a subdivision or combination or consolidation of the outstanding shares of Common Stock (by reclassification or otherwise than by payment of a dividend in shares of Common Stock) into a greater or lesser number of shares of Common Stock, then in each such case the number of votes per share to which holders of shares of Series B Preferred Stock were entitled immediately prior to such event shall be adjusted by multiplying such number by a fraction, the numerator of which is the number of shares of Common Stock outstanding immediately after such event and the denominator of which is the number of shares of Common Stock that were outstanding immediately prior to such event.

(b) Except as otherwise provided herein, in any other Certificate of Designations creating a series of Preferred Stock or any similar stock or by law, the holders of shares of Series B Preferred Stock and the holders of shares of Common Stock shall vote together as one class on all matters submitted to a vote of stockholders of the Corporation.

(c) Except as set forth herein, or as otherwise provided by law, holders of Series B Preferred Stock shall have no special voting rights and their consent shall not be required (except to the extent they are entitled to vote with holders of Common Stock as set forth herein) for taking any corporate action.

SECTION 4. Certain Restrictions.

(a) Whenever quarterly dividends or other dividends or distributions payable on the Series B Preferred Stock as provided in Section 2 are in arrears, thereafter and until all accrued and unpaid dividends and distributions, whether or not declared, on shares of Series B Preferred Stock outstanding shall have been paid in full, the Corporation shall not:

(i) declare or pay dividends, or make any other distributions, on any shares of stock ranking junior (either as to dividends or upon liquidation, dissolution or winding up) to the Series B Preferred Stock;

(ii) declare or pay dividends, or make any other distributions, on any shares of stock ranking on a parity (either as to dividends or upon liquidation, dissolution or winding up) with the Series B Preferred Stock except dividends paid ratably on the Series B Preferred Stock and all such parity stock on which dividends are payable or in arrears in proportion to the total amounts to which the holders of all such shares are then entitled;

(iii) redeem or purchase or otherwise acquire for consideration shares of any stock ranking junior (either as to dividends or upon liquidation, dissolution or winding up) to the Series B Preferred Stock provided that the Corporation may at any time redeem, purchase or otherwise acquire shares of any such junior stock in exchange for shares of any stock of the Corporation ranking junior (either as to dividends or upon dissolution, liquidation or winding up) to the Series B Preferred Stock; or

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Export-Restricted Data
1106-1002

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(iv) redeem or purchase or otherwise acquire for consideration any shares of Series B Preferred Stock or any shares of stock ranking on a parity with the Series B Preferred Stock except in accordance with a purchase offer made in writing or by publication (as determined by the Board of Directors) to all holders of such shares upon such terms as the Board of Directors, after consideration of the respective annual dividend rates and other relative rights and preferences of the respective series and classes, shall determine in good faith will result in fair and equitable treatment among the respective series or classes.

(b) The Corporation shall not permit any subsidiary of the Corporation to purchase or otherwise acquire for consideration any shares of stock of the Corporation unless the Corporation could, under paragraph (a) of this Section 4, purchase or otherwise acquire such shares at such time and in such manner.

SECTION 5. Reacquired Shares. Any shares of Series B Preferred Stock purchased or otherwise acquired by the Corporation in any manner whatsoever shall be retired and canceled promptly after the acquisition thereof. All such shares shall upon their cancellation become authorized but unissued shares of Preferred Stock and may be reissued as part of a new series of Preferred Stock subject to the conditions and restrictions on issuance set forth herein, in the Certificate of Incorporation, or in any other Certificate of Designations creating a series of Preferred Stock or any similar stock or as otherwise required by law.

SECTION 6. Liquidation, Dissolution or Winding Up. Upon any liquidation, dissolution or winding up of the Corporation, no distribution shall be made (1) to the holders of shares of stock ranking junior (either as to dividends or upon liquidation, dissolution or winding up) to the Series B Preferred Stock unless, prior thereto, the holders of shares of Series B Preferred Stock shall have received $100 per share, plus an amount equal to accrued and unpaid dividends and distributions thereon, whether or not declared, to the date of such payment, provided that the holders of shares of Series B Preferred Stock shall be entitled to receive an aggregate amount per share, subject to the provision for adjustment hereinafter set forth, equal to 100 times the aggregate amount to be distributed per share to holders of shares of Common Stock or (2) to the holders of shares of stock ranking on a parity (either as to dividends or upon liquidation, dissolution or winding up) with the Series B Preferred Stock except distributions made ratably on the Series B Preferred Stock and all such parity stock in proportion to the total amounts to which the holders of all such shares are entitled upon such liquidation, dissolution or winding up. In the event the Corporation shall at any time declare or pay any dividend on the Common Stock payable in shares of Common Stock, or effect a subdivision or combination or consolidation of the outstanding shares of Common Stock (by reclassification or otherwise than by payment of a dividend in shares of Common Stock) into a greater or lesser number of shares of Common Stock then in each such case the aggregate amount to which holders of shares of Series B Preferred Stock were entitled immediately prior to such event under the proviso in clause (1) of the preceding sentence shall be adjusted by multiplying such amount by a fraction the numerator of which is the number of shares of Common Stock outstanding immediately after such event and the denominator of which is the number of shares of Common Stock that were outstanding immediately prior to such event.

SECTION 7. Consolidation, Merger, etc. In case the Corporation shall enter into any consolidation, merger, combination or other transaction in which the shares of Common

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Stock are exchanged for or changed into other stock or securities, cash and/or any other property, then in any such case each share of Series B Preferred Stock shall at the same time be similarly exchanged or changed into an amount per share, subject to the provision for adjustment hereinafter set forth, equal to 100 times the aggregate amount of stock securities, cash and/or any other property (payable in kind), as the case may be, into which or for which each share of Common Stock is changed or exchanged. In the event the Corporation shall at any time declare or pay any dividend on the Common Stock payable in shares of Common Stock or effect a subdivision or combination or consolidation of the outstanding shares of Common Stock (by reclassification or otherwise than by payment of a dividend in shares of Common Stock) into a greater or lesser number of shares of Common Stock then in each such case the amount set forth in the preceding sentence with respect to the exchange or change of shares of Series B Preferred Stock shall be adjusted by multiplying such amount by a fraction, the numerator of which is the number of shares of Common Stock outstanding immediately after such event and the denominator of which is the number of shares of Common Stock that were outstanding immediately prior to such event.

SECTION 8. No Redemption. The shares of Series B Preferred Stock shall not be redeemable.

SECTION 9. Rank. The Series B Preferred Stock shall rank, with respect to the payment of dividends and the distribution of assets, junior to all series of any other class of the Corporation's Preferred Stock.

SECTION 10. Amendment. The Certificate of Incorporation of the Corporation shall not be amended in any manner which would materially alter or change the powers, preferences or special rights of the Series B Preferred Stock so as to affect them adversely without the affirmative vote of the holders of at least two-thirds of the outstanding shares of Series B Preferred Stock voting together as a single class.

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IN WITNESS WHEREOF, the Corporation has caused this Certificate of Designation to be executed by its duly authorized officer and attested by its secretary this 1st day of April, 2002.

RAYTHEON COMPANY

By: Neal E. Minahan /s/
Name: Neal E. Minahan
Title: Senior Vice President and General Counsel

ATTEST:

John W. Kapples /s/
Name: John W. Kapples
Title: Secretary

Delaware

PAGE 1

The First State

I, JEFFREY W. BULLOCK, SECRETARY OF STATE OF THE STATE OF DELAWARE, DO HEREBY CERTIFY THE ATTACHED IS A TRUE AND CORRECT COPY OF THE CERTIFICATE OF DESIGNATION OF "RAYTHEON COMPANY", FILED IN THIS OFFICE ON THE TWENTIETH DAY OF JULY, A.D. 2004, AT 12:17 O'CLOCK P.M.

0472015 8100

110455950

You may verify this certificate online at corp.delaware.gov/authver.shtml

Jeffrey W. Bullock, Secretary of State

AUTHENTICATION: 8717621

DATE: 04-26-11

State of Delaware
Secretary of State
Division of Corporations
Delivered 12:43 PM 07/20/2004
FILED 12:17 PM 07/20/2004
SRV 040529698 - 0472015 FILE

CERTIFICATE OF ELIMINATION

OF

RAYTHEON COMPANY

SERIES B JUNIOR PARTICIPATING

PREFERRED STOCK

* * * * * * * *

Raytheon Company, a corporation organized and existing under the General Corporation Law of the State of Delaware,

DOES HEREBY CERTIFY:

FIRST: That at a meeting of the Board of Directors of Raytheon Company on May 5, 2004, resolutions were duly adopted setting forth the proposed elimination of the 6,000,000 shares designated as Series B Junior Participating Preferred Stock as set forth herein:

> RESOLVED, that no shares of the Series B Junior Participating Preferred Stock are outstanding and none will be issued.
>
> FURTHER RESOLVED, that a Certificate of Elimination be executed, which shall have the effect when filed in Delaware of eliminating from the Restated Certificate of Incorporation all reference to the Series B Junior Participating Preferred Stock.

SECOND: That the Certificate of Designation with respect to the above Series B Junior Participating Preferred Stock was filed in the office of the Secretary of State of Delaware on April 2, 2002. None of the authorized shares of the Series B Junior Participating Preferred Stock are outstanding and none will be issued.

THIRD: That in accordance with the provisions of Section 151 of the General Corporation Law of the State of Delaware, the Restated Certificate of Incorporation is hereby amended to eliminate all reference to the Series B Junior Participating Preferred Stock.

IN WITNESS WHEREOF, said Raytheon Company has caused this certificate to be signed by John W. Kapples, its Vice President and Secretary, this 19th day of July, 2004.

By John W. Kapples /s/
John W. Kapples
Secretary

Delaware

PAGE 1

The First State

I, JEFFREY W. BULLOCK, SECRETARY OF STATE OF THE STATE OF DELAWARE, DO HEREBY CERTIFY THE ATTACHED IS A TRUE AND CORRECT COPY OF THE CERTIFICATE OF AMENDMENT OF "RAYTHEON COMPANY", FILED IN THIS OFFICE ON THE FIFTH DAY OF MAY, A.D. 2005, AT 12:16 O'CLOCK P.M.

0472015 8100

110455950

You may verify this certificate online at corp.delaware.gov/authver.shtml

Jeffrey W. Bullock, Secretary of State

AUTHENTICATION: 8717622

DATE: 04-26-11

State of Delaware
Secretary of State
Division of Corporations
Delivered 12:24 PM 05/05/2005
FILED 12:16 PM 05/05/2005
SRV 050365635 - 0472015 FILE

CERTIFICATE OF AMENDMENT
of
RESTATED CERTIFICATE OF INCORPORATION
of
RAYTHEON COMPANY

Raytheon Company, a corporation organized under the Delaware General Corporation Law, does hereby certify as follows:

1. The name of the corporation (the "Corporation") is Raytheon Company.

2. That at a meeting of the Board of Directors of Raytheon Company, resolutions were duly adopted setting forth the following proposed amendment to the Restated Certificate of Incorporation of said Corporation, declaring said amendment to be advisable and calling upon the Corporation's stockholders to consider said amendment at it next annual meeting of stockholders. The resolution adopted by the Board is as follows:

   VOTED: That The Restated Certificate of Incorporation of the Corporation be, and it hereby is, amended by deleting Article VI thereof in its entirety and by substituting in lieu thereof the following:

   Section 1. Number, election and terms. The number of directors of the Corporation shall be, except as otherwise fixed by or pursuant to the provisions of Article IV relating to the rights of the holders of any class or series of stock having a preference over the Common Stock as to dividends or upon liquidation to elect additional directors under specified circumstances, fixed from time to time exclusively pursuant to a resolution adopted by a majority of the Whole Board (but shall not be less than three). The term of office of each director who is in office immediately prior to the closing of the polls for the election of directors at the 2006 annual meeting of stockholders shall expire at such time. From and after the 2006 annual meeting of stockholders, each director, other than those who may be elected by the holders of any class or series of stock having a preference over the Common Stock as to dividends or upon liquidation, shall be elected to hold office for a term of one year, until the next annual meeting of stockholders and until such person's successor is duly elected and qualified.

   Section 2. Stockholder nomination of director candidates; Stockholder Proposal of Business. Advance notice of stockholder nominations for the election of directors and of the proposal of business by stockholders shall be given in the manner provided in the By-Laws of the Corporation, as amended and in effect from time to time.

Section 3. Vacancies and newly created directorships. Except as otherwise provided for or fixed by or pursuant to the provisions of Article IV relating to the rights of the holders of any class or series of stock having a preference over the Common Stock as to dividends or upon liquidation to elect directors under specified circumstances, any vacancy on the Board for any reason and newly created directorships resulting from any increase in the number of directors shall be filled by the affirmative vote of a majority of the remaining directors then in office, even though less than a quorum of the Board. Any director elected in accordance with this Section 3 of Article VI shall hold office until the next annual or special meeting of stockholders at which directors are to be elected and until such director's successor shall have been duly elected and qualified.

Section 4. Removal. Subject to the rights of any class or series of stock having a preference over the Common Stock as to dividends or upon liquidation to elect directors under specified circumstances, any director may be removed from office with or without cause by the affirmative vote of the holders of the shares of Common Stock, voting in accordance with the provisions of Section 2 of Article IV.

3. Thereafter, pursuant to resolution of the Board of Directors, the amendment was approved by the requisite number of shares at the Corporation's annual stockholders' meeting duly called and held upon notice given in accordance with Section 222 of the Delaware General Corporation Law.

4. This Amendment to the Restated Certificate of Incorporation of the Corporation set forth above has been duly adopted in accordance with Section 242 of the Delaware General Corporation Law.

This Certificate has been duly executed by the undersigned on behalf of the Corporation on May 5, 2005.

RAYTHEON COMPANY

John W. Kapples /s/
John W. Kapples
Vice President and Secretary

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Delaware

PAGE 1

The First State

I, JEFFREY W. BULLOCK, SECRETARY OF STATE OF THE STATE OF DELAWARE, DO HEREBY CERTIFY THE ATTACHED IS A TRUE AND CORRECT COPY OF THE CERTIFICATE OF AMENDMENT OF "RAYTHEON COMPANY", FILED IN THIS OFFICE ON THE SECOND DAY OF JUNE, A.D. 2010, AT 3:38 O'CLOCK P.M.

0472015 8100

110455950

You may verify this certificate online at corp.delaware.gov/authver.shtml

Jeffrey W. Bullock, Secretary of State

AUTHENTICATION: 8717623

DATE: 04-26-11

State of Delaware
Secretary of State
Division of Corporations
Delivered 03:42 PM 06/02/2010
FILED 03:38 PM 06/02/2010
SRV 100621597 - 0472015 FILE

CERTIFICATE OF AMENDMENT
of
RESTATED CERTIFICATE OF INCORPORATION
of
RAYTHEON COMPANY

Raytheon Company, a corporation organized under the Delaware General Corporation Law, does hereby certify as follows:

1. The name of the corporation (the "Corporation") is Raytheon Company.

2. The Restated Certificate of Incorporation of the Corporation was filed with the Secretary of State of the State of Delaware on April 2, 2002 and was amended on May 5, 2005.

3. That at a meeting of the Board of Directors of the Corporation, resolutions were duly adopted setting forth the following proposed amendment to the Restated Certificate of Incorporation, as amended, of said Corporation, declaring said amendment to be advisable and calling upon the Corporation's stockholders to consider said amendment at its next annual meeting of stockholders.

   VOTED: To delete Article V of the Restated Certificate of Incorporation, as amended, in its entirety and substitute in lieu thereof the following:

   Article V

   Stockholder Action

   Any action required or permitted to be taken by the stockholders of the Corporation must be effected at a duly called annual or special meeting of such holders and may not be effected by any consent in writing by such holders. Except as otherwise required by law and subject to the rights of the holders of any class or series of stock having a preference over the Common Stock as to dividends or upon liquidation, special meetings of stockholders of the Corporation for any purpose or purposes may be called only (i) by the Board pursuant to a resolution stating the purpose or purposes thereof approved by a majority of the total number of directors which the Corporation would have if there were no vacancies (the ""Whole Board"), (ii) by the Chairman of the Board, or (iii) pursuant to the written request of the holders of not less than twenty-five percent (25%) of the outstanding shares of the Corporation's voting capital stock, as specified in and subject to the provisions and conditions of the Corporation's By-Laws. No business other than that stated in the notice shall be transacted at any special meeting.

4. Thereafter, pursuant to resolution of the Board of Directors, the above amendment was approved by the requisite number of shares at the Corporation's annual stockholders' meeting on May 27, 2010, duly called and held upon notice given in accordance with Section 222 of the Delaware General Corporation Law.

5. This Amendment to the Restated Certificate of Incorporation of the Corporation, as amended, set forth above has been duly adopted in accordance with Section 242 of the Delaware General Corporation Law.

This Certificate has been duly executed by the undersigned on behalf of the Corporation on June 2, 2010.

RAYTHEON COMPANY

Jay B. Stephens /s/
Jay B. Stephens
Senior Vice President, General
Counsel and Secretary

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B. EXECUTIVE SUMMARY

The Raytheon Team, consisting of Raytheon and Metron Aviation, is a proven and trusted partner for global surface and Air Traffic Management (ATM) systems and solutions, able to provide the best value Surface Management System (SMS) solution while reducing overall risk for the Port Authority of NY & NJ (PANYNJ) at John F. Kennedy International Airport (JFK).

We have been in the ATM business for over 60 years, having delivered over 350 ATM systems worldwide in more than 50 countries, controlling greater than 60% of the world's airspace. We are actively demonstrating our ongoing commitment to the Port Authority on the Perimeter Intrusion Detection System (PIDS) program and this unwavering commitment will extend to the SMS solution at JFK, enhanced by our Team's collective core business strength in ATM, Collaborative Decision Making (CDM), airport tower and surface solutions, and Traffic Flow Management (TFM).

Our Teammate, Metron Aviation, is the world leader in Collaborative Air Traffic Flow Management (C-ATFM), with more than 15 years of experience working with the Federal Aviation Administration (FAA) and National Airspace System (NAS) stakeholders. Metron Aviation maintains an unparalleled understanding of airport surface operations, and the relationship between the surface and NAS TFM, as they are the only commercial provider with demonstrated performance in the application of C-ATFM to the challenges on the airport surface. Metron Aviation provides a proven, system-wide, network-based approach to predictive surface management with a superior prediction accuracy that is not achievable with a solution that is limited to local surface surveillance with no consideration for airspace constraints. Without sophisticated predictive algorithms that consider NAS Traffic Flow Management Initiatives (TMIs), surface management and departure planning will be suboptimal, resulting in lost capacity at JFK. With Metron Aviation's expertise, we are able to offer the Port Authority a deep understanding of the unique constraints of the New York airspace, and the need to better predict demand and capacity on the surface to facilitate more efficient management of JFK operations.

The Raytheon Team is a proven and trusted partner for global surface management and ATM systems and solutions, delivering a best value and lowest risk SMS solution

- U.S.-based Top 10 Fortune Aerospace and Defense Company with over 50 years integrating and delivering successful ATM systems and solutions for all airspace domains
- Industry recognized experts in ATM and C-ATFM systems and solutions, with specific operational experience in the unique challenges at JFK
- Proven partner for delivery, implementation, training, maintenance and support of ATM systems, including STARS, ITWS, LRR, DASR, AutoTrac and Harmony – focused customer service, ensuring reliable, continuous operations
- Multiyear Raytheon IRAD investment in a NextGen Common Automation Platform focused on surface and tower will be leveraged for JFK SMS success, reducing overall risk
- Proven surface and C-ATFM hosted COTS solution enabling airport and airline operators the ability to accurately predict departure times – NAS-wide system approach enables accurate predictions required, but not achievable, through local surface surveillance-based solutions

Metron Aviation's SMS and Harmony Commercial Off-the-Shelf (COTS) solutions have been delivered to some of the largest and most forward-thinking flight operators and Air Navigation Service Providers (ANSPs) in the world, including Delta Air Lines, FedEx and Airservices Australia. This expertise and capability has already been delivered as a hosted and redundant service offering, similar to the JFK SMS requirement, to Delta Air Lines at LGA. Recognized industry experts in C-ATFM, Metron Aviation was tasked by the FAA to develop the mid-term TFM Concept of Operations (ConOps), which highlights the operational benefits of integrating TFM data with airport surface operations data, resulting in more accurate predictions of demand and capacity, both on the surface and in the surrounding airspace. Accordingly, the Raytheon Team brings distinguished experts who are prepared to work in partnership with the Port Authority to ensure that the SMS solution at JFK is aligned with the FAA's NextGen plans.

As experts in the airport surface and ATM market, we understand the importance of total life cycle support, including continuous operations and outstanding customer service, as required for the JFK SMS mission. In addition to being a premier ATM systems and solutions partner to the FAA through such systems as the Standard Terminal Automation Replacement System (STARS), System Wide Information Management (SWIM) Terminal Data Distribution System (STDDS), Integrated Terminal Weather System (ITWS), En Route Automation Modernization (ERAM), Digital Airport Surveillance Radar (DASR), Long Range Radar (LRR) and others, we are also the FAA's partner of choice for operational and maintenance training through the Air Traffic Control Optimum Training Solution (ATCOTS) program, training all controllers in the NAS, and partners to the FAA for customer service, maintenance and support for all associated programs. We know the importance of a mission-critical system, as our STARS platform is designed to a 99.9995% availability requirement. We also understand the importance of the surface and tower domain, as we currently are the only tower integrator for the FAA through the STDDS program. Our expertise in the domestic market also extends internationally through our AutoTrac family of automation systems, used by controllers to manage the entire airspace, from the tower domain through to the en route airspace. These systems have been delivered and operational worldwide, including locations in Australia, Brazil, Germany, Norway, India, Hong Kong and many others. Our expertise enables us to deliver on the JFK SMS mission requirement through a total life cycle solution that maintains continuous operations.

Our Raytheon Technical Services Company (RTSC) provides controller training to all air traffic controllers in the NAS through the ATCOTS program. Raytheon and Metron Aviation are also staffed with professional controllers with New York Airspace expertise and who specifically have operational expertise at JFK in the tower and at the ramp. With this operational expertise, we provide the required SMS operational support, reducing operational and schedule risk.

As a top 10 Fortune Aerospace and Defense company based in the United States (U.S.), Raytheon continues to invest in the success of its ATM product line. We have an ongoing multiyear Independent Research and Development (IRAD) investment called the NextGen Common Automation Platform that integrates all airspace domain capabilities to converge all automation onto one platform. Our focus for 2011 includes the NextGen Surface and Tower domain, which efforts generally address capabilities that are needed in this space. These efforts can be leveraged for the SMS at JFK. Our flexible IRAD architecture enables us to integrate with Metron Aviation's proven Harmony product using SWIM, a Service Oriented Architecture (SOA), to provide effective SMS capabilities to the users. This will help mitigate deployment risk and enable us to meet the aggressive operational schedule required by the Port Authority. While this schedule is aggressive, we understand the need for the Port Authority to improve the efficiency of the surface operation at JFK, as the real bottleneck to NAS-wide congestion is the airport surface. While improving surface operations and increasing throughput at the airport, we also appreciate the revenue impact this may have on the Port Authority. We understand that current aviation fees generate a double digit percentage of the total revenue stream for the Port Authority. It is clear to us that a SMS solution with enhanced accuracy has the potential to increase efficiency and also drive up the revenue stream because of the network effect of "pushing more tin." Given the importance of this market to the Raytheon Team and the importance of the SMS mission to JFK, Raytheon's ability to leverage its ongoing IRAD investment in this product line should support the success of all our customers, including the Port Authority.

The Raytheon Team is well positioned to provide the comprehensive SMS solution that the Port Authority is seeking to reduce delays and improve surface operations at JFK. The Port Authority will benefit from our proven management approach, which we have applied across the breadth of our airport surface and ATM programs. We have the operational domain knowledge and expertise, the proven C-ATFM approach to surface management, the ATM system integrator expertise with a proven track record of delivering mission-critical systems, a total life cycle approach to customer service to maintain continuous operations and the demonstrated commitment to the Port Authority to deliver the best value, lowest risk SMS solution.

B.1 Major Features of Our Proposal – Our SMS Solution

We understand the mission requirements for the SMS at JFK and view the following as key elements to the overall solution:

- Proven and innovative technical capabilities
- Proven system integration, including transitioning of existing systems
- Dependable continuously operational service
- Effective management approach led by airport surface and ATM experts
- Training, customer service and operational expertise

Proven and Innovative Technical Capabilities

In our Technical Proposal (Section F.1), we show that the mission capabilities for effective and efficient surface management at JFK will be fulfilled. We demonstrate that our approach is not only unique, but is the most effective in managing the surface through C-ATFM, providing accurate demand and capacity predictions, and the decision support tools to mitigate imbalances. We see the core technical capabilities in surface management, departure management, situational awareness, CDM, automated alerting and operational analysis.

Together, Raytheon and Metron Aviation was one of the original industry pioneers in the SMS. In 2001, we teamed to work on the National Aeronautics and Space Administration (NASA) Air Traffic Management System Development and Integration (ATMSDI) contract. Under this contract, we performed the fundamental research, design, development and deployment of the SMS. The system went through a technology transfer to FedEx and the capability was further refined by Metron Aviation for FedEx at Memphis International Airport (MEM). The SMS began operations in 2005 and continues in operation today. This SMS provides situational awareness with a map display, including surface and airborne surveillance, timeline displays depicting predicted and actual operations, runway utilization decision support and operational analysis. The FedEx SMS situational display is shown in Figure B-1, as used in operations at Memphis International Airport. An independent third party study concluded that the SMS decreased taxi times by 2.8 minutes per flight for $8.3M in savings per year, increased departure capacity by 2.5% per year and reduced excessive taxi times (>40 minutes) by over 50%[1].

Metron Aviation's Harmony is a modern, web-based, COTS product built to realize the NextGen concept of integrating Air Traffic Flow Management (ATFM) and airport surface management for multiple stakeholder use through CDM to increase the predictability, throughput, and efficiency of the NAS and airport operations. Metron Aviation Harmony was designed and built as a hosted turnkey solution for ease of adaptation, deployment, maintenance and upgrades to provide high availability, mission-critical applications for users based on existing, proven algorithms from systems, including the operational SMS at FedEx. The Metron Aviation Harmony COTS product was deployed operationally for Delta Air Lines at New York's LaGuardia Airport (LGA) in 2010. In addition to surface situational awareness, Metron Aviation's Harmony provides Delta with surface operations management

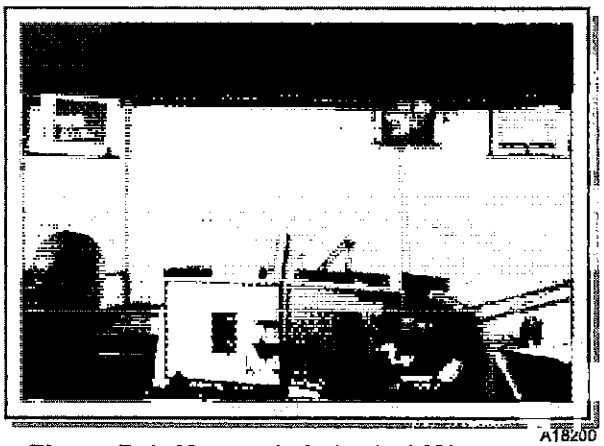

Figure B-1. Metron Aviation's SMS – Metron Aviation's system is operational at MEM and is being actively used by FedEx today to streamline surface operations

[1] "Effect of Surface Surveillance Data Sharing on FedEx Operations at Memphis International Airport," Dan Howell, CNA Corporation, FAA ATO Study, 2004.

functionality, including demand predictions, flow rate programs, automated user alerts, and operational reporting and analysis. Harmony is at the core of our capability offering for the SMS program at JFK, reducing overall technical and schedule risk.

Metron Aviation pioneered the Ration by Schedule algorithm and CDM Slot Substitution functionality for the FAA Traffic Flow Management System (TFMS). This technology, combined with Metron Aviation's surface management and airline operation decision support capabilities, provides the strongest foundation required for departure management and slot substitution functionalities for the Port Authority. Our Team recognizes that the Port Authority has the vision to improve departure efficiency and reduce surface congestion at JFK through active control of gate departure management. This is complimentary to FAA ATC, and reduces fuel and Carbon Dioxide (CO_2) emissions by managing gate departure to meet FAA constraints at JFK and the surrounding airspace.

This expertise is applied to providing the COTS-based SMS solution that the Raytheon Team will deliver to the Port Authority. Our solution is based on many years of airport surface and ATM expertise in integrated systems and solutions. The high level system and operational view of the SMS offering is shown in Figure B-2.

Metron Aviation has developed, deployed, and maintained airport and airline surface management solutions for major aircraft operators and airports. Accurate demand predictions and the application of all operational constraints are required to efficiently manage surface operations. Metron Aviation's demand predictions are based on FAA and airline flight data, augmented by tactical surveillance data. Operational constraints are automatically determined from FAA interfaces, including New York metro area departure fix restrictions that impact JFK and surrounding airports.

Our technical proposal focuses on the proven and innovative capabilities in the Harmony solution that we already provide today. We will address how our solution will provide the capabilities to ensure mission success. As our JFK SMS solution integrates proven and unique capabilities already delivered at operational sites, we are able to reduce overall operational risk while providing the best value through our NAS-wide approach to management of traffic flows on the airport surface, resulting in the most accurate surface predictive capabilities today.

Proven System Integration, Including Transitioning of Existing Systems

In our proposal, we demonstrate our ability to integrate ATM systems across all airspace domains, including the airport surface. Our solution will be based on the SWIM FAA NextGen Enabler, an SOA providing a flexible and adaptable architecture that is accepted in the industry as the low risk and low cost way of integrating capabilities and services. We will prove, through our technical and past performance sections of the proposal, that this is a core Raytheon Team strength and document how this has been performed successfully across many airport surface, tower, and ATM systems and solutions.

Raytheon is currently the only tower system integrator for the FAA. We are performing this work on the STDDS program, supplying operational prototypes, development, deployment, and final system maintenance and support. Our system was recently installed at Bradley International Airport and is currently undergoing operational trials that will lead to 37 tower installations across the NAS. As part of this scope of work, we are using SWIM, the FAA's SOA approach, to integrate disparate FAA systems into the tower environment. As depicted in Figure B-3, STDDS receives Airport Surface Detection Equipment – Model X (ASDE-X) surveillance data directly from the Data Distribution Unit (DDU), extracts surface movement events and publishes them, along with surface tracks, as eXtensible Markup Language (XML) to SWIM systems (i.e., TFMS). It receives Runway Visual Range (RVR) messages directly from local and remote RVR systems on the airport surface and publishes them as XML to SWIM systems (i.e., TFMS). It receives Tower Data Link Service (TDLS) clearance deliveries and Electronic Flight Strip Transfer System (EFSTS) scan messages, and publishes them as XML departure events to SWIM systems. Our STDDS experience, in terms of management approach, system architecture and design, and system and interface integration are all relevant to the JFK SMS solution.

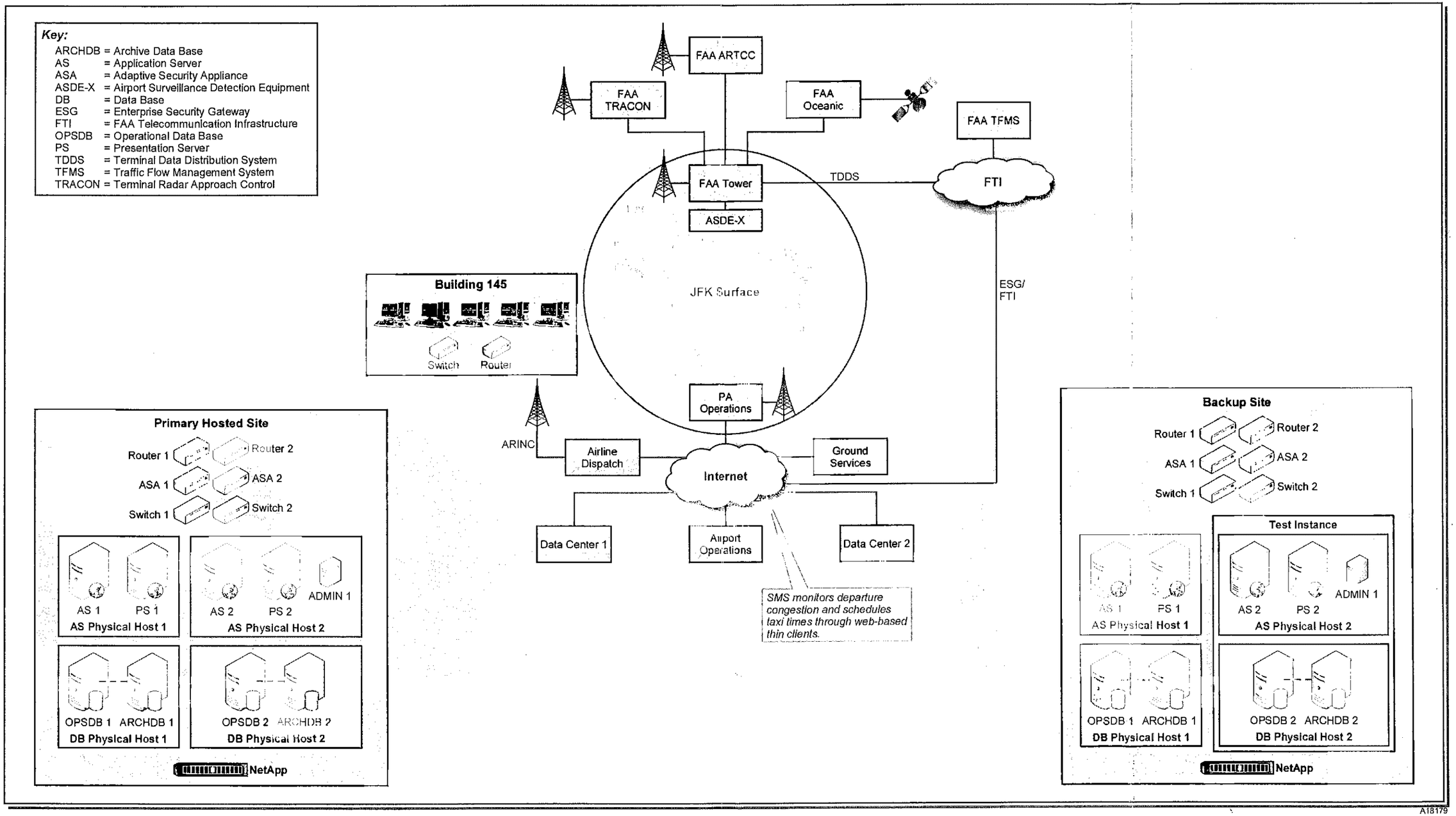

Figure B-2. High Level System and Operational View – Our SMS solution provides continuous operations to the entire JFK user community

Use or disclosure of data contained on this sheet is subject to the restriction on the title page of this proposal.

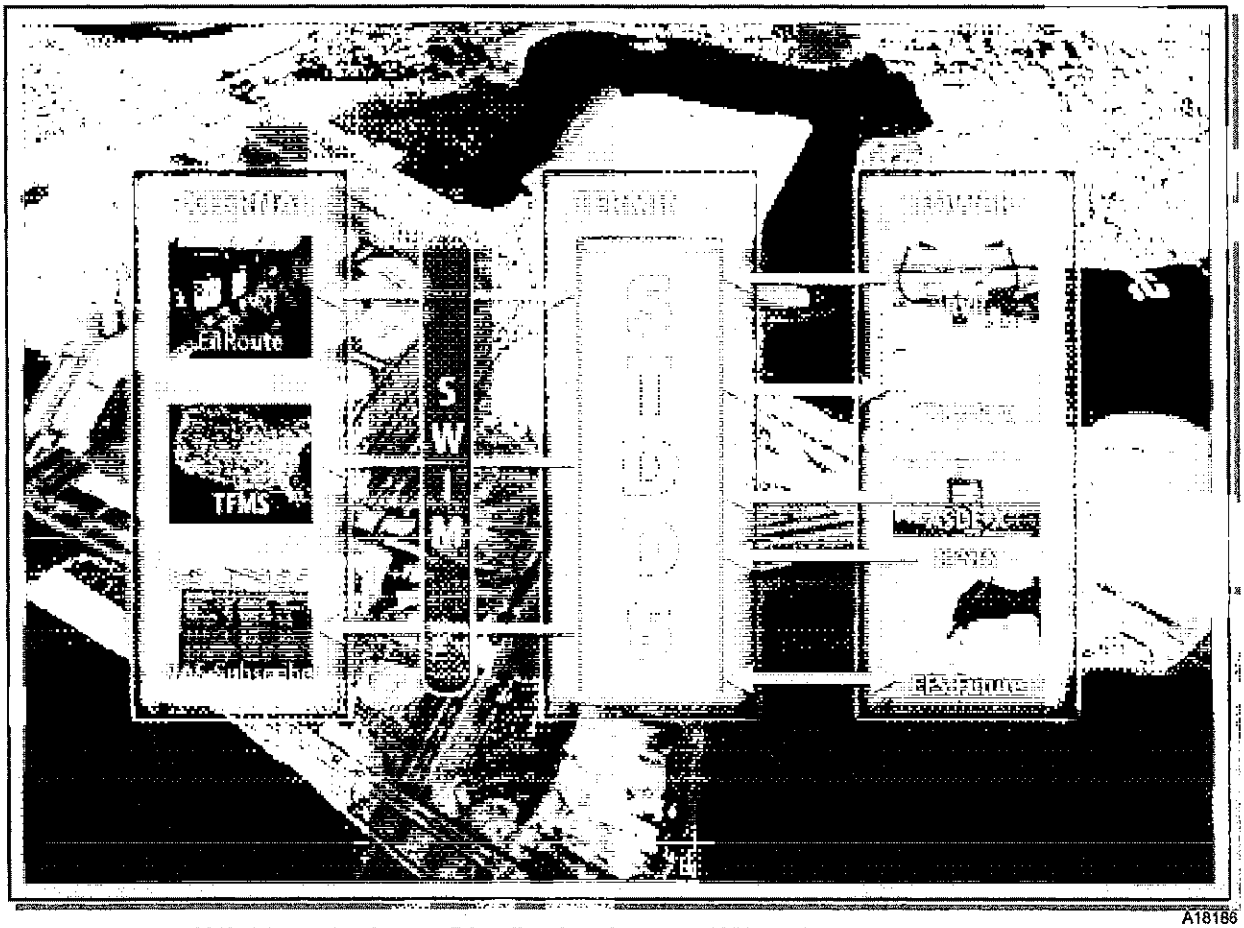

Figure B-3. SWIM Terminal Data Distribution System (STDDS) – Our tower solution publishes tower data using SWIM core services

For over a decade, Raytheon has been working with Avinor AS, a commercial entity that is a limited company wholly owned by the Norwegian State, in the development, installation, management, testing and maintenance of an airport tower system that is specifically tailored to the function of improving overall surface and airspace system efficiency and predictability, while enhancing safety. For the Gardermoen tower, which is a state-of-the-art, 14-display, integrated tower system in Oslo, Norway, we delivered and continue to maintain the first true integrated tower system in the world that combines approach radar, surface radar, ground movement control, apron and taxiway lighting control. The Gardermoen tower has been in operation since 1998.

We are also the FAA's terminal automation system provider under the STARS program, awarded to Raytheon in September 1996. During the course of this 15-year program, 84 systems have been delivered to the FAA and 68 systems have been delivered to the Department of Defense (DoD). These systems have been delivered to 70% of the 50 busiest airports in the U.S., including Miami, Charlotte, Philadelphia and Houston. Raytheon recently received the Terminal Automation Modernization Replacement (TAMR) 3 contract award to deliver STARS to 11 of the busiest Terminal Radar Approach Control Facilities (TRACONs) in the U.S., including southern and northern California, New York, Atlanta, Potomac and Dallas. Under TAMR 3 Segment 2, up to 96 smaller TRACONs will potentially be replaced by STARS (a total of 251 by 2015). Under STARS, we worked directly with the FAA to ensure that the capabilities and usability of STARS provided a smooth transition from the legacy terminal platforms that they were replacing. This transition was ensured through our collaboration with the FAA, controllers and other users,

without jeopardizing the operational effectiveness of the controllers. Many of the tasks performed by Raytheon on the STARS program over the last 15 years directly correlate to the scope of work required by the JFK SMS program. This includes expertise in transitioning from an existing operational system to a more advanced system for continued operations, deploying and integrating mission-critical ATC systems, and mission support services.

Metron Aviation has performed system integration for multiple airport surface systems that are directly relevant to the JFK SMS requirements. SMS integration for MEM and FedEx included integrating surface and airborne surveillance, as required for JFK. Additionally, this system integrated directly with the FedEx operational data system for access to flight-specific data, including pushback estimates and gate/parking assignments. For the integration of Metron Aviation's Harmony for Delta Air Lines at LGA, Metron Aviation performed complete integration of a hosted web-based solution, including integration of LGA ASDE-X data, FAA TFMS data (Aggregate Demand Lists (ADLs)), National Traffic Management Log (NTML) and Delta Air Lines flight-specific data, similar to the JFK SMS requirements. Figure B-4 shows the Harmony surface management map in operation for Delta Air Lines at LGA. For both deployments, Metron Aviation provides 24 hour/day support services to users.

Our expertise in airport surface and ATM system integration will reduce overall technical and schedule risk associated with the JFK SMS program.

Dependable Continuously Operational Service

Our SMS solution is designed for a dependable continuously operational service, even in the event of a disaster. This solution is based on demonstrated performance on similar-to- programs.

The Raytheon Team is experienced in developing and deploying highly available systems to defense, aviation and commercial customers. For example, we have demonstrated this capability to the FAA on the STARS program with a solution designed with five 9s high availability. Our SMS system brings together the Teams' experience into a service that is highly dependable, providing continuous operations while maintaining the best value and lowest risk for the Port Authority. The SMS system is able to achieve this through an architecture that employs multiple levels of redundancy and fault tolerance. Our COTS-based Harmony system for airports and airlines, which is operational for Delta Air Lines at LGA, is set up for high availability through highly redundant servers located at a remote data center. For the JFK SMS solution, multiple diversely located data centers are used to enable continued operations, even in various disaster recovery scenarios, as shown in Figure B-2. Each data center is SAS-70 Type II compliant, designed with physical and environmental security in mind, and includes redundant power and network connectivity. Inside each data center is the SMS application software, which has been designed to operate on multiple redundant servers, with application data replicated across each of the diversely located data centers. Our experienced staff with its operations ability, combined with our flexible system architecture, is ready to deliver a dependable SMS solution providing continuous operations to the Port Authority and its diverse users, even in the event of a disaster.

Effective Management Approach Led by Airport Surface and ATM Experts

We leverage our proven management approach across all our ATM systems and solutions, including:

- FAA programs such as STARS, STDDS and ITWS
- Our international programs featuring our AutoTrac family of automation products
- Commercial offering programs, such as SMS at MEM for FedEx, Harmony for Airports and Airlines at LGA for Delta Air Lines, and Harmony for ANSPs for Airservices Australia

As a global ATM system and solution provider, and as experts in this market, we have an in-depth understanding of how to manage such programs. We will promote lessons learned from these programs to ensure they get applied to the SMS program at JFK. As an example, we have learned from our STDDS experience that obtaining permission to use FAA data feeds such as ASDE-X and TFMS takes a long lead time. Without this knowledge, obtaining similar data feeds for the SMS solution at JFK could cause substantial delays in the operational schedule. With this knowledge, we can work with the Port Authority to ensure that an early request to the FAA is made so that interfacing to secure these data feeds does not jeopardize the operational schedule. We will also leverage Metron Aviation as an authorized Class I Aircraft Situation Display to Industry (ASDI) subscriber to ensure ready access to this critical data source.

Effective management also comes with experience. Only experienced program managers and leaders in the ATM domain space can apply lessons learned from previous programs properly, given their direct involvement. With their market and program expertise in ATM, they will be in the best position to make the proper management judgment on similar programs. Consequently, we will use leaders who have worked on similar programs to effectively manage and support this program. We demonstrate this to the Port Authority by the key personnel we use to staff the program, as identified in Section F.3.11. All key personnel have worked on comparable programs to ensure management success.

Raytheon is a Capability Maturity Model Integration (CMMI) Level 5 organization with repeatable processes proven across a myriad of programs. Our robust processes and best practices enable effective management of any program, demonstrated by the excellent past performance records on many of our programs. The Points of Contact (POCs) that are named in Section F.3.2 (Relevant Experience) can attest to our performance. Clearly, past performance on its own does not guarantee future success, but past

performance repeated across different programs by experienced leaders and staff through an effective process creates future success. This management approach, as described above and depicted in Figure B-5, will be applied to effectively manage the SMS program at JFK, lowering overall program risk.

Training, Customer Service and Operational Expertise

This is part of our core expertise in ATM, providing training, 24x7 customer service and operational experts who can properly use and manage the SMS at JFK.

Under the ATCOTS contract, Raytheon provides trained instructors to deliver training at the FAA Academy in Oklahoma City, OK, and at FAA ATC facilities nationwide, and is responsible for 316 training locations. We provide ATC training across all four domains (en route, tower, terminal and TRACONs) and are engaged in the total training process. Our STARS customer service solution has included training of 4150 FAA controllers, a 24x7 help line with on-call service, 24x7 depot logistics services and second level engineering support. We leverage our operational Subject Matter Experts (SMEs), many of whom have spent more than 30 years as full performance air traffic controllers with specific New York and JFK airspace expertise. This expertise and experience will be applied to the JFK SMS solution.

The Raytheon Team effectively addresses all the major components of the SMS offering. What discriminates us from the industry is that we can prove that, for every major component identified and required by the Port Authority for the SMS program, we are the recognized industry experts in that area. The expertise and the capability discriminator enable us to provide the best value solution while reducing major program risk.

B.2 Compliance with JFK SMS Requirements

To demonstrate our compliance with the requirements set forth by the Port Authority for the SMS solution at JFK, we have developed a requirements compliance matrix that will not only state compliance, but also describe how we address compliance. The full compliance matrix can be found in Section F.1.3. An excerpt from the requirements matrix is shown in Figure B-6.

As required, any areas where we are not fully compliant are discussed. After a comprehensive review of the requirements by our Team engineering staff, it is clear that the mission requirements for successful deployment and operation of the SMS solution at JFK are fulfilled, resulting in the best value system for the Port Authority.

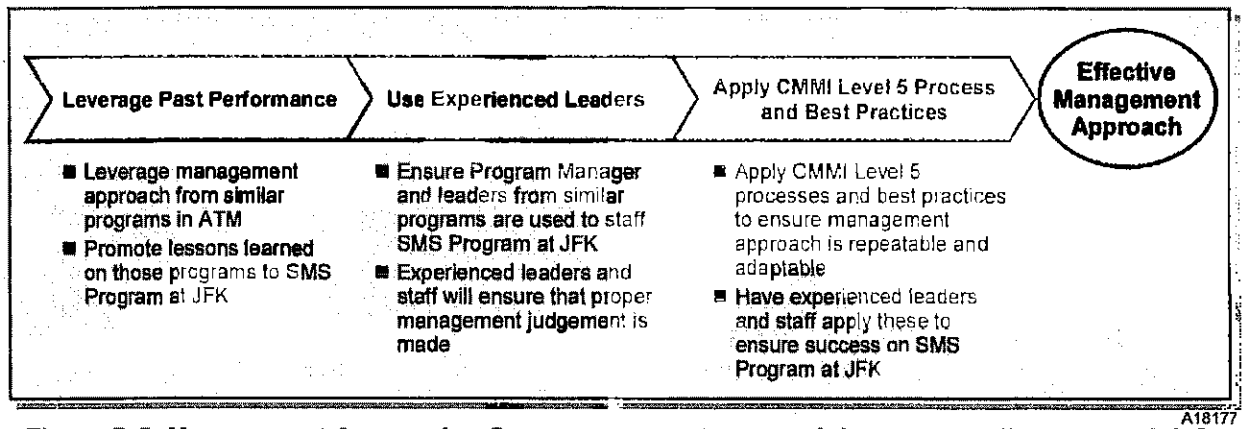

Figure B-5. Management Approach – Our management approach lowers overall program risk for the Port Authority

Requirement Paragraph	Requirement Text	Compliance	Compliance Comments
C.4.C.1	Departure management capability utilizing rationing principles	Full	Rationing principles will be based on existing FAA TFMS and Metron Aviation traffic flow product updated to address specifics of SMS needs.
C.4.C.2	Allocate "call-for—taxi" times (CFT's) based on set rules and protocols using rationing principles and calculation under the guidance of the Port Authority	Full	CFT determinations specific to SMS requirements will be based on Metron Aviation experience with Harmony for airline surface predictions and FAA TFMS and Metron Aviation traffic flow rationing principles.
C.4.C.3	Automatically populate scheduled flight information through a Port Authority approved source, such as ETMS (Enhanced Traffic Management System) into the departure management capability of the System. Additionally, the Service shall have the capability to manually input and add flights, which are not automatically populated. Such type flights may include non-scheduled, ad hoc, ferry flights and general aviation flights	Full	Primary source will be ADLs. A web-based capability will be provided for aircraft operators to bulk upload flight schedule data (create, modify, cancel) to increase advance notice about operations. A single flight create option for manual additions will also be provided.
C.4.C.4	Automatically populate a "call-for-taxi" time based on Port Authority approved parameters	Full	CFTs as derived from Requirement IV-C.2 will be provided to users via web displays
C.4.C.5	As conditions and demand require, monitor and process substitution requests for eligible flights based on Rationing principles and other variables deemed appropriate by the Port Authority	Full	System will provide capability for an airline to cancel their flights, make substitutions or swaps of flights that they have control over, and re-use cancelled slots.
C.4.C.6	Provide an interface enabling instant communication, textual and otherwise, with all parties (i.e. a chat function) for information sharing or another Port Authority approved method	Full	A highly-customizable COTS chat server (OpenFire) which can provide secure communication sessions will be provided.
C.4.C.7	Gain knowledge of and distribute the forecasted operational plan for the airport, airspace, expected arrival and departure rates and runway usage, expected/known delays, weather forecast, and challenges either by participation in strategic teleconference with the FAA or an approved equivalent source	Full	The processing of NTML will automatically populate airport configuration, ADR, AAR, and departure restrictions. Support personnel will monitor the FAA strategic teleconference and the NTML-determined values to validate and update as appropriate.
C.4.C.8	Monitor status of departure queues by runway and departure fix, and current taxi-out times, then predict and mitigate imbalances prior to development	Full	CFT times determined by the Departure Management function are the result of prediction and mitigation of imbalance. Mitigation is performed by holding flights at the gate or the use of the holding areas. Updates to the predictions based on aircraft operator input, ASDE-X (arrivals and departures), and ASDI (arrivals) represent the monitoring component, and periodic updates to the CFTs incorporate the latest predictions in the solution.

Figure B-6. Requirements Compliance Matrix Excerpt – Our solution addresses the JFK SMS mission

C. AGREEMENT ON TERMS OF DISCUSSION

ATTACHMENT A
AGREEMENT ON TERMS OF DISCUSSION

The Port Authority's receipt or discussion of any information (including information contained in any proposal, vendor qualification, ideas, models, drawings, or other material communicated or exhibited by us or on our behalf) shall not impose any obligations whatsoever on the Port Authority or entitle us to any compensation therefor (except to the extent specifically provided in such written agreement, if any, as may be entered into between the Port Authority and us). Any such information given to the Port Authority before, with or after this Agreement on Terms of Discussion ("Agreement"), either orally or in writing, is not given in confidence. Such information may be used, or disclosed to others, for any purpose at any time without obligation or compensation and without liability of any kind whatsoever. Any statement which is inconsistent with this Agreement, whether made as part of or in connection with this Agreement, shall be void and of no effect. This Agreement is not intended, however, to grant to the Port Authority rights to any matter, which is the subject of valid existing or potential letters patent. The foregoing applies to any information, whether or not given at the invitation of the Authority.

Notwithstanding the above, and without assuming any legal obligation, the Port Authority will employ reasonable efforts, subject to the provisions of the Port Authority's Freedom of Information Policy and Procedure adopted by the Port Authority's Board of Commissioners on November 20, 2008, which may be found on the Port Authority website at: *http://www.panynj.gov/corporate-information/pdf/Freedom-of-Information-Policy-and-Procedure.pdf*, not to disclose to any competitor of the undersigned, information submitted which are trade secrets or is maintained for the regulation or supervision of commercial enterprise which, if disclosed, would cause substantial injury to the competitive position of the enterprise, and which information is identified by the Proposer as proprietary, which may be disclosed by the undersigned to the Port Authority as part of or in connection with the submission of a proposal.

Raytheon Company
(Company)

Ellen K Kelley
(Signature)

Manager, Contracts
(Title)

8 August 2011
(Date)

ORIGINAL AND PHOTOCOPIES OF THIS PAGE ONLY.

PART I – CONTRACT SPECIFIC TERMS AND CONDITIONS

Raytheon Competition Sensitive/Raytheon Proprietary
Export-Restricted Data
1106-1002

Use or disclosure of data contained on this sheet is subject to the restriction on the title page of this proposal.

D. CERTIFICATIONS WITH RESPECT TO THE CONTRACTOR'S INTEGRITY PROVISIONS

Raytheon acknowledges that, by signing the Letter of Transmittal in Section A, we make the certifications set forth in the Attachment B General Contract Provisions, "Contractor's Integrity Provisions," Clause 32.

E. DOCUMENTATION OF PROPOSER PRE-REQUISITES

The Raytheon Team has the necessary and required prerequisite experience to deliver the SMS at JFK on schedule and to successfully fulfill the requirements of the RFP.

E.1 Experience Provisioning Similar Services (in Last 3 Years)

Reference the notarized letter under separate cover for Proposer Prerequisites.

E.2 Financial Information (Annual Report)

Raytheon's 2010 Annual Report is shown in Appendix C.

Raytheon has the current and past performance and expertise as required by the proper prerequisite

- More than the required 3 years of continuous worldwide experience with similar systems
- Directly related experience at Gardermoen in Norway, FedEx at Memphis International Airport and LGA
- Demonstrated and proven financial stability and capability to perform this contract
- SOW for SWIM TDDS program, which is now in system test phase

E.3 Past SOW Example

No other team can match our proven past performance in the development and deployment of FAA systems. Although we have numerous programs (ERAM, WAAS, ITWS and DASR, to name some) to choose from, we will focus on the System Wide Information Management (SWIM) Terminal Data Distribution System (STDDS). The STDDS is being developed for The Volpe National Transportation Systems Center, a research arm of the U.S. Department of Transportation (DOT), under a contract awarded in early 2009. STDDS will adhere to the evolving FAA SWIM standards to net-enable a number of legacy systems in order to improve capacity, efficiency and security for all National Air Space (NAS) users. In Segment 1, STDDS implements network-centric capability for the NAS systems within the terminal and tower domains to replace today's environment of point-to-point interfaces with unique communication links and special purpose protocols. STDDS will replace these point-to-point interfaces with SWIM-compliant service-oriented interfaces using an Internet Protocol wide area network, facilitating cost effective future NAS expansion.

The STDDS program is comprised of three program phases each of which iteratively build upon the previous phase. These phases are the proof of concept system, the prototype system and the final system. The Raytheon team has completed development activities for the prototype system and is preparing for an operational prototype demonstration at Bradley International Airport. The system includes fully functioning data distribution services that integrate key legacy tower systems into the NextGen architecture using the SWIM core services. The Raytheon team is now leveraging the prototype system to complete the final system phase to provide a deliverable and deployable product.

The annual dollar value of STDDS has been sales of $1,012,388.93 in 2009, $2,629,178 for 2010, and $3,382,490.74 for 2011. This contract is Cost Plus Fixed Fee (CPFF) and its specific number is DTRT57-08-D-30013, Task Order CA 9501. The location by City and State of the customer for STDDS (The Volpe National Transportation Systems Center) is:

U.S. DOT/RITA/Volpe Center
55 Broadway
Cambridge, MA 02142-1001
USA

The expected date of completion for STDDS is 1/26/2013 and currently the contract is approximately 70% complete. Listed below are the individuals who are most familiar with Raytheon's work on this particular job:

- Key personnel involvement (Raytheon, Network Centric Systems):

Timothy P. Donovan
Raytheon Company
1001 Boston Post Road East
Marlborough, MA 01752-3789
USA
Telephone Number: 508.490.2707
E-Mail Address: Timothy_P_Donovan@raytheon.com

William M. Nevits
Raytheon Company
1001 Boston Post Road East
Marlborough, MA 01752-3789
USA
Telephone Number: 508.490.1201
E-Mail Address: William_M_Nevits@raytheon.com

Joseph Rex
Raytheon Company
1001 Boston Post Road East
Marlborough, MA 01752-3789
USA
Telephone Number: 508.490.3323
E-Mail Address: joseph.rex@raytheon.com

- Contracting Officer's address, telephone number and e-mail address:

Robert Robinson
U.S. DOT/RITA/Volpe National Transportation Systems Center
55 Broadway
Cambridge, MA 02142-1001
USA
Telephone Number: 617.494.3433
E-Mail Address: robert.robinson@dot.gov

- Contracting Officer's Technical Representative's address, telephone number and e-mail address:

Laura Mellen
U.S. DOT/RITA/Volpe Center
55 Broadway RVT-73
Cambridge, MA 02142-1001
USA
Telephone Number: 617.494.2038
E-Mail Address: Laura.Mellen@dot.gov

The STDDS Task Order Statement of Work (SOW) is shown in Figure E-1.

ORDER FOR SUPPLIES OR SERVICES

PAGE 1 OF PAGES 35

IMPORTANT: Mark all packages and papers with contract and/or order numbers.

1. DATE OF ORDER: 01/27/2009
2. CONTRACT NO. (If any): DTRT57-08-D-30013
3. ORDER NO.: CA9501
4. REQUISITION/REFERENCE NO.:
5. ISSUING OFFICE (Address correspondence to):
U.S.DOT/RITA/Volpe Center
Contracts & Program Support Service
55 Broadway RVP-31
Cambridge MA 02142-1001

6. SHIP TO:
a. NAME OF CONSIGNEE: U.S. DOT/RITA/Volpe Center
b. STREET ADDRESS: 125 Munroe Street, Receiving Dock
c. CITY: Cambridge
d. STATE: MA
e. ZIP CODE: 02142-1001
f. SHIP VIA:

7. TO:
a. NAME OF CONTRACTOR: Raytheon Company
b. COMPANY NAME:
c. STREET ADDRESS: 1001 Boston Post Road
d. CITY: Marlboro
e. STATE: MA
f. ZIP CODE: 01752

8. TYPE OF ORDER
☐ a. PURCHASE
REFERENCE YOUR:
Please furnish the following on the terms and conditions specified on both sides of this order and on the attached sheet, if any, including delivery as indicated.
☒ b. DELIVERY
Except for billing instructions on the reverse, this delivery order is subject to instructions contained on this side only of this form and is issued subject to the terms and conditions of the above-numbered contract.

9. ACCOUNTING AND APPROPRIATION DATA: 51FA8EA100 FD2AM00000 25205V $300,000
10. REQUISITIONING OFFICE: RVT-73

11. BUSINESS CLASSIFICATION (Check appropriate box(es))
☐ a. SMALL ☐ b. OTHER THAN SMALL ☐ c. DISADVANTAGED ☐ g. SERVICE-DISABLED VETERAN-OWNED
☐ d. WOMEN-OWNED ☐ e. HUBZone ☐ f. EMERGING SMALL BUSINESS

12. F.O.B. POINT: Destination

13. PLACE OF
a. INSPECTION
b. ACCEPTANCE

14. GOVERNMENT B/L NO.:
15. DELIVER TO F.O.B. POINT ON OR BEFORE (Date):
16. DISCOUNT TERMS:

17. SCHEDULE (See reverse for Rejections)

ITEM NO. (a)	SUPPLIES OR SERVICES (b)	QUANTITY ORDERED (c)	UNIT (d)	UNIT PRICE (e)	AMOUNT (f)	QUANTITY ACCEPTED (g)
	Award of Task Order No. CA 9501 entitled "Terminal Data Distribution System."			Obligate	$300,000.00	
	Continued ...					

18. SHIPPING POINT:
19. GROSS SHIPPING WEIGHT:
20. INVOICE NO.:
21. MAIL INVOICE TO:
a. NAME: DOT/FAA Enterprise Services Center
b. STREET ADDRESS (or P.O. Box): Volpeinvoices@faa.gov
c. CITY:
d. STATE:
e. ZIP CODE:

SEE BILLING INSTRUCTIONS ON REVERSE

17(h) TOTAL (Cont. pages): NTE $9,548,673.00

17(i) GRAND TOTAL: NTE $9,548,673.00

22. UNITED STATES OF AMERICA
BY (Signature): Carol A. Ferrante

23. NAME (Typed): Carol A. Ferrante
TITLE: CONTRACTING/ORDERING OFFICER

AUTHORIZED FOR LOCAL REPRODUCTION
PREVIOUS EDITION NOT USABLE

OPTIONAL FORM 347 (Rev. 3/2005)
Prescribed by GSA/FAR 48 CFR 53.213(e)

Figure E-1. STDDS Task Order SOW – The Raytheon Team has the necessary and required prerequisite experience to deliver the SMS at JFK

SECTION B - SUPPLIES OR SERVICES AND PRICE/COSTS

B.1 This Task Order is issued as a Cost-Plus-Fixed-Fee Term-type in accordance with CLIN 0001AD.

B.2 Consideration - Cost-Plus-Fixed-Fee

Subject to the clauses Limitation of Cost (FAR 52.232-20), Allowable Cost and Payment (FAR 52.216-7), and Fixed Fee (FAR 52.216-8), the total allowable cost of this task shall not exceed $8,844,811, which is the total estimated cost of the Contractor's performance hereunder exclusive of fixed fee. In addition, the Government will pay the Contractor a fixed fee of $703,862, for the performance of this task.

B.3 Level of Effort

The level of effort estimated to be ordered during the term of this Task Order is **58,800** labor-hours of direct labor, including authorized subcontract labor, if any. The level of effort is expected to increase during the first three full years, peaking in FY '11, and then declining until the end of the Task Order term. The Contractor shall not exceed 100% of the total level of effort specified in the Task Order. The estimated composition of the total labor-hours of direct labor by classification is as follows:

Labor Category	Hours
Senior Staff	16,512
Middle Staff	25,120
Staff	5,614
Junior	6,700
Senior Technician	4,456
Technician	398
Administrative	*
Total	**58,800**

2

Figure E-1. STDDS Task Order SOW – The Raytheon Team has the necessary and required prerequisite experience to deliver the SMS at JFK (continued)

SECTION C – DESCRIPTION/SPECIFICATIONS/STATEMENT OF WORK

The contractor shall furnish the necessary personnel, material, equipment, air traffic management services, and facilities (except as otherwise specified), required to comply with the Statement of Work (SOW) and the general provisions of the CNS/TM IDIQ contract, as follows:

INTRODUCTION AND BACKGROUND

The Volpe National Transportation Systems Center is supporting the Federal Aviation Administration (FAA) in Washington, DC to implement the Terminal Data Distribution System (TDDS). This statement of work is for development of TDDS.

The TDDS is a planned terminal enhancement to implement System-Wide Information Management (SWIM) Segment 1. TDDS is intended to provide select terminal data to other NAS components and receive select flight data from other NAS components using SWIM standards, guidance, and approved toolsets. In addition, the TDDS will include the functions for generating surface events currently performed by the Traffic Flow Management (TFM) Electronic Flight Strip Transfer System (EFSTS) Flight Strip Forwarder and the Surface Movement Event Extractor (SMEE) applications.

There are two different configurations of TDDS-to-tower system interfaces. The first configuration is based on Flight Data Input/Output (FDIO) remaining in place at the tower but not interfaced with TDDS. This configuration includes a TDDS interface with the EFSTS. The second configuration is based on EFS (Electronic Flight Strip) System replacing FDIO and EFSTS. This configuration includes a TDDS interface with EFS.

The TDDS requirements related to the EFS interface are not yet sufficiently mature but are included to ensure extensibility of the system. Therefore, the contractor shall only address these requirements up to and including development of the functional architecture that is capable of handling EFS when it matures.

OBJECTIVE

Support Volpe's overall project objective to complete development of TDDS.

SCOPE

The contractor shall furnish all necessary qualified personnel, materials, equipment, facilities, and air traffic management services, required to conduct the development as defined in Section C.3 below, except as provided by the government. The effort is focused on the final system design, development, test of TDDS; however a proof-of-concept or a working model of TDDS (without SWIM) will first be developed to help elicit, formulate, and refine the detailed requirements; and reduce the overall development risk. SWIM conformant components, and interfaces will be added to the model to create a SWIM TDDS prototype. The prototype will facilitate finalization of system and software requirements; provide a guide to the preparation of a solid system design, and create a template for the master test plan.

3

Figure E-1. STDDS Task Order SOW – The Raytheon Team has the necessary and required prerequisite experience to deliver the SMS at JFK (continued)

C.2 APPLICABLE DOCUMENTS

To assist in proposal preparation, a copy of the applicable documents on electronic media is provided under separate cover. If you would like additional copies you may go to the following websites listed below. There are copyright exceptions as noted below.

The following specifications, standards, instructions, orders, guidelines and handbooks form a part of this SOW and are applicable to the extent specified herein. The latest version of these documents as of the task order date shall apply. In the event of a conflict between this SOW and a referenced document, the SOW shall take precedence:

Copies of FAA specifications and interface documents may be obtained from the Federal Aviation Administration, Headquarters Public Inquiry Center APA-230, 800 Independence Avenue, SW, Washington, D.C. 20591, 202-267-3484. Requests should fully identify material desired and cite the solicitation or contract number. Most FAA Documents may be found online at www.faa.gov. Documents pertaining to SWIM may be found at www.swim.gov.

Military Standards and Specifications may be ordered from the Department of Defense Single Stock Point (DODSSP), Building 4/Section D, 700 Robbins Avenue, Philadelphia, PA 19111-5098. Information and direct, on-line access is also available at http://assist.daps.dla.mil/ using Acquisition Streamlining and Standardization Information System (ASSIST)-Online. ASSIST-Online provides users access to information associated with defense and federal specifications. Although available to all, first time users must complete the ASSIST-Online Account Application to receive a user identification and password.

National Institute of Standards and Technology (NIST) standards may be obtained from the Information Technology Laboratory National Institute of Standards and Technology, Gaithersburg, MD 20899 or ordered from the NIST website at http://www.nist.gov/.

Institute of Electrical and Electronics Engineers (IEEE) documents may be obtained from Institute of Electrical and Electronics Engineers-USA, 1828 L Street, NW, Suite 1202 Washington, D.C. 20036-5104 or ordered from the IEEE website at http://www.ieee.org.

Electronic Industries Alliance (EIA) documents may be obtained from ECA/EIA, 2500 Wilson Boulevard, Arlington, VA 22201 or ordered from EIA website at http://www.eia.org or from EIA's distributor at http://global.ihs.com.

American Society of Mechanical Engineers (ASME) documents may be obtained or ordered by contacting the ASME by calling 1-800-843-2763 or by E-mail at infocentral@asme.org or via the ASME website at http://asme.org/.

Integrated Baseline Review (IBR) guidance is provided in the National Defense Industrial Association (NDIA) IBR Guide, April 2003 may be found on the NDIA website at http://www.ndia.org..

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Figure E-1. STDDS Task Order SOW – The Raytheon Team has the necessary and required prerequisite experience to deliver the SMS at JFK (continued)

Requests for copies of documents not covered in the preceding paragraphs should be addressed to the Contracting Officer (CO). Requests should fully identify material desired and cite the solicitation or task order number.

C.2.1 FAA ORDERS, SPECIFICATIONS, STANDARDS AND MANUALS

FAA-PM-01	Program Management Plan (PMP) Data Item Description
FAA Order 1800.58A	National Airspace Integrated Logistics Support (NAILS) Policy
FAA Order 1370.82A	Information Systems Security Program
FAA-STD-025F	Preparation of Interface Documentation; November 30, 2007
FAA-STD-026A	FAA Standard for Software Development for NAS; Incorporates ISO/IEC 12207: Information Technology- Software Life cycle Processes, and Software Quality Assurance Standard
FAA-STD-045	Open Systems Interconnection Security Architecture, Protocols and Mechanisms, November 21, 1994
FAA-G-2100H	Electronic Equipment, General Requirements May 9, 2005
NAS System Engineering Manual Version 3.1	Section 4.10, Programmatic Risk Management
DOT/FAA/CT-03/05, HF-STD-001	Human Factors Design Standard (HFDS) 2003
TDDS SSD	Terminal Data Distribution (TDDS) System Specification Document (SSD), 11 June 2008, DRAFT
	Interface Requirements Document (IRD), Terminal Data Distribution System (TDDS) with the Runway Visual Range System for SWIM Segment 1, March 2006, DRAFT
	Interface Requirements Document (IRD), Terminal Data Distribution System (TDDS) with the Tower Data Link System-Pre-Departure Clearance Application (TDLS-PDC) for SWIM Segment 1, 11 June 2008, DRAFT
	Interface Requirements Document (IRD), Terminal Data Distribution System (TDDS) with the NAS Subscriber for SWIM Segment 1, 11 June 2008, DRAFT
	En Route Automation Modernization (ERAM) To System-Wide Information Management (SWIM) Service Consumers Interface Requirements Document (IRD), October 13, 2008, Preliminary
FAA Order 1370.79A	Internet Use Policy, October 12, 1999

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Figure E-1. STDDS Task Order SOW – The Raytheon Team has the necessary and required prerequisite experience to deliver the SMS at JFK (continued)

FAA Order 1370.81A	Electronic Mail Policy, 5/13/02
DOT/FAA Order 1600.75	Protecting Sensitive Unclassified Information (SUI), February 1, 2005

C.2.2 INDUSTRY STANDARDS AND GUIDELINES

NIST SP 800-30	Risk Management Guide for Information Technology Systems, dated July 2002
NIST SP 800-18 – Revision 1	Guide for Developing Security Plans for Information Technology Systems, February 2006
NIST SP 800-53 – Revision 1	Recommended Security Controls for Federal Information Systems, December 2006
NIST SP 800-53A	Guide for Assessing the Security Controls in Federal Information Systems, December 2007
NIST SP 800-37	Guide for the Security Certification and Accreditation of Federal Information Systems, May 2004

The following three documents contain proprietary information and cannot be reproduced or duplicated. These documents may only be viewed in person. The Volpe Center has purchased hardcopies of these documents and will make available for viewing to all Offerors. Offerors will be allowed no more than three (3) individuals up to four (4) hours in a secluded room. Notes are permitted. Replication of documents is not. Please contact Carl Chin, Contract Specialist, at carl.chin@dot.gov, 617-494-2072, to make an appointment.

C.2.2 INDUSTRY STANDARDS AND GUIDELINES

EIA-748-B	Earned Value Management Systems, June 2007
ANSI/ASQC ISO-9001-2000	Quality Management Systems: Requirements
IEEE/EIA 12207	Standard for Information Technology - Software Life Cycle Processes, Institute of Electrical and Electronics Engineers, 2008

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Figure E-1. STDDS Task Order SOW – The Raytheon Team has the necessary and required prerequisite experience to deliver the SMS at JFK (continued)

C.2.3 OTHER DOCUMENTS

Version 2.1, 2008	System Wide Information Management (SWIM) Technical Overview, Version 2.1, 28 March 2008
AV-1	National Airspace System Enterprise Architecture (NASEA), System Wide Information Management (SWIM) Architecture Segment 1, Version 1.0, Overview and Summary Information, 23 April 2007
OV-1	High-Level Operational Concept, System Wide Information Management (SWIM) Segment 1, 3 July 2007
FIPS PUB 199	Federal Information Processing Standards Publication, Standards for Security Categorization of Federal Information and Information Systems, February 2004
FIPS PUB 200	Minimum Security Requirements for Federal Information and Information Systems, March 2006
DI-MGMT-81650	Integrated Master Schedule (IMS) Data Item Description
DI-MGMT-81466A	Contract Performance Report (CPR) Data Item Description
DI-MGMT-81334C	Contract Work Breakdown Structure (CWBS)

C.3 TASK ORDER REQUIREMENTS

The contractor shall accomplish the necessary development to define, build TDDS as an efficiency-critical and SWIM-conformant component of the NAS. The requirements of this effort are defined in the paragraphs below and correlate to the WBS found in Attachment J-2. First-level WBS elements correspond directly to three digit SOW paragraphs, C.3.1, C.3.2, ... , C.3.7. A list of acronyms used in this SOW is found in Attachment J-4.

C.3.1 PROJECT MANAGEMENT

The contractor shall establish and maintain an organization to execute the requirements of the task order. The contractor's organization shall be responsive to government project management requirements; control TDDS business and technical activities of the contractor; ensure prime contractor and subcontractor(s) compliance with contract and task order requirements; and effectively manage all subcontract(s). The contractor shall assign a dedicated project manager (PM) with overall responsibility to organize, plan, schedule, implement, control, analyze and report all elements of the task order. The PM shall have sufficient authority to direct, execute, manage risk, and control all elements of the TDDS program within the contractor's scope of responsibility. The PM, as focal point within the contractor's organization, shall present and discuss as required the status of task order activities with the government Contracting Officer (CO) and the Task Order Contracting Officer's Technical Representative (TOCOTR).

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Figure E-1. STDDS Task Order SOW – The Raytheon Team has the necessary and required prerequisite experience to deliver the SMS at JFK (continued)

C.3.1.1 Project Review, Assessment, Cost Control, and Risk Management - The contractor shall participate in all activities necessary to review, assess, control costs, and manage the risk of the development of TDDS. In addition, systems engineering management activities are allocated to this work element. To define the activities in detail, the contractor shall develop, maintain and update an integrated Project Management Plan (PMP). The PMP shall demonstrate prime contractor and subcontractor(s) integration within the overall project management plan. The PMP shall integrate all functional areas (e.g., systems engineering, software engineering, testing, configuration management, quality assurance, integrated logistics support) and define the specific objectives to be accomplished for the successful execution of the program. The PMP shall specify the work tasks, at an overview level, necessary to meet all SOW requirements. The PMP shall also detail staffing and other resources required to meet task order requirements.

The contractor shall, as a special section of the PMP, define in detail an estimate of the resources necessary to develop the final system software as defined in SOW C.3.7. The estimate shall be based on the contractor's development approach, a high-level breakout of system components, an assessment of the size and complexity of developmental software components, and the contractor's historical performance on software development projects similar in scope and type.

C.3.1.2 Project Status Reporting - To accomplish project status reporting, the contractor shall conduct and logistically support monthly Project Management Reviews (PMR) to review the work effort being conducted. The first PMR shall be held a month after task order award and in accordance with the schedule provided in Attachment J-6. PMRs may occur in connection with Technical Interchange Meetings (TIM) to minimize travel. For all PMRs, the TOCOTR may modify the meeting schedule and location to accommodate special project needs. At PMRs, the contractor shall provide, at a minimum, the program's management, technical, cost and schedule status and after deployment, a report on system support and corrective action activities since the last PMR. The contractor shall provide a government approved agenda, presentation materials, action item list and meeting minutes for all PMRs. PMRs shall be accomplished nominally during one working day and shall include, but not be limited to, the following: (1) major accomplishments since last PMR and expected major accomplishments prior to next PMR; (2) cost, schedule and performance status including identification of major drivers behind cost or schedule variances and the action plan to resolve those variances, including changes to program Estimates At Completion (EAC); (3) changes in organization; (4) review of action items; (5) status of contractor deliverables with a focus on deliverables due within the next three months; (6) problem reports including alternative solutions and recommended action; (7) status of software development; (8) status of program risks including any deviation of probability of occurrence or impact; (9) support and corrective action activity and resolution, and (10) status of subcontracts, vendors, and/or delivery of non-developmental items.

C.3.1.3 Earned Value Management (EVM) - The contractor shall establish, maintain, and use an Earned Value Management System (EVMS) that is approved by the Volpe Center. The contractor shall use the same EVMS system and Work Breakdown Structure (WBS) for itself and subcontractors. The EVMS shall be used to plan and control costs; measure performance; and identify cost and schedule variances. The contractor shall prepare and submit a monthly EVM report starting at an initial baseline review and utilizing the EVMS system along with a

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Figure E-1. STDDS Task Order SOW – The Raytheon Team has the necessary and required prerequisite experience to deliver the SMS at JFK (continued)

written analysis that examines actual prime contractor and subcontractor(s) expenditures measured against planned expenditures. The data used to generate performance information shall also be used to develop a financial report providing funding status and requirements. The following subparagraphs identify detailed EVM and EVMS requirements for this effort:

C.3.1.3.1 Notice of Earned Value Management System (EVMS) - The offeror's response to this solicitation request must include proof of a certified EVMS or provide a plan to implement a certified system or systems that comply with the government's Earned Value Management criteria stated in subparagraph (b) of C.3.1.3.2 – EVMS. The offeror must submit the following as part of the offeror's proposal for government approval:

a) Documentation demonstrating that the EVMS proposed for this effort is ANSI/EIA 748 certified and EVM surveillance documentation demonstrating that the offeror has maintained an ANSI/EIA 748 compliant EVMS at the time of this TORFP.
b) If the proposed EVMS is not certified, the plan will explain how the offeror's EVMS will be certified for each guideline of the ANSI/EIA standard
c) For subcontracting information, see Section L.3, Subcontracting of the TORFP.

C.3.1.3.2 Earned Value Management System (EVMS) - The Earned Value Management System (EVMS) is a management tool that provides for integrating technical, cost and schedule information about contract/task performance. This information enables the government and the contractor project managers to manage tasks effectively

The contractor must use an EVMS complying with ANSI/EIA 748 that the government certifies before task award. If the offeror does not have a certified EVMS in place at the time of award, the offeror must provide a plan to the government to create an EVMS that complies with the ANSI standard before award and implement the system within 90 days after award.

a) The government must approve subcontractor EVMS plans before they begin work.
b) The offeror must require subcontractors listed in the task and subject to EVMS certification to comply with this clause.

The offeror is expected to develop a Work Breakdown Structure (WBS) prepared under DID DI MGMT 81334C. The WBS furnished in Attachment J-7 shall serve as the initial version. The reporting contractor shall prepare and submit the task WBS within 60 days of the required post award conference/kickoff meeting or, in the absence of a conference, within 60 days of task award or task modification. WBS ensures a consistent and compatible with the project baseline WBS to facilitate performance information into the project performance reports. The expectation is the WBS will not have an excessive number of lower-level elements to minimize excessive reporting requirements. The offeror should be cognizant of determining the level of reporting that allows visibility into those high-cost, high-risk or specific areas critical to the success of the project. The SOW requires the offeror to extend the WBS to a meaningful management or product-oriented lower level that reflects the way it conducts business and to prepare and deliver a WBS Index and Dictionary. The reporting of progress, performance, as well as financial data and variance analysis are based on the WBS.

The offeror must submit a Contract Performance Report (CPR) prepared under DID DI MGMT 81466A paragraph a-g. This DID contains the format and content preparation instruction for the

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Figure E-1. STDDS Task Order SOW – The Raytheon Team has the necessary and required prerequisite experience to deliver the SMS at JFK (continued)

data product generated by the specific and discrete task requirement as delineated in this task. As the DID states, Formats 1 and 5 are mandatory. The CPR shall be required no less frequently than monthly. All formats shall be submitted to the procuring activity no later than 10 working days following the contractor's accounting period cutoff date. Reports may reflect data either as of the end of the calendar month or as of the contractor's accounting period cutoff date, provided it is consistent with the IMS. (Note: contractors may elect to attach subcontractor Format 5 reporting and cross reference this analysis in the Format 5 reporting submitted to the Government to gain time efficiencies and meet submission dates.)

The offeror must obtain approval for EVMS system revisions consistent with the EVM system change process approved with the EVM certification. The offeror is expected to participate in the any EVM reviews as requested by the government, and provide access to all pertinent records and data requested by the CO so that the government can verify that the EVMS complies with the criteria specified in subparagraph b at the time of award and throughout task performance.

C.3.1.3.3 Integrated Master Schedule - The offeror must submit an Integrated Master Schedule (IMS) prepared under DID DI MGMT 81650 paragraph a-e. This DID contains the format and content preparation instruction for the data product generated by the specific and discrete task requirement as delineated in this task. The schedule shall contain the task milestones, accomplishments, and discrete tasks/activities (including planning packages where applicable) from task award to the completion of the task. The schedule shall be an integrated, logical network-based schedule that correlates to the WBS, and is vertically and horizontally traceable to the cost/schedule reporting instrument used to address variances such as the CPR (if applicable). The schedule shall have a numbering system that provides traceability to the IMS (if applicable) and SOW. It shall contain milestones and descriptions; display summary, intermediate, and detailed schedules; and periodic analysis of progress to date. It shall include fields and data that enable the user to access the information by product, process, or organizational lines.

The offeror must manage the execution of the project using the IMS as a day-to-day execution tool and periodically assess project progress in meeting project requirements. Progress reporting must be consistent with the IMS of each project management review, at selected technical reviews and other times at government request. Revisions to the IMS are expected to reflect current task milestones and deliverables. The IMS must include all activities of the prime contractor, subcontractors and dependencies of the government. All contractor information delivered to the government or presented at project reviews must originate from the IMS. Appropriate analysis of IMS task must be performed to represent existing problem areas and corrective actions required to eliminate or reduce schedule impact to the project.

C.3.1.3.4 Contractor Integrated Baseline Review - The offeror shall participate in a government-conducted Integrated Baseline Review (IBR) with acceptable action plans approved by the government within 180 days after award or significant task modifications. The IBR will be conducted consistent with ANSI/EIA 748. The IBR will evaluate the government and offeror's implementation of the performance measurement baseline. It is intended to ensure all parties mutually understand project scope, schedule, resources, inherent risk and management approach to ensure early and adequate planning. The IBR is a continuous part of the government's and offeror's project management process.

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Figure E-1. STDDS Task Order SOW – The Raytheon Team has the necessary and required prerequisite experience to deliver the SMS at JFK (continued)

C.3.1.4 Other Direct Costs (Travel, Supplies, Equipment) - The contractor shall plan, track, and report prime contractor and subcontractor Other Direct Costs (ODC), not including subcontractor labor, under SOW C.3.1.4 for purposes of EVM (as defined in C.3.1.3) and funding status reports. ODCs shall include, but not be limited to travel, supplies, tools, equipment, Commercial Off-The-Shelf (COTS), fees, and materials that are directly and exclusively required in the performance of the requirements of this task order. Subcontractor labor costs must be planned, tracked, and reported as defined in C.3.1.3 and correlated to the schedule provided in Attachment J-6 and WBS in Attachment J-7.

C.3.2 SYSTEMS ENGINEERING

The contractor shall perform the systems engineering including all technical and management activities associated with a specific solution that concentrates on the definition, design, and application of the whole system throughout the program life cycle. These activities include planning, directing, and controlling an integrated engineering effort.

C.3.2.1 Systems Engineering Management – All systems engineering management functions are included as part of project management, SOW C.3.1.

C.3.2.2 Systems Requirements and Definition - The contractor shall perform those activities associated with transformation of the system requirements into specifications and a preferred solution configuration. System engineering shall be applied to each component of the solution over the program life cycle and includes development of design criteria; and preparation of system-level data flows, block diagrams, change proposals; and documentation trees. Efforts shall include the following activities: (1) risk management to identify and analyze the uncertainties of achieving program objectives and develop plans to reduce the likelihood and consequences of those uncertainties; (2) life cycle engineering to identify and manage requirements for system life cycle attributes including, as applicable, real estate management, deployment and transition, integrated logistics support, sustainment/technology evolution, and disposal; (3) functional analyses to describe the functional characteristics based on stakeholders' needs, using functional flow diagramming as a representative structured analysis process, and to translate the needs into a sequenced and traceable functional architecture; and (4) a synthesis of alternatives to define design solutions to identify systems that will satisfy the requirements baseline. This synthesis shall translate the requirements, as set in context by the functional architecture, into the design architecture, consisting of the physical architecture with its associated technical requirements. All value engineering and supportability, maintainability, and reliability activities shall be performed and tracked under this work element.

In conjunction with activities in SOW 3.3, 3.4, and 3.5, the contractor shall work with the Volpe Center to finalize Terminal Data Distribution System (TDDS) System Specification Document (SSD) and all referenced Interface Requirements Documents (IRDs). The TTDS SSD shall form the primary basis of system requirements analysis.

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Figure E-1. STDDS Task Order SOW – The Raytheon Team has the necessary and required prerequisite experience to deliver the SMS at JFK (continued)

In conjunction with activities in SOW 3.5.1, the contractor shall work with the Volpe Center to maintain the supporting engineering documents that describe the form, fit, and functionality of how TDDS fits into the NAS Architecture as a whole and, specifically, how it meets the requirements and guidance provided by the SWIM program office.

TDDS SSD and IRD requirements related to the EFS interface are not yet sufficiently mature but are included to ensure extensibility of the system. Therefore, the contractor shall only address these requirements up to and including development of the functional architecture that is capable of handling EFS when it matures.

C.3.2.3 Analysis, Design, and Integration - The contractor shall perform and be responsible for overall analysis, design, test, and integration of the solution, (e.g., hardware system, software, facility, and telecommunications). This includes design, integrity, test and analysis, intra- and inter-system compatibility assurance (interface identification, analysis, and design), and the integration and balancing of reliability, maintainability, producibility, safety, and survivability. In the design the contractor shall allocate functions to the appropriate elements (e.g., hardware, software, telecommunications, user functions, services, facilities, etc.). The contactor shall prepare design information for identified design reviews as stated in C.3.1.2.

This activity shall include a tradeoff analysis to determine the optimum location for hardware to support the interfaces with airport systems and to determine the optimum interfacility communication services and capacity needs.

Requirements for design, test and integration do not apply to TDDS requirements related to the interface with EFS.

C.3.2.4 Value Engineering - All value engineering functions are included as part of system requirements and definition covered under SOW C.3.2.2.

C.3.2.5 Supportability, Maintainability, and Reliability - All supportability, maintainability, and reliability engineering functions are included as part of system requirements and definition, covered under SOW C.3.2.2.

C.3.2.6 Quality Assurance Program - The contractor shall assist by providing documentation, materials, and software as requested to support the government's Quality Assurance Program.

C.3.2.7 Configuration Management - The contractor shall deliver a TDDS using modern configuration management development tools, documentation, and version library controls. The contractor shall be responsible for establishing and sustaining consistency of a product's performance, functional, and physical attributes with its requirements, design, and operational information throughout its life. This includes the establishment, monitoring, and administration of change control procedures, including collecting, processing, distributing, and tracking modification request forms; establishment and administration of change control boards, and formal audits to compare product to documentation. It also includes configuration management of hardware, software, facilities, data, interfaces, tools, and documentation.

C.3.2.8 Human Factors - The contractor shall assist by providing only documentation, materials, and software as requested to support the government's Human Factors' effort.

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Figure E-1. STDDS Task Order SOW – The Raytheon Team has the necessary and required prerequisite experience to deliver the SMS at JFK (continued)

C.3.2.9 Security - The contractor shall perform activities associated with creating a TDDS that conforms to government standards for security. Security activities shall address US DOT and FAA policy, requirements, and issues with respect to information security. The TDDS shall be designed and tested against unauthorized access or use, or susceptibility to sabotage, and the ability of the system to survive a security threat in the expected operational environment. For purpose of security planning, the contractor shall identify tests and develop test schedules that meet the security requirements of the SOW, and shall integrate these test schedules into the overall TDDS Master Test Plan (MTP) and project schedule. The contractor shall perform system testing in accordance with the government approved TDDS MTP and in accordance with the system test requirements outlined in C.3.7.1 with respect to test environmental controls; readiness; conduct; configuration baselines; data collection; analysis; and reporting. The contractor shall develop and deliver security test procedures to be used in testing in accordance with the government approved MTP and deliver security test reports to formally document the security test results.

C.3.2.10 System Safety Engineering and Management - The contractor shall assist by providing documentation, materials, and software as requested to support the government's Safety Engineering and Management effort.

C.3.2.11 Other Systems Engineering Specialties - All other systems engineering specialties are included as part of system requirements and definition, SOW C.3.1.

C.3.3 PLANNING

C.3.3.1 – C.3.3.8 Paragraphs have been left intentionally blank.

C.3.3.9 Kickoff Meeting - The contractor shall plan for, host, participate in, and provide logistical support for a post award kickoff meeting to be scheduled in accordance with the project schedule furnished in Attachment J-6. The contractor shall demonstrate adequacy of proposed planning efforts to meet contractual requirements in areas such as, but not limited to, complete coverage of this SOW, logical scheduling of the work activities, and risk management. The contractor shall deliver and provide an overview of the following deliverables at the kickoff meeting: (1) Draft Project Management Plan (PMP); and (2) project schedule.

C.3.4 PROOF-OF-CONCEPT SYSTEM

The contractor shall develop a proof-of-concept system that implements the system requirements as understood at task award and documented in the Terminal Data Distribution (TDDS) System Specification Document (SSD) listed in Section C.2.1. The contractor shall transition research components from other domains; implement new capabilities; develop simulated interfaces where necessary; and provide feedback to the requirements process. The expected result or outcome is a working model of TDDS without SWIM defined standards, tools, and interfaces.

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Figure E-1. STDDS Task Order SOW – The Raytheon Team has the necessary and required prerequisite experience to deliver the SMS at JFK (continued)

Requirements in this section do not apply to TDDS SSD and IRD requirements related to the interface with EFS.

C.3.4.1 Design - The contractor shall address specific proof-of-concept implementation details; identify any technical constraints; establish an implementation/target environment; produce a design model; host and participate in a design review within the context of a TIM; document the design in sufficient clarity for implementation and correlation to the requirements. The contractor shall develop or adopt coding standards that will enable maintainable, reusable code.

C.3.4.2 Code and Test – The contractor shall develop code in accordance with the design model; document the code, submit completed packages for testing; and correct any deficiencies found. Coding standards shall be followed.

C.3.4.3 System Integration – The contractor shall integrate completed components into the working model of TDDS. Instances of the working model shall be installed at the contractor's facility; at the Volpe Center; and at the FAA's WJHTC (William J. Hughes Technical Center) for the purpose of evaluation.

C.3.4.4 Test and Evaluation – The contractor shall test the proof-of-concept for integrity, verify its performance to system requirements, document any differences; and prepare a test report. Deficiency reports shall be provided back to developers. The proof-of-concept shall also be tested for workload performance; reliability; and availability. Results of the testing shall be provided to the requirements activity defined in C.3.5.

C.3.4.5 Proof-Of-Concept Demonstration – The contractor shall plan for, host, participate in, and provide technical and logistical support for a proof-of-concept demonstration to be scheduled in accordance with the project schedule furnished in Attachment J-6. The contractor shall demonstrate the working TDDS model, address all defined interfaces, present results of contractor performed tests, and identify all corrective actions needed.

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Figure E-1. STDDS Task Order SOW – The Raytheon Team has the necessary and required prerequisite experience to deliver the SMS at JFK (continued)

C.3.5 REQUIREMENTS

The contractor shall analyze, manage, develop, and document all TDDS requirements. The primary products/deliverables of SOW C.3.5 are: the System/Subsystem Specification (SSS); Software Requirements Specification (SRS); and the Master Test Plan (MTP). Activities shall include analysis of existing documentation, development of a requirements model, development of test-level requirements; and refinements to the task order basis of requirements defined in the TDDS System Specification Document (SSD) and Interface Requirements Documents (IRDs) listed in SOW C.2.1.

Requirements in this section do not apply to TDDS SSD and IRD requirements related to the interface with EFS.

C.3.5.1 Requirements Development, Review, and Validation – The contractor shall review all requirements documents generated for TDDS, applicable SWIM standards and guidance, and program documentation available to describe other ongoing and future Terminal Systems efforts. Specific documents to review include but will not be limited to: the TDDS Segment 1 Services; Flight & Flow System Thread Configurations SWIM Segment 1; Tower Services and TDDS Initial Requirements; Terminal Data Exchange Concept of Use for SWIM Segment 1; SWIM Final Program Requirements – Segment 1; SWIM Architecture Document; TDDS Interface Requirements Documents; Flight and Flow Management Final Program Requirements for FPR; and the TDDS System Specification Document. Using the requirements derived from the documents listed, the contractor will develop a requirements model and logically decompose each requirement into sets of lower tier requirements until each can be classified as non-developmental items belonging to hardware; COTS software, tools, environments, databases; developmental items; reusable components; etc. From the sets of lower tier requirements, those of particular interest to development will be extracted and itemized as potentially having significant development cost impact.

The contractor shall incorporate any information, details, and refinements on requirements to the requirements model as the proof-of-concept (SOW C.3.4) and the SWIM TDDS Prototype (SOW C.3.6) evolve.

Based on the requirements model, the contractor, as described in SOW C.3.2.2, shall provide comments and/or draft material to refine or update the TDDS SSD; the TDDS Interface Requirements Documents (IRD); and/or SWIM documentation. Comments may reflect missing or ambiguous requirements and/or feedback from the TDDS proof-of-concept and SWIM TDDS prototype development.

C.3.5.2 System/Subsystem Specification (SSS) - The contractor shall use the TDDS SSD as the basis of all system requirements analysis. The contractor shall identify the major functional subsystems of the TDDS, and for each subsystem, shall document the expanded requirements in the System/Subsystem Specification (SSS). The SSS development process shall be based upon a contractor-proposed schedule as approved by the government. The contractor shall keep the SSS current throughout all TDDS activities throughout the duration of the task order. The contractor

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Figure E-1. STDDS Task Order SOW – The Raytheon Team has the necessary and required prerequisite experience to deliver the SMS at JFK (continued)

shall develop and preserve requirements traceability throughout all phases of the TDDS life cycle. A verification requirements traceability matrix shall be developed and used to document the requirements traceability between the government's SSD and the contractor's SSS.

C.3.5.3 Software Requirements Specification (SRS) – The contractor shall develop a Software Requirements Specification (SRS) to record software requirements. The contractor shall describe how any COTS, NDI (Non-Developmental Item) and/or other reused software will be integrated with newly developed TDDS software. COTS, NDI and/or other reused software documentation shall meet the standards for newly developed software. Embedded COTS within reused software shall be tracked with all other COTS products in the contractor's TDDS design.

C.3.5.4 Master Test Plan – The contractor shall develop, provide for government approval, and maintain a Master Test Plan (MTP), which shall serve as the high-level planning document for the contractor's TDDS test program. The contractor shall identify tests and develop test schedules that meet the requirements of the SOW, and shall integrate these test schedules into the overall TDDS project schedule. The contractor shall include in the MTP a cross-reference matrix that correlates the SSD and SSS to a proposed test procedure and assigns a verification test method (Test, Demonstration, Analysis, and/or Inspection) to each.

C.3.5.5 System Requirements Reviews (SRR) – The contractor shall plan for, host, participate in, and provide technical and logistical support for three progressively incremental system requirements reviews, to be scheduled in accordance with Attachment J-6. The purpose of each system requirements review shall be to support a technical exchange with the government on the following topics: (1) draft SSS; (2) draft SRS; and (3) second draft SSS, SRS, and draft Master Test Plan (MTP).

C.3.6 PROTOTYPE SYSTEM

The contractor shall develop a prototype system that implements the system requirements as understood after an initial review, clarification, refinement, and definition is completed and documented in the TDDS SSD, SSS, and SRS. The contractor shall extend the proof-of-concept model developed in C.3.4 and add SWIM conformant components. The expected result or outcome is a working model of TDDS with SWIM defined standards, tools, and interfaces. The working model shall be sufficient to gather system performance data, reliability and availability measurements, and with the ability to demonstrate the functional features and interfaces of TDDS from an external system's point of view.

C.3.6.1 Install SWIM Components and Interfaces – Using the TDDS proof-of-concept model as a starting point, the contractor shall replace or add SWIM compliant components, standards, and interfaces to effect the transfer of data to the NAS Subscribers and to and from the En Route Automation Modernization (ERAM) system in accordance with the Interface Requirements Documents identified in Section C.2.1. Coding standards shall be followed for all software development and with respect to any modifications to existing components performed. Instances of the working model shall be installed at the contractor's facility; at the Volpe Center; and at the FAA's WJHTC for the purpose of evaluation.

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Figure E-1. STDDS Task Order SOW – The Raytheon Team has the necessary and required prerequisite experience to deliver the SMS at JFK (continued)

C.3.6.2 Test and Evaluation – The contractor shall test the prototype for integrity, verify its performance to system requirements, document any differences; and prepare a test report. Deficiency reports shall be provided back to developers. The prototype shall also be tested for workload performance; reliability; and availability. Results of the testing shall be provided to the requirements activity defined in C.3.5.

C.3.6.3 Prototype Demonstration – The contractor shall plan for, host, participate in, and provide technical and logistical support for a prototype demonstration to be scheduled in accordance with the project schedule furnished in Attachment J-6. The contractor shall demonstrate the working TTDS model, address all defined interfaces, present results of contractor performed tests, and identify all corrective actions needed.

C.3.7 FINAL SYSTEM

The contractor shall develop a TDDS that implements the system requirements as documented in an updated Terminal Data Distribution (TDDS) System Specification Document (SSD), SSS, and SRS. The contractor shall build upon proof-of-concept and prototype activities conducted in SOW C.3.4 and SOW C.3.6. The system design and product shall be fully documented through the development of the TDDS System/Subsystem Design Description (SSDD); Interface Control Documents (ICDs); Software Design Descriptions (SDDs); and Software Product Specification (SPSs). Software for TDDS shall be released in increments to coincide with software testing, system integration and system testing, key site testing and operational test and evaluation, and ready for deployment. The expected result or outcome is a working and fully documented TDDS. In addition, the contractor shall assist the government in populating and using the government provided SWIM Registry in accordance with SWIM provided standards, guidance, and tools with respect to naming conventions, protocols, and formats.

Requirements in this section do not apply to TDDS SSD and IRD requirements related to the interface with EFS.

C.3.7.1 Design - The contractor shall develop and document all aspects of a TDDS design that meets TDDS contractual requirements. The contractor shall plan for, host, participate in, and provide logistical support for design reviews to be scheduled in accordance with the project schedule furnished in Attachment J-6.The TDDS hardware and software architecture shall be documented at a sufficient level in the SSDD. The contractor shall conduct required systems engineering risk reduction activities to the government to provide insight into the requirements, design alternatives and systems engineering issues that form the basis for key system design issues. These may include, but are not limited to, system modeling/analysis, engineering mock-ups/prototype demonstrations as identified in SOW C.3.4 and C.3.6, non-development item demonstrations, and joint government/contractor evaluation activities. These activities shall be planned for and coordinated with the government to be conducted at the contractor's facilities, the Volpe Center facilities, WJHTC facilities, or other facilities, as appropriate. The contractor shall provide planning documentation for TDDS development, test, training and maintenance.

'e E-1. STDDS Task Order SOW – The Raytheon Team has the necessary and requ prerequisite experience to deliver the SMS at JFK (continued)

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The contractor shall define and document in the SSDD the high-level TDDS system architecture including allocation of SSS and SRS requirements to appropriate components/configuration items. The contractor shall maintain this document throughout the duration of the task order.

The contractor shall document, in Appendix A of the SSDD, the traceability from the SSS and SRS requirements to the system components/configuration items (hardware and software) identified in the SSDD, including all SSS and/or requirements allocated to COTS or NDI. The contractor shall develop a requirements allocation matrix. Requirements allocated to COTS or NDI shall be clearly identified in the requirements allocation matrix. The contractor shall maintain the requirements allocation matrix throughout the duration of the task order.

The contractor shall document the detail design of each major software component in Software Design Documents (SDD) and draft Interface Control Documents (ICD) to document the as-built system interfaces. The SDDs will be delivered and reviewed in increments.

C.3.7.2 Code and Test - The contractor shall develop, code, build, integrate (software and system) and test TDDS software increments in accordance with the government approved SDDs. The contractor shall refine the ICDs, as necessary, to document the as-built system interfaces. The contractor shall obtain government approval prior to modification of any COTS/NDI product that is used as an integral part of the software architecture, either as a software component or within a component. The contractor shall document the as-coded TDDS software in Software Product Specifications (SPSs), and Software Version Descriptions (SVDs). Coding standards shall be followed for all software development.

The contractor shall develop a Software Test Plan (STP) in accordance with the Master Test Plan and develop Software Test Procedures (STPr), and schedule all development and unit testing for each detailed component of software. Test conduct shall be documented in Software Test Reports (STR).

C.3.7.3 System Integration – The contractor software development shall include software integration activities including developmental tests of modified COTS, NDI, modified NDI, newly developed software, and partially integrated software and hardware using a representative environment to ensure the system software works as a whole. The government will monitor the software integration activities. The contractor shall document operation of the software and system in the Computer Operations Manual (COM). System Integration shall also consist of system test activities; key site testing; test readiness review; and system acceptance test.

The contractor shall conduct Test Readiness Reviews (TRRs) prior to each phase of formal testing to ensure readiness to begin that phase of testing. Government approval of the contractor's TRR is required as a prerequisite to the start of each formal test. The contractor shall prepare and deliver to the government a TRR agenda, meeting minutes, action item list, and presentation materials in accordance with the government approved MTP.

All formal testing shall be conducted on established configuration baselines in accordance with government approved test plans and test procedures. No change shall be made to the established configuration baselines during test and evaluation without concurrence from the government.

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Figure E-1. STDDS Task Order SOW – The Raytheon Team has the necessary and required prerequisite experience to deliver the SMS at JFK (continued)

The contractor shall conduct all tests, collect and analyze data, and perform all required data reduction; and shall furnish analysis methods and results to support claims of test success upon completion of each test or series of tests. Upon completion of each test (or as otherwise agreed), the contractor shall present a post-test briefing to discuss with the government representatives the test results including all completed and pending data reduction and analysis activities, discrepancies, deficiencies, and log book entries, unless otherwise directed by the government.

The contractor shall perform a System Acceptance Test (SAT) in accordance with the government approved TDDS MTP and System Test Procedures (SysTPr). The contractor's testing shall verify that TDDS increments meet the physical, functional, interface, and performance requirements contained in the SSD and IRDs. The contractor shall develop and deliver System Test Plans (SysTP) and system and key site test procedures (SysTPr) to be used in testing in accordance with the government approved MTP. System and Key Site Testing shall be documented in System Test Reports (SysTR).

Key site testing shall be conducted at a site designated by the government. The contractor shall provide, for government approval, a key site system acceptance test plan and procedures prior to conduct of key site testing. The contractor shall generate test reports after the test and provide them for government approval. The contractor shall integrate and configure the key site system for key site testing. The contractor shall perform formal key site testing, witnessed by the government, using the government approved test procedures. The key site testing shall be tailored to specific site requirements. The contractor shall ensure the key site is fully operational, has all required documentation, tools and test equipment, and is complete and ready for operation and maintenance. The contractor shall successfully complete a site configuration inventory and TDDS system configuration prior to the government acceptance of the delivered system version and a transfer of ownership to the government.

C.3.7.4 Operational Test and Evaluation - The contractor shall assist by providing documentation, materials, and software as requested to support the government's OT&E effort.

C.4 SPECIAL REQUIREMENTS

Non-Proprietary Information

By submission of any deliverable, the contractor warrants that these deliverables do not infringe upon the property rights of others nor contain proprietary information which cannot be disclosed outside the government and its designated users. The government has the right to duplicate, use, or disclose the data contained in all deliverables under this effort, in whole or part.

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Figure E-1. STDDS Task Order SOW – The Raytheon Team has the necessary and required prerequisite experience to deliver the SMS at JFK (continued)

SECTION D - PACKAGING AND MARKING

The Contractor shall comply with the terms and conditions as cited in the Master Contract.

SECTION E - INSPECTION AND ACCEPTANCE

The Contractor shall comply with the terms and conditions as cited in the Master Contract.

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Figure E-1. STDDS Task Order SOW – The Raytheon Team has the necessary and required prerequisite experience to deliver the SMS at JFK (continued)

SECTION F – DELIVERABLES AND PERFORMANCE

The Contractor shall comply with the terms and conditions as cited in the Master Contract and the following terms and conditions:

F.1 Deliverables/Timetables

The deliverables for this Task Order are as shown in the table below. Due dates are measured in calendar days.

DELIVERABLE/DESCRIPTION	SOW	DUE	REFERENCE/REMARKS/COMMENTS
Kickoff Meeting	C.3.3.9	To be determined with Technical direction	Presentation Material, Contractor Format Acceptable
Project Management Plan (PMP)	C.3.1.1	TBD with technical direction	FAA-PM-01, Contractor Format Acceptable
Project Status Report	C.3.1.2	TBD with technical direction	Recurring, Contractor Format Acceptable
Contract Performance Report	C.3.1.3	TBD with technical direction	Recurring, DID DI MGMT 81466A
Work Breakdown Structure (WBS)	C.3.1.3	TBD with technical direction	DID DI MGMT 81334C
Integrated Master Schedule (IMS)	C.3.1.3	TBD with technical direction	DID DI MGMT 81650
Integrated Baseline Review (IBR)	C.3.1.3	TBD with technical direction	ANSI/EIA 748
System Specification Document (SSD)	C.3.2.2	TBD with technical direction	Comments only
System/Subsystem Specification (SSS)	C.3.5.2	TBD with technical direction	FAA-STD-026a, DID-FAA-026-05
Software Requirements Specification (SRS)	C.3.5.3	TBD with technical direction	FAA-STD-026a, DID-FAA-026-07
Proof-Of-Concept Demonstration	C.3.4.5	TBD with technical direction	Presentation Material, Contractor Format Acceptable
Master Test Plan (MTP)	C.3.5.4	TBD with technical direction	FAA-STD-026a, DID-FAA-026-12 Contractor Modified/Adapted for purpose of MTP

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Figure E-1. STDDS Task Order SOW – The Raytheon Team has the necessary and required prerequisite experience to deliver the SMS at JFK (continued)

DELIVERABLE/DESCRIPTION	SOW	DUE	REFERENCE/REMARKS/COMMENTS
Prototype Demonstration	C.3.6.5	TBD with technical direction	Presentation Material, Contractor Format Acceptable
System Requirements Reviews (SRR)	C.3.5.5	TBD with technical direction	Presentation Material, Contractor Format Acceptable, 3 Progressively Incremental Occurrences Of Event
System/Subsystem Design Description (SSDD)	C.3.7.1	TBD with technical direction	FAA-STD-026a, DID-FAA-026-06
Interface Control Documents (ICD)	C.3.7.1	TBD with technical direction	FAA-STD-025f, Required for Each External Interface
Software Design Descriptions (SDD)	C.3.7.1	TBD with technical direction	FAA-STD-026a, DID-FAA-026-09, Required for Each Major Software Component
System Design Reviews (SDR)	C.3.7.1	TBD with technical direction	Presentation Material, Contractor Format Acceptable
Critical Design Review (CDR)	C.3.7.1	TBD with technical direction	Presentation Material, Contractor Format Acceptable
Software Product Specification (SPS)	C.3.7.2	TBD with technical direction	FAA-STD-026a, DID-FAA-026-15
Software Version Descriptions (SVD)	C.3.7.2	TBD with technical direction	FAA-STD-026a, DID-FAA-026-16, Concurrent with Progressively Incremental Releases of Software
Software Test Plan (STP)	C.3.7.2	TBD with technical direction	FAA-STD-026a, DID-FAA-026-12
Software Test Procedures (STPr)	C.3.7.2	TBD with technical direction	FAA-STD-026a, DID-FAA-026-13, Required for Each Major Software Component
Software Test Reports (STR)	C.3.7.3	TBD with technical direction	FAA-STD-026a, DID-FAA-026-14, Required for Each Major Software Component
Computer Operation Manual (COM)	C.3.7.4	TBD with technical direction	FAA-STD-026a, DID-FAA-026-20
System and Key Site Test Procedures (SysTPr)	C.3.7.4	TBD with technical direction	FAA-STD-026a, DID-FAA-026-13 Contractor Modified/Adapted for System Testing
System Test Readiness Review (TRR)	C.3.7.4	TBD with technical direction	Presentation Material, Contractor Format Acceptable
System Acceptance Test (SAT)	C.3.7.4	TBD with technical direction	Presentation and Test Material, Contractor Format Acceptable

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Figure E-1. STDDS Task Order SOW – The Raytheon Team has the necessary and required prerequisite experience to deliver the SMS at JFK (continued)

DELIVERABLE/DESCRIPTION	SOW	DUE	REFERENCE/REMARKS/COMMENTS
System Test Report (SysTR)	C.3.7.4	TBD with technical direction	FAA-STD-026a, DID-FAA-026-14 Contractor Modified/Adapted for System Testing
Key Site Tests	C.3.7.4	TBD with technical direction	Presentation and Test Material, Contractor Format Acceptable
Key Site Test Reports	C.3.7.4	TBD with technical direction	FAA-STD-026a, DID-FAA-026-14 Contractor Modified/Adapted for Key Site Testing

F.2 Documentation and Reporting

- All deliverables not identified and defined in FAA-STD-026a and/or FAA-STD-025f shall be delivered as Technical Reports. Technical Reports may be delivered in contractor format unless otherwise specified. All deliverables identified and defined in FAA-STD-026a shall use the associated Data Item Description (DID) as a requirement for content and guide for format. The Contractor shall modify/adapt the FAA-STD-026a DIDs for select deliverables as shown in Section F.1. Contractor format must be government approved.
- Reports:
  - Monthly Progress Reports: The Contractor shall provide monthly reports to the TOCOTR. These reports shall include a status update of the project, accomplishments since the last report, and issues that must be addressed by the Contractor or Volpe.
  - Monthly Cost Reports: The Contractor shall provide a monthly cost, schedule and status report as defined in the Master Contract

F.3 Submission of Deliverables

All deliverables not identified and defined in FAA-STD-026a and/or FAA-STD-025f shall be delivered as a Technical Reports. All deliverables identified defined in FAA-STD-026a shall use the associated Data Item Description (DID) as a requirement for content and guide for format. The contractor shall modify/adapt the FAA-STD-026a DIDs for select deliverables as shown in Section F.1.

All deliverables that reference a Data Item Description (DID) and show "contractor format acceptable" shall use the referenced DID as a requirement for content and guide for format.

Contractor format must be government approved. Technical Reports may be delivered in contractor format unless otherwise specified.

F.4 Period of Performance

Period of performance for this Task Order is approximately 48 months from date of award of the task order.

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Figure E-1. STDDS Task Order SOW – The Raytheon Team has the necessary and required prerequisite experience to deliver the SMS at JFK (continued)

SECTION G - TASK ORDER ADMINISTRATION DATA

The Contractor shall comply with the terms and conditions of the Master Contract. In addition:

G.1 Fee

The requirement for earning full fixed fee in accordance with the Payment of Fee - Cost-Plus-Fixed-Fee Clause of the contract is as follows:
The total fee for each term-type task shall be payable upon acceptance of the work by the Government and upon receipt of a written certification from the Contractor that the level-of-effort specified in the task order has been expended. If fewer direct labor hours are provided than set forth in the task order, the fee will be adjusted downward for each hour not provided.

G.2 Task Order Contracting Officer's Technical Representative (TOCOTR):

The TOCOTR for this Task Order is:

Jim Hill RVT-73
U.S DOT/RITA/ Volpe National Transportation Systems Center
55 Broadway
Cambridge, MA 02142

The Alternate TOCOTR for this Task Order is:

Laura Mellen RVT-73
U.S. DOT/RITA/Volpe National Transportation Systems Center
55 Broadway
Cambridge, MA 02142

G.3 Administrative Contracting Officer (ACO):

The ACO for this Task Order is:
Daniel J. Leone RVP-31
U.S. DOT/RITA/Volpe National Transportation Systems Center
55 Broadway
Cambridge, MA 02142

G.4 Contracting Officer (CO):

The CO for this Task Order is:
Carol A. Ferrante, RVP-31
U.S. DOT/RITA/Volpe National Transportation Systems Center
55 Broadway
Cambridge, MA 02142

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Figure E-1. STDDS Task Order SOW – The Raytheon Team has the necessary and required prerequisite experience to deliver the SMS at JFK (continued)

SECTION H - SPECIAL CONTRACT REQUIREMENTS

The Contractor shall comply with the terms and conditions of the Master Contract.

H.1 Limitation of Liability – Incremental Funding (Term Form)

(a) The amount available for payment and allotted to this incrementally funded Task Order is $300,000. The amount allotted to the estimated cost is $276,000. The amount obligated for the fixed fee is $24,000. The Limitation of Funds Clause, FAR 52.232-22, applies to the amount allotted to cover the estimated costs only.

(b) The estimated level of effort applicable to the incremental funding provided herein is 1,880 professional labor hours.

(c) The incremental funding provided herein is estimated to be applicable for services performed through 60 months from date of award.

(d) The funding must be tracked and billed accordingly. The funds obligated in Block No. 9 of the OF 347 are available only for work performed on or after the effective date of the Task Order award

H.2 Technical Direction

Given the nature of the work involved, work performed under this Task Order may not require a constant, or predictable level-of-effort and further clarifying information may be required. Accordingly, work performed under this Task Order may be directed via written Technical Memoranda.

All technical direction will be developed by the Task Order COTR (TOCOTR) and will be issued to the Contractor by the TOCOTR. This technical direction is limited in accordance with the Responsibility for Contract clause of the contract and may include:

- Reference to the specific subtask in the SOW;
- Further definition of documentation/reporting requirements; and
- Deliverable timetables.

H.3 Contractor Responsibility (DEC 1998)

The Contractor shall, without additional expense to the Government, be responsible for all damage to persons or property that occur as a result of its fault or negligence in connection with the prosecution of the work, and shall be responsible for the proper care and protection of the work performed. Breakage or loss of office equipment or other property including that of a Government employee, which may occur in or about the building as a result of a fault or negligence in the Contractor's operations or fault or negligence in the actions of the Contractor's agent, subcontractors or its employees shall be made good by the Contractor at its own expense.

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Figure E-1. STDDS Task Order SOW – The Raytheon Team has the necessary and required prerequisite experience to deliver the SMS at JFK (continued)

H.4 Non-Proprietary Information (SEP 2008)

By submission of any deliverable, the contractor warrants that these deliverables do not infringe upon the property rights of others nor contain proprietary information which cannot be disclosed outside the government and its designated users. The government has the right to duplicate, use, or disclose the data contained in all deliverables under this effort, in whole or part.

H.5 Disclosure of Conflicts of Interest (OCT 2008)

(a) If, after receiving technical direction or commencing work, the Contractor discovers an organizational conflict of interest which was not previously identified to the Contracting Officer, the Contractor shall promptly notify the Contracting Officer of such conflict. For purposes of this clause, an "organizational conflict of interest" shall have the meaning set forth in FAR (48 CFR) 9.501. A conflict of interest for the purposes of this Task Order is indicated if the Contractor's objectivity may be impaired by any past, present or planned interest (financial or otherwise) in organizations or in agreements or contracts with organizations, whose interests may be substantially affected by activities covered by this Task Order. The contractor shall submit a statement AND CERTIFICATION AS REQUIRED BY TAR 1252.209-70(A), describing THE POTENTIAL organizational conflict of interest, any action the Contractor proposes to avoid or mitigate the organizational conflict, and providing any other information the Contractor believes would be helpful to the Contracting Officer in analyzing the situation. If the Contractor believes that the conflict is not significant and would not cause a conflict of interest in their performance of the work, IT shall provide a statement, with a supporting explanation, describing its rationale. The Contracting Officer shall make the final determination.

(b) In addition to any other remedies available to the Government by law, the Contractor's failure to identify an actual or potential organizational conflict of interest, or the misrepresentation of facts in connection with a reported conflict, may be a basis for default termination of the TO or the contract.

H.6 Ordering Limitations (NOV 2008)

This Task Order is not the exception to Ordering Limitations referenced in Section H.18 of the Master Contract. Any Cost proposal in excess of $10,000,000.00 will be rejected.

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Figure E-1. STDDS Task Order SOW – The Raytheon Team has the necessary and required prerequisite experience to deliver the SMS at JFK (continued)

SECTION I - CONTRACT CLAUSES

The Contractor shall comply with the terms and conditions as cited in the Master Contract.

I.1 Key Personnel

The following are considered by the Government to be Key Personnel (as defined under TAR 1252.237-73) under the Task Order:

Name	Position
Anthony Jagodnik	Task Order Manager
Tim Donovan	Senior Staff (Engineering/Requirements Lead)
Jennifer Rendon	Senior Staff (Software Lead)
William Nevits	Senior Staff
Patrick Pierce	Senior Staff
Robert Stamm	Senior Staff
James Bocchi	Senior Staff

Note: More than one individual may be required to satisfy this requirement.

SECTION J - LIST OF ATTACHMENTS

J.1 - TDDS Project Schedule
J.2 - TDDS Work Breakdown Structure
J.3 - TDDS Site List
J.4 - TDDS List of Acronyms

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Figure E-1. STDDS Task Order SOW – The Raytheon Team has the necessary and required prerequisite experience to deliver the SMS at JFK (continued)

ATTACHMENT J-1 – TDDS PROJECT SCHEDULE

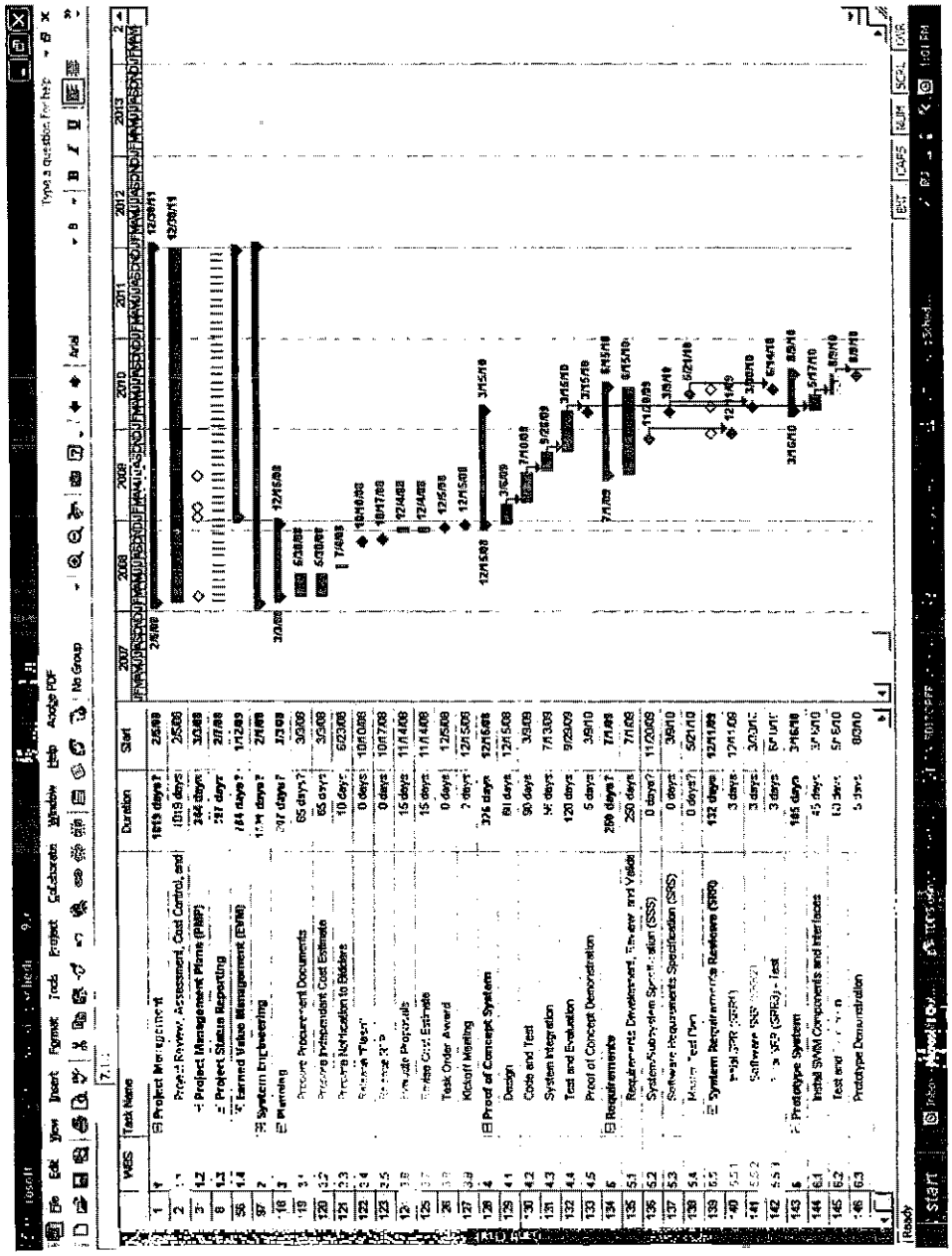

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Figure E-1. STDDS Task Order SOW – The Raytheon Team has the necessary and required prerequisite experience to deliver the SMS at JFK (continued)

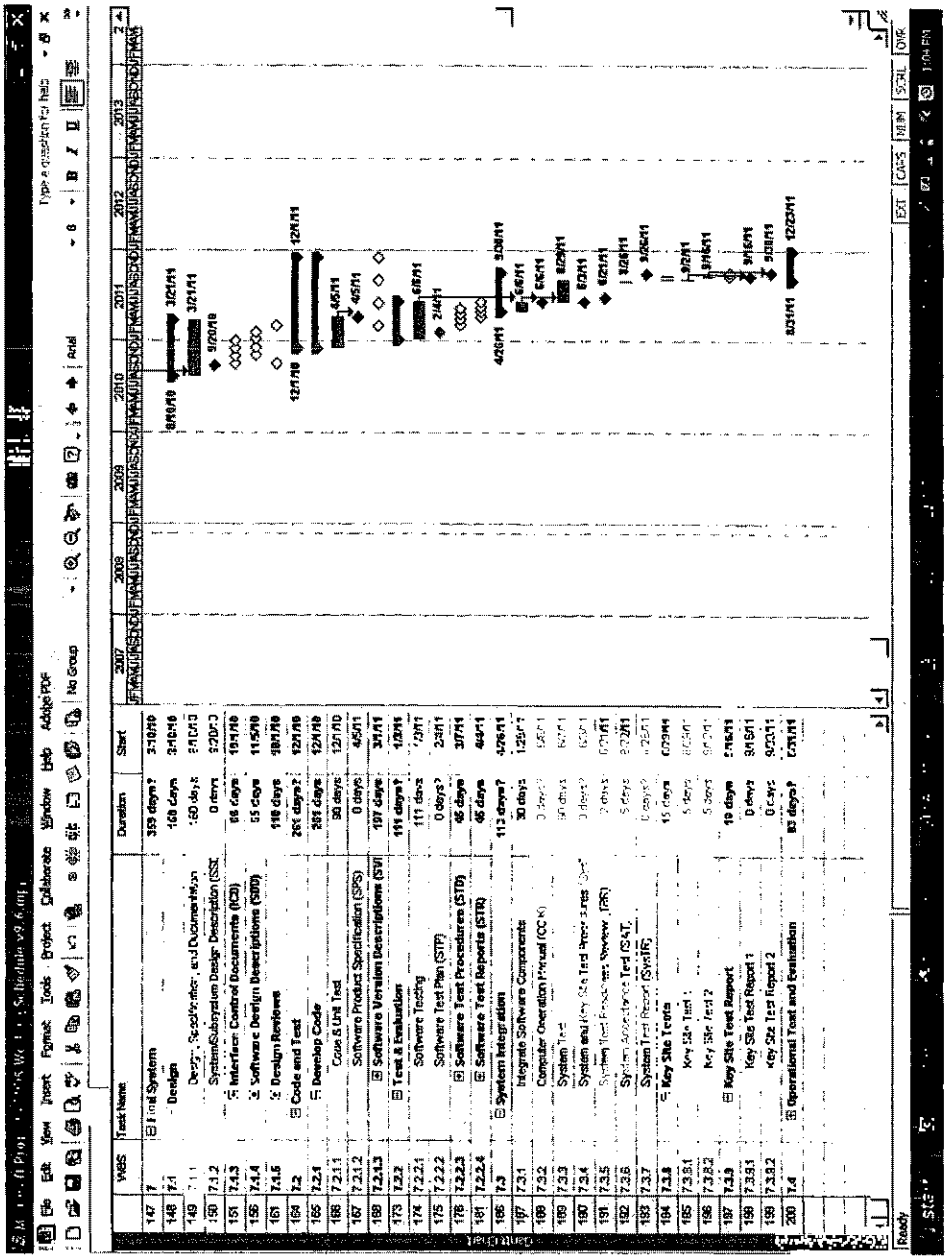

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Figure E-1. STDDS Task Order SOW – The Raytheon Team has the necessary and required prerequisite experience to deliver the SMS at JFK (continued)

ATTACHMENT J-2 – WORK BREAKDOWN STRUCTURE (WBS)

WBS	ELEMENT DESCRIPTION/NAME
1	**Project Management**
1.1	Project Review, Assessment, Cost Control, and Risk Management
1.2	Project Management Plans (PMP)
1.3	Project Status Reporting
1.4	Earned Value Management (EVM)
2	**System Engineering**
2.1	System Engineering Management
2.2	System Requirements and Definition
2.3	Analysis, Design, and Integration
2.4	Value Engineering
2.5	Supportability, Maintainability, and Reliability Engineering
2.6	Quality Assurance Program
2.7	Configuration Management
2.8	Human Factors
2.9	Security
2.10	System Safety Engineering and Management
2.11	Other System Engineering Specialties
3	**Planning**
3.1-3.8	Intentionally Left Blank
3.9	Kickoff Meeting
4	**Proof of Concept System**
4.1	Design
4.2	Code and Test
4.3	System Integration
4.4	Test and Evaluation
4.5	Proof of Concept Demonstration
5	**Requirements**
5.1	Requirements Development, Review, and Validation
5.2	System/Subsystem Specification (SSS)
5.3	Software Requirements Specification (SRS)
5.4	Master Test Plan
5.5	System Requirements Reviews (SRR)
5.5.1	Initial SRR (SRR1)
5.5.2	Software SRR (SRR2)
5.5.3	Final SRR (SRR3) - Test
6	**Prototype System**
6.1	Install SWIM Components and Interfaces
6.2	Test and Evaluation
6.3	Prototype Demonstration
7	**Final System**
7.1	Design
7.1.1	Design, Specification, and Documentation
7.1.2	System/Subsystem Design Description (SSDD)
7.1.3	Interface Design Descriptions (IDD)

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Figure E-1. STDDS Task Order SOW – The Raytheon Team has the necessary and required prerequisite experience to deliver the SMS at JFK (continued)

WBS	ELEMENT DESCRIPTION/NAME
7.1.4	Software Design Descriptions (SDD)
7.1.5	Design Reviews
7.1.5.1	System Design Reviews (SDR)
7.1.5.2	Critical Design Review (CDR)
7.2	Code and Test
7.2.1	Develop Code
7.2.1.1	Code & Unit Test
7.2.1.2	Software Product Specification (SPS)
7.2.1.3	Software Version Descriptions (SVD)
7.2.1.3.1	SVD 1
7.2.1.3.2	SVD 2
7.2.1.3.3	SVD 3
7.2.1.3.4	SVD 4
7.2.2	Test & Evaluation
7.2.2.1	Software Testing
7.2.2.2	Software Test Plan (STP)
7.2.2.3	Software Test Procedures (STD)
7.2.2.4	Software Test Reports (STR)
7.3	System Integration
7.3.1	Integrate Software Components
7.3.2	Computer Operation Manual (COM)
7.3.3	System Test
7.3.4	System and Key Site Test Procedures (SysTD)
7.3.5	System Test Readiness Review (TRR)
7.3.6	System Acceptance Test (SAT)
7.3.7	System Test Report (SysTR)
7.3.8	Key Site Tests
7.3.8.1	Key Site Test 1
7.3.8.2	Key Site Test 2
7.3.9	Key Site Test Report
7.3.9.1	Key Site Test Report 1
7.3.9.2	Key Site Test Report 2
7.4	Operational Test and Evaluation

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Figure E-1. STDDS Task Order SOW – The Raytheon Team has the necessary and required prerequisite experience to deliver the SMS at JFK (continued)

ATTACHMENT J-3 – TDDS SITE LIST

Table of Planned TDDS Sites

Location	Fac ID	Site Surveys		Deployment		Notes on the Choice of TTDS Sites
		Start Date	End Date	Start Date	End Date	
Las Vegas	L30	12/12/2011	12/14/2011	7/2/2012	7/9/2012	1. First geographical locations of ASDE-X, TDLS, and EFS sites are examined. One or more of these systems cover anumber of regions such as, for example, Miamia, Orlando, and Tampa in Florida; Boston, New York, Philadelphia, and Washington Metropolitan area in the Northeast; and San Francisco and Los Angeles in California. The TDDS sites were selected to cover these areas. Honolulu is the only off-shore facilities selected for TDDS; San Juan is expected to be connected to FTI only via an IP connection.
Minneapolis	M98	12/15/2011	12/17/2011	7/10/2012	7/17/2012	
Detroit	D21	1/9/2012	1/11/2012	7/18/2012	7/25/2012	
Pittsburg	PIT	1/12/2012	1/14/2012	7/26/2012	8/2/2012	
DC	PCT	1/17/2012	1/18/2012	8/3/2012	8/10/2012	
Philadelphia	PHL	1/19/2012	1/21/2012	8/13/2012	8/20/2012	
Los Angeles	SCT	1/23/2012	1/25/2012	8/21/2012	8/28/2012	
San Francisco	NCT	1/26/2012	1/28/2012	8/29/2012	9/5/2012	
S46	SEA	1/30/2012	2/1/2012	9/6/2012	9/13/2012	
Tampa	TPA	2/2/2012	2/4/2012	9/14/2012	9/21/2012	
Miami	MIA	2/6/2012	2/8/2012	9/24/2012	10/1/2012	
Orlando	MCO	2/9/2012	2/11/2012	10/2/2012	10/9/2012	
Jacksonville	JAX	2/13/2012	2/15/2012	10/10/2012	10/17/2012	
New York	N90	2/16/2012	2/18/2012	10/18/2012	10/25/2012	
Y90	Y90	2/21/2012	2/22/2012	10/26/2012	11/2/2012	
Boston	A90	2/23/2012	2/25/2012	11/5/2012	11/12/2012	
Phoenix	P50	2/27/2012	2/29/2012	11/13/2012	11/20/2012	
Omaha	R90	3/1/2012	3/3/2012	11/21/2012	11/28/2012	
Kansas City	MCI	3/5/2012	3/7/2012	11/29/2012	12/6/2012	
Atlanta	A80	3/8/2012	3/10/2012	12/7/2012	12/14/2012	2. The order of site implementation was decided as follows: (i) first a few small TRACON sites with EFS are selected for implementation. These installations will provide a valudable experinece related to fielding TDDS systems; (ii) next some large TRACONS with EFS are selected for TDDS implementation. Such installations will begin to provide early benefits; and (iii) the other TDDS systems will be implemented on a regional basis; these sites may or may not have the EFS system.
CLT	CLT	3/12/2012	3/14/2012	1/7/2013	1/14/2013	
Raleigh Durahm	RDU	3/15/2012	3/17/2012	1/15/2013	1/22/2013	
Chicago	C90	3/19/2012	3/21/2012	1/23/2013	1/30/2013	
Cleveland	CLE	3/22/2012	3/24/2012	1/31/2013	2/7/2013	
CMH	CMH	3/26/2012	3/28/2012	2/8/2013	2/15/2013	
MKE	MKE	4/2/2012	4/4/2012	2/26/2013	3/5/2013	
Indianapolis	IND	4/5/2012	4/7/2012	3/6/2013	3/13/2013	
SDF	SDF	4/9/2012	4/11/2012	3/14/2013	3/21/2013	
Memphis	MEM	4/12/2012	4/14/2012	3/22/2013	3/29/2013	
St. Louis	T75	4/16/2012	4/18/2012	4/1/2013	4/8/2013	
Houston	I90	4/19/2012	4/21/2012	4/9/2013	4/16/2013	
Denver	D01	4/23/2012	4/25/2012	4/17/2013	4/24/2013	
Alburquerque	ABQ	4/26/2012	4/28/2012	4/25/2013	5/2/2013	
Dallas	D10	4/30/2012	5/2/2012	5/3/2013	5/10/2013	
Portland	P80	5/3/2021	5/5/2012	5/13/2013	5/20/2013	
Salt Lake	S56	5/7/2012	5/9/2012	5/21/2013	5/28/2013	

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Figure E-1. STDDS Task Order SOW – The Raytheon Team has the necessary and required prerequisite experience to deliver the SMS at JFK (continued)

ATTACHMENT J-4 – LIST OF ACRONYMS

ACRONYM	REPRESENTED PHRASE OR TITLE
ANSI	American National Standards Institute
ASDE-X	Airport Surface Detection Equipment (ASDE) - X
ASME	American Society of Mechanical Engineers
ASQC	American Society for Quality Control
ASSIST	Acquisition Streamlining and Standardization Information System
ATC	Air Traffic Control
ATM	Air Traffic Management
CNS/TM	Communications, Navigation, and Surveillance/Traffic Management
CO	Contracting Officer
COM	Computer Operations Manual
COTS	Commercial Off-The-Shelf
CPR	Contract Performance Report
CWBS	Contract Work Breakdown Structure
DID	Data Item Description
DODSSP	Department of Defense Single Stock Point
EAC	Estimates At Completion
EAN	European Article Numbering
EFSTS	Electronic Flight Strip Transfer System
EIA	Electronic Industries Alliance
ERAM	En Route Automation Modernization
EVM	Earned Value Management
EVMS	Earned Value Management System
FAA	Federal Aviation Administration
FIPS PUB	Federal Information Processing Standards Publication
FOB	Freight On Board
FY	Fiscal Year
HFDS	Human Factors Design Standard
IAW	In Accordance With
IBR	Integrated Baseline Review
IBS	Integrated Baseline Review
IDD	Interface Design Descriptions
IDIQ	Indefinite Delivery Indefinite Quantity
IEEE	Institute of Electrical and Electronics Engineers
IMS	Integrated Master Schedule
IP	Internet Protocol
IRD	Interface Requirements Document
ISO	International Organization for Standardization
ISP	Integrated Support Plan

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Figure E-1. STDDS Task Order SOW – The Raytheon Team has the necessary and required prerequisite experience to deliver the SMS at JFK (continued)

ACRONYM	REPRESENTED PHRASE OR TITLE
ISS	Information System Security
IV&V	Independent Verification And Validation
LRU	Lowest Replaceable Unit
MTP	Master Test Plan
NAILS	National Airspace Integrated Logistics Support
NAS	National Airspace System
NASEA	National Airspace System Enterprise Architecture
NDI	Non-Developmental Item
NDIA	National Defense Industrial Association
NextGen	Next Generation Air Transportation System
NIST	National Institute of Standards and Technology
ODC	Other Direct Costs
OT&E	Operational Test and Evaluation
PDC	Pre-Departure Clearance
PMP	Project Management Plan
PMR	Project Management Review
RMA	Reliability, Maintainability, And Availability
RVR	Runway Visual Range
SAT	System Acceptance Test
SDD	Software Design Descriptions
SOW	Statement of Work
SPS	Software Product Specification
SRR	System Requirements Reviews
SRS	Software Requirements Specification
SSD	System Specification Document
SSDD	System/Subsystem Design Description
SSS	System/Subsystem Specification
STP	Software Test Plan
STPr	Software Test Procedures
STR	Software Test Reports
SUI	Sensitive Unclassified Information
SVD	Software Version Descriptions
SW	Southwest
SWIM	System Wide Information Management
SysTP	System Test Plans
SysTPr	System Test Procedures
TBD	To Be Done
TDDS	Terminal Data Distribution System
TDLS	Tower Data Link System
TDLS-PDC	Tower Data Link System - Pre-Departure Clearance
TIM	Technical Interchange Meeting
TOCOTR	Task Order Contracting Officer's Technical Representative

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Figure E-1. STDDS Task Order SOW – The Raytheon Team has the necessary and required prerequisite experience to deliver the SMS at JFK (continued)

ACRONYM	REPRESENTED PHRASE OR TITLE
TRR	Test Readiness Review
UCC	Uniform Code Council
Volpe Center	John A. Volpe National Transportation Systems Center
WBS	Work Breakdown Structure
WJHTC	William J. Hughes Technical Center

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Figure E-1. STDDS Task Order SOW – The Raytheon Team has the necessary and required prerequisite experience to deliver the SMS at JFK (continued)

E.4 Banking Information

The name and address of Raytheon's banking institution, the chief banking representative handling Raytheon's account, Raytheon's Federal Employer Identification Number (i.e., the number assigned to firms by the Federal Government for tax purposes), Raytheon's Dun and Bradstreet (DUNS) number, the name of any credit service to which Raytheon furnished information and the number, if any, assigned by such service to Raytheon's account are as follows:

Raytheon Company
Account Number: Ex. 1
Swift Code: BOFAUS3N
Routing Number: 121000358
ABA 121000358
Banking Institution: Bank of America, Concord, CA
DUNS Number: 193049236
Tax ID Number: Ex. 1
RTN Banking Representative: Bart Hogan (telephone no. 978.436.8150)

F. PROPOSAL

F.1 Technical Proposal

Raytheon and Metron Aviation experience working with the FAA, airlines, and the PANYNJ provides the best value and lowest risk approach for deploying an SMS at JFK to reduce surface congestion and increase user efficiency.

F.1.1 Implementation Approach to Statement of Work (SOW)

This section describes our approach to the implementation and maintenance of the SMS addressing each heading in the scope of work and specification, Attachment C of the RFP. Our approach involves combining Phases A and B into one integrated "Operational Readiness" delivery. In Section F.1, when Phases A and B are referenced, no original scheduled deliveries are implied other than our combined delivery schedule of 15 July 2012. We are only addressing the capabilities as required by the RFP.

Our fielded SMS product, coupled with our wealth of experience as a large FAA system integrator, ensures successful deployment at JFK, providing accelerated benefits to all airport stakeholders

- Harmony product developed by Metron Aviation is commercially available, and is deployed at LGA and Airservices Australia
- Raytheon expertise developing and maintaining mission-critical systems for FAA, including ASR-11, STARS and SWIM TDDS, is directly applicable to integrating Harmony SMS with FAA for PANYNJ
- Metron Aviation has refined advanced prediction models used for taxi and departure through an operational SMS deployed at MEM for FedEx
- Raytheon operations, maintenance and training services applied to FAA systems, including STARS and ATCOTS, is leveraged to support continuous operations of SMS at JFK
- Combination of Raytheon and Metron Aviation capabilities provides a best value solution to PANYNJ that will enhance surface operations at JFK with no program risk

F.1.1.1 General Description of Services (C.1)

Our best value and lowest risk approach uses the Harmony product from Metron Aviation as the basis for the system design and implementation, with additional capabilities integrated into the product to meet requirements. This existing product already provides much of the capabilities needed, and is currently deployed at LGA for Delta Air Lines and in Australia for Airservices Australia.

Harmony is an advanced, integrated Air Traffic Flow Management solution with capabilities that provide strategic, pretactical and tactical efficiency, post-operations metrics and performance analysis of air traffic operations. With a focus on improving overall system efficiency and predictability, Harmony delivers the necessary information to stakeholders for the benefit of the entire air traffic system. Harmony supports the following gate-to-gate operations:

- Traffic flow management through slot allocations and Calculated Takeoff Times (CTOTs)
- Departure management for merging to a common departure fix
- Airport surface management for optimizing operations
- Fuel, emissions and noise impact modeling, monitoring and reporting
- Operational metrics and performance analysis

The system is hosted on Raytheon hardware deployed in redundant data centers provided by Internap, each providing low latency, high bandwidth, high availability access via diverse internet backbones for all system users, whether located at JFK, PANYNJ, FAA or the various airline operation centers.

The system is operated by Metron Aviation employees from the JFK operations center using Raytheon provided workstations for continuous monitoring, fault reporting, customer support, and user administration. Raytheon employees provide additional second level maintenance and repair support ensuring a system operational availability of 99.99% with no dependencies on PANYNJ infrastructure.

User training is provided at PANYNJ-selected locations by Raytheon employees leveraging personnel with operational experience at JFK, N90, and ZNY, using operational training material adapted from Air Traffic Control Optimum Training Solution (ATCOTS) where appropriate.

F.1.1.2 Project Delivery Guidelines (C.2)

F.1.1.2.1 Implementation Schedule (C.2.A)

The Integrated Master Schedule (IMS) provides and documents the Team's executable plan for deploying the Surface Management System at John F. Kennedy International Airport (JFK). The IMS integrates the activities of all team members and includes all aspects of the program: pre-contract award demonstration, development, warranty, and maintenance.

Our approach to delivering and deploying Phase A and B capabilities is to combine the two phases into one single delivery 2 weeks earlier than required. The Phase B delivery requirement is currently 1 August 2012. Our combined delivery will produce one final system for "Operational Usage" to the Port Authority on 15 July 2012.

Based on our experience on the STDDS program, securing approval to use the external data feeds from the FAA is challenging and time consuming, with very long lead times. Given the number of external data feeds required, we do not feel that a Phase A "Operational Usage" date of 15 February 2012 is achievable with only a 2.5-month schedule, assuming contract award is 1 December 2011. While these dependencies will potentially delay Operational Usage, we will work with the Port Authority to accelerate this as much as possible. Given this rationale, trying to deliver Phase A with only a short turnaround to Phase B would jeopardize both deliveries, as the system will require two testing and review periods for operational acceptance. Combining these events allows a schedule to absorb any potential impact due to unresolved external dependencies and minimizes the overall testing and review periods. This also mitigates overall schedule risk and enables early delivery of the final capability.

Figure F-1 is the team's high level overview of the schedule produced with "OnePager Pro." The proposed IMS is shown in Section F.3.1 and the full Microsoft Project file is included on the CD. The Program Manager (PM) will be assisted by a dedicated project scheduler that will use and maintain the IMS over the life of the program. Changes and updates to the IMS are shared with the customer per the submittal schedule and whenever necessary to minimize risk. The critical path is highlighted in red for easy reference on the IMS.

The proposed IMS contains all activities required to fully deploy the Surface Management System at JFK are grouped under the following program phases:

- ***Pre-Contract Award Demonstration*** – Prepare and deliver demonstration on proposed date of 14 October 2011.
- ***Phase A/B*** – Design, development, test plan, test procedures, user manuals, training manuals, and test reports; conduct pre-acceptance testing, acceptance testing, training, and 14-day operational test.
- ***Warranty*** – The warranty begins the day after operational test is complete.
- ***Maintenance*** – Maintenance begins after warranty is complete.

The critical path runs through the submission of the Phase A/B test plan and procedure, and Notification of Testing. The critical path continues through development, procurement of hardware, test plan and procedures, Notification of Testing, pre-acceptance testing and test report, 14-day operational test, warranty and maintenance.

F.1.1.2.2 Base Date of Operational Usage

Phase A and B capabilities will be operational after the 14-day operational test conducted on 15 July 2012.

F.1.1.3 Requirements for Staffing (C.3)

Proposed staffing to operate, interact, and maintain the system, including detailed ATC operational experience within the NAS are provided in Section F.3.5. Pricing for all staff necessary to host, operate, maintain and support the project are provided in Section F.2.

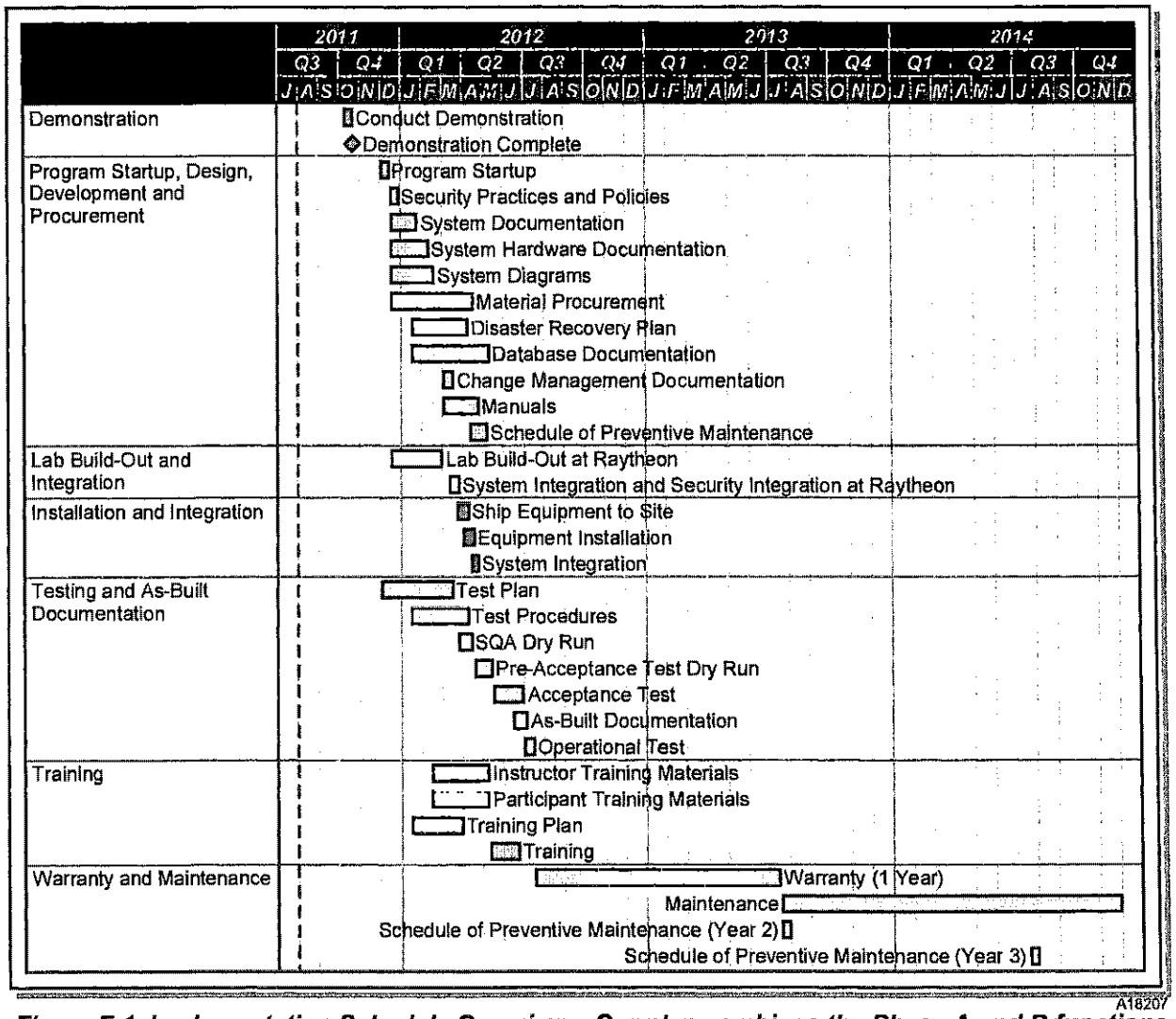

Figure F-1. Implementation Schedule Overview – Our plan combines the Phase A and B functions into a single delivery on 15 July 2012

Raytheon does not plan to provide the option for the provision of direct communication with aircraft. The SMS is providing decision support information to the current operators to enhance their situational awareness and management efficiency and it is our experience that all operators will be fully capable of providing this support after the training provided during base period of the contract.

F.1.1.4 Functional Requirements (C.4)

F.1.1.1.4.1 General Description of Services (C.4.A)

The purpose of the SMS is to provide capabilities that increase revenue to the PANYNJ and its users at JFK by reducing surface congestion, improving operational efficiency, and increasing capacity through the use of proven, advanced surface traffic management technologies that are consistent with current Air Traffic Management (ATM) operations and NextGen.

While the active movement area of the JFK airport surface is managed by the FAA (Figure F-2), the Port Authority, in cooperation with the airlines, may influence the efficiency of operations by:

- Managing when departing aircraft push from the gate (i.e., Call for Taxi)
- Providing Collaborative Decision Making (CDM) functionality for airlines to perform substitutions of scheduled taxi times

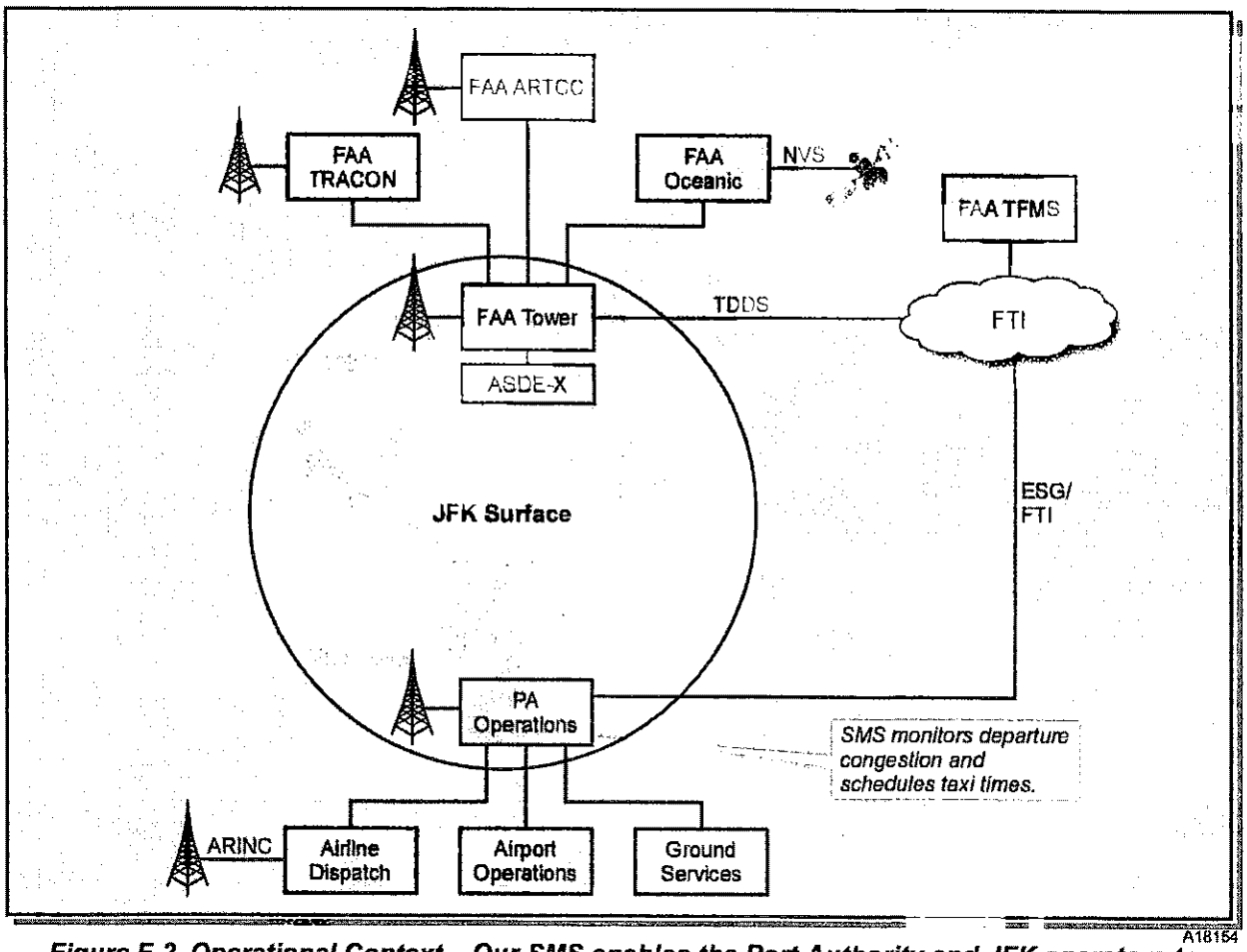

Figure F-2. Operational Context – Our SMS enables the Port Authority and JFK operators to reduce surface congestion by absorbing delays at the gate or holding area

- Alerting airlines/operators of gate conflicts between arrivals and departures
- Alerting airlines/operators of excessive taxi delays
- Providing situational awareness of the surface traffic (both aircraft and vehicles), airborne traffic, and weather
- Providing metrics and playback for operational analysis and training
- Providing data for fuel and emissions impact modeling

By reducing surface congestion and improving operational efficiency, JFK users will reduce their operating costs: decreased taxi times reduce fuel consumption, avoided gate conflicts reduce labor overhead, schedule substitutions enable airlines to select higher revenue flights, etc. And by making surface operations more predictable, throughput, demand and Port Authority revenue will also increase.

Our system provides specific capabilities that may be used by the Port Authority and JFK users to improve operational efficiency. These capabilities include: Departure Queue Management, Operational Alerts, Situational Awareness, and Reporting and Playback.

Departure Queue Management

With current operations, once a departing aircraft receives a clearance from ATC, either by voice or TDLS-PDC, the pilot calls ground control for taxi instructions, and proceeds as instructed to the departure end of the controller specified runway. This often results in a lengthy queue of aircraft on the taxiway,

excessive fuel burn and emissions, and potential gridlock from departures taxiing to a parallel runway, and arrivals taxiing to the ramp.

With the deployment of SMS (Figure F-3), this departure demand is accurately predicted and the departure queue length of each runway is actively managed through scheduling Call for Taxi (CFT) times. The rationing algorithm is parameter driven to ensure that departure delays are absorbed at the gate (or holding area) instead of in the departure queue.

Demand predictions and operational constraints are the basis for the Ration by Schedule (RBS) departure management functionality and are based on the Aggregate Demand List (ADL) received from TFMS, flight schedules and gate assignments received from the airlines, and surveillance data received from ASDE-X and Aircraft Situation Display to Industry (ASDI).

The ADL was pioneered by Metron Aviation as an integral part of the TFMS system. The ADL provides information on flights operating at JFK, LGA, EWR, TEB, ISP and includes FAA assigned EDCTs due to traffic management initiatives as well as the departure fix demand within N90 TRACON airspace.

N90 has unique operational constraints where the FAA imposes departure fix restrictions (e.g., MIT or MINIT) for departing flights from multiple NY airports. Without accounting for the demand from all affected NY airports, the JFK departure queue predictions would be inaccurate and would impact the quality of any CFT rationing; the FAA will meet the departure restrictions regardless of the SMS predicted take-off times.

Processing of flight status received from airline automation systems, or when not available, from the Flight Information Display System (FIDS) at the airport, provides the very latest operational status and operator intent as well as gate assignments, estimated time updates, and cancellations. This data is not provided to FAA systems, and is not available through TFMS data feeds. This advanced planning and status improves the predictability of the system and increases the overall efficiency of the SMS.

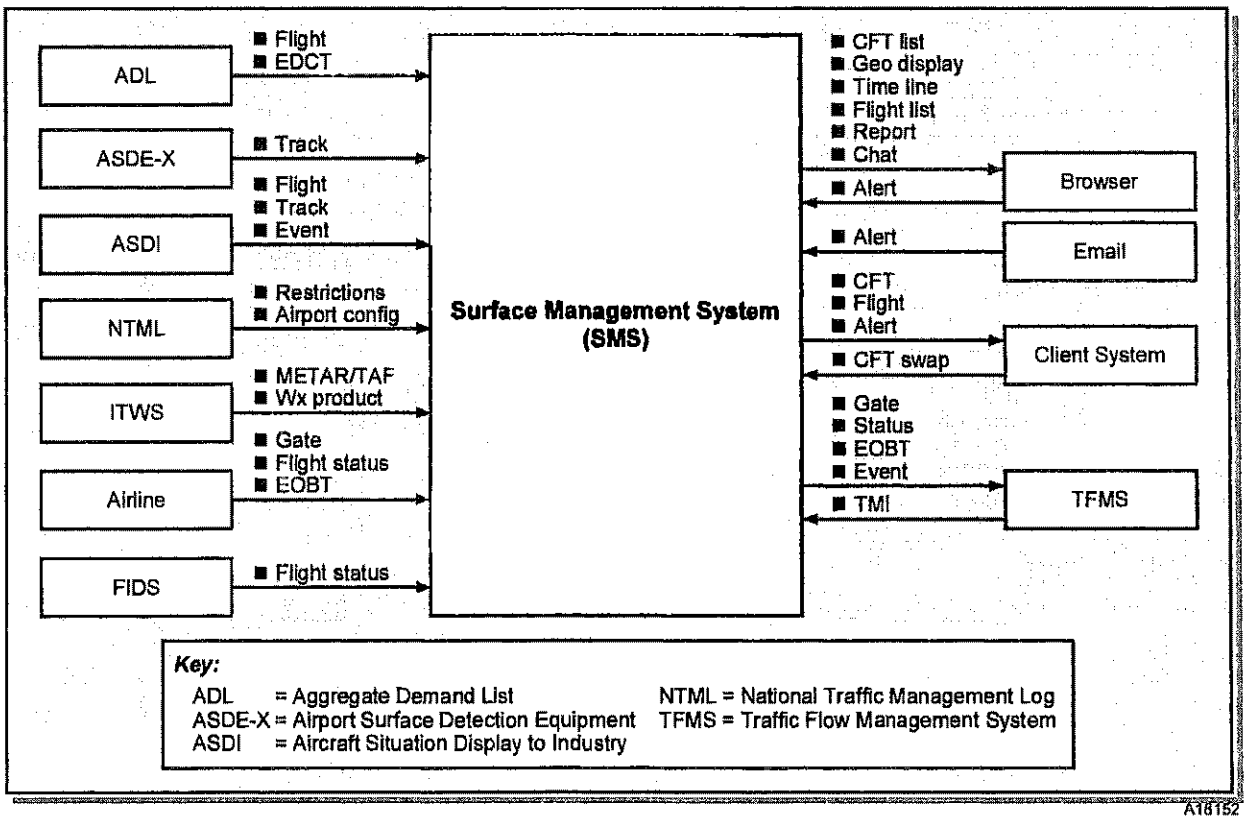

Figure F-3. System Context – Our SMS uses the latest data from the FAA and airlines to provide the most accurate predictions possible

The FAA National Traffic Management Log (NTML) data is parsed to determine current and future airport configurations, which is then used in determining the taxi times between gates and runways for departures and arrivals. Additionally, the system monitors ASDE-X surface surveillance and overrides the airport configuration automatically when operations indicate that an update was not entered into the NTML.

The NTML data is also used to set airport operational constraints (e.g., airport departure rate and N90 departure fix MIT, MINIT, and DSP restrictions). Metron Aviation's Harmony product already understands the N90 NTML syntax and parses this into specific departure rates and operational constraints. However, manual updates are also supported as NTML is not always updated to reflect actual operating conditions.

ASDE-X surveillance data is used to update the taxi estimate for both departing and arriving flights. When key surface events occur, the corresponding taxi estimate is refined and reflected in the user demand predictions. Key surface events include pushback, ramp entry/exit, holding area entry/exit, de-icing area entry/exit, runway entry/exit, rollout, takeoff, landing, and in block. Aircraft Situation Display to Industry (ASDI) surveillance data is used to receive aircraft position updates in enroute and terminal airspace, estimate fix crossing times, arrival time, and potential gate conflicts. The system also uses surveillance data to correct assumptions in the predicted departure or arrival runway allocated for specific flights.

The RBS algorithms and CDM substitution capabilities were pioneered by Metron Aviation as an integral part of the TFMS to provide fair slot allocations for constrained resources while encouraging airline data sharing. For the FAA DFM program, Metron Aviation developed web-based departure automation, which is also planned for use in the TBFM program.

Additionally, SMS technology that was developed for FedEx in Memphis, TN, including CDQM research, provides invaluable background that will be applied to SMS to operations at JFK. Metron Aviation's rich history in developing and deploying RBS, CDM, and airport efficiency algorithms will be applied to the unique operational requirements at JFK including departure runway allocations, departure queue limits, and the use of holding areas to mitigate gate conflicts.

When the system predicts that an arriving aircraft has a gate conflict with a departing aircraft that is ready to taxi but is holding at the gate due to the CFT departure management, the algorithm will automatically adjust the CFT time to eliminate the gate conflict. These aircraft will be allocated to holding areas prior to taxiing to the departure runway to retain the desired departure runway queue size.

The resulting CFT times factor in all operational constraints from both the FAA (airport configuration, airport departure rate, departure fix restrictions), and Airlines (earliest ready-to-taxi time, substitutions) and use the latest flight status and gate departure times to:

- Improve surface predictability
- Reduce departure queue length
- Reduce fuel/emissions by absorbing delays at the gate
- Reduce gate conflicts with judicious use of holding areas

Operational Alerts

When there are ground delays due to traffic management initiatives (e.g., weather at the destination airport constrains arrival rates) or rationed CFT times, some of the departing aircraft will still be at the gate as arriving aircraft assigned to the same gate land. With current operations, this conflict is not detected until the arriving aircraft reaches the ramp, leading to congestion as the arriving aircraft waits for a new gate to be vacated.

With the deployment of SMS, this gate conflict is predicted well before landing using predictions based on ASDI and ASDE-X surveillance data and up-to-date gate pushback predictions. By combining the best

available information with accurate surface modeling capabilities, these gate conflicts are predicted while nondisruptive corrective actions are still possible. This information can be used by the departure queue management algorithm to recommend pushbacks to holding areas when they are available. If the surface situation degrades so that the holding areas are predicted to be full, then any predicted gate conflict is provided to user along with candidate alternative gate assignments that will eliminate the conflict.

Configurable alerts can also be provided for extended taxi times (predicted and actual), and other events identified by the user, including turnback flights, aircraft entering unexpected runways, and aircraft not using expected holding area.

Alerts are provided to users as visual notifications, audible alarms, if supported by the browser, and email. The user can set specific thresholds for alerts.

Situational Awareness

Surface surveillance data is invaluable to the JFK users (airlines, aircraft operators, terminal operators, ground services, etc.) by enabling the monitoring of aircraft and ground vehicles to efficiently manage ground assets (gates, crews, service vehicles) to optimize operations. The SMS receives both ASDE-X and ASDI surveillance data and provides a continuously updated display of the airport surface and surrounding airspace, including:

- Surface and terminal traffic shown on a geographic display with configurable filters and data tags
- Flight specific details through configurable flight lists
- Timeline displays showing utilization of gates, runways and departure fixes
- Summary displays showing surface delay, airport demand, runway configuration, arrival and departure sequencing, taxi duration, and active flight views.
- Alerts based on key events (e.g., gate conflict, taxi duration) and configurable thresholds
- Surface saturation prediction and decision support capabilities to mitigate imbalances
- Runway and holding area conformance
- Chat for user collaboration

The data is displayed using a standard web browser and provide user access to all system functions for which the user is authorized. The user interface is described in detail in Sections F.1.1.4.4 and F.1.1.4.5.5.

Reporting and Playback

To enable continuous improvement of surface operations, all system inputs and outputs of the SMS are recorded and key metrics and reports are provided for daily operational analysis. Additionally, standard and ad hoc reports may be generated on recent or archived data to support the JFK users in enhancing their operational procedures. Reporting requirements are described in detail in Section F.1.1.4.5.

A playback capability is also provided for visualization. Playback is described in detail in Section F.1.1.5.4.9.

All chat communications are recorded, enabling a synchronized playback of past operations for event recreation, analysis and training.

F.1.1.4.2 Description of Work (C.4.B)

Combining Metron Aviation's SMS experience developing and deploying the Harmony for Airlines product with Raytheon's experience integrating and maintaining large, complex, safety critical automation and radar systems for the FAA, provides a very low risk solution for the PANYNJ.

Our team will provide a fully integrated, highly available implementation that is installed in redundant, secure and geographically diverse data centers. We will also provide full operations support, including

system monitoring and control, fault reporting, equipment repair, preventive maintenance, user administration, user help desk, and training to the user community.

Implementation

The system design is based on the Harmony for Airlines product developed by Metron Aviation and currently in use by Delta Air Lines to manage their surface operations at LGA. The product is being enhanced with capabilities from the Harmony for ANSP used by Airservices Australia, and from the Surface Management System used by FedEx at Memphis International Airport. Additional features are integrated to receive weather data from the Integrated Terminal Weather System (ITWS) developed by Raytheon and surface surveillance data originating from the SWIM Terminal Data Distribution System (STDDS) also developed by Raytheon. A full list of functions provided is described in Sections F.1.1.4.3 and F.1.1.4.4.

Installation

The software and hardware components of the system will be installed in two secure data centers provided by Internap Network Services, with the primary located in Boston, MA, and the backup in Houston, TX. 15 workstations for PANYNJ users will be installed at PANYNJ Operation Center.

The software and hardware components are fully integrated within each data center, and fully tested using both simulated and operational inputs prior to acceptance by the Port Authority. Testing includes automated failover within the data center as well as automated failover between data centers. Future updates will be deployed to separate test hardware within the data center, and integrated and tested without impacting the running operational system. The backup data center will be used for failover testing during off-peak hours of operation. The hardware components installed are described in Section F.1.1.5.3.

Note that an approved MOU is required before FAA operational data may be used. We will assist the Port Authority is securing such approval for the ADL, NTML, ASDE-X, and ASDI data feeds. Once approved, the FAA will provision each interface to supply data to each data center using a VPN established through the internet. This is a prerequisite for testing the system and its operational use.

Operations

Once accepted, support for continuous operations will be provided by Raytheon services. This support includes continuous monitoring of the system operation from the JFK OC, and fault reporting to the Port Authority and its users. It also includes user administration during normal business hours and operation of the user help portal 24x7.

Repair and maintenance will be provided by Raytheon services. This includes 1-hour response to critical failures that affect the operational availability of the system. However, note that redundancy with automatic failover is provided within the data center, as well as between data centers. The system operational availability is required to be 99.99% and is driven primarily by the communication links to the internet. An initial availability analysis is described in detail in Section F.1.1.6.2. The fault tolerant architecture is described in Section F.1.1.5.3.

Training

Training is provided by Raytheon services and is modeled after the ATCOTS program developed for the FAA. Raytheon currently employs former controllers who are intimately familiar with all aspects of ATC operations at facilities throughout the nation.

Security

Providing a secure environment to ensure both operational availability and data privacy is paramount as users are connected to the service via the public internet. Multiple barriers to intrusion are provided using VPN technologies, Adaptive Security Appliances (ASA), user authentication, and user access controls. Data is encrypted at the transport layer using Transport Layer Security (TLS). Details of our approach to securing the system are described in Section F.1.1.5.2.

F.1.1.4.3 Functional Requirements of Initial Implementation – Phase A (C.4.C)

The Phase A functions leverage existing COTS products and proven technology to meet the Port Authority requirements. Reference Section F.1.1 for Phase A and B capabilities, and schedule clarification.

The Harmony product already supports most of the functional requirements of Phase A. Where the Port Authority requirements are not currently available, we are investing in product development necessary to deliver a compliant system. The product already provides information to users that may be displayed on COTS workstation or laptop computers using standard internet browsers running on the native operating system. Access to specific information is based on the user's role, authentication, and is encrypted using VPN based security.

The surface situation is based on the JFK ASDE-X feed. A typical Harmony surface situation display zoomed out to show the full airport is shown in Figure F-4. To meet the 100-mile airborne flight tracking requirement, the ASDI data feed is also used. Metron Aviation's airport surface products have successfully integrated both ASDE-X and ASDI surveillance feeds and will apply this technology for the JFK SMS.

Flight data is populated using data feeds from the Aggregate Demand List (ADL), and augmented using flight schedule and status from aircraft operator systems and FIDS. Users can access this flight data using a web-based interface as shown in Figure F-5. If a system-to-system interface is not available for an aircraft operator, a web-based capability to enter flight data (create, modify, cancel) is available and is shown in Figure F-6. Use of this aircraft operator data provides advanced awareness of intended operations well before flight plan data is provided by an FAA.

A key function of the system is to limit traffic operating on the surface, and this is done through managing gate pushback events by assigning a coordinated CFT time to each flight. CFTs are determined by a Ration-by-Schedule (RBS) algorithm that assigns gate departure times to meet operational airport constraints (e.g., airport departure rate), local airspace constraints (e.g., departure fix crossing, DSP restrictions), predicted departure queue length by runway, and holding area capacity. This departure

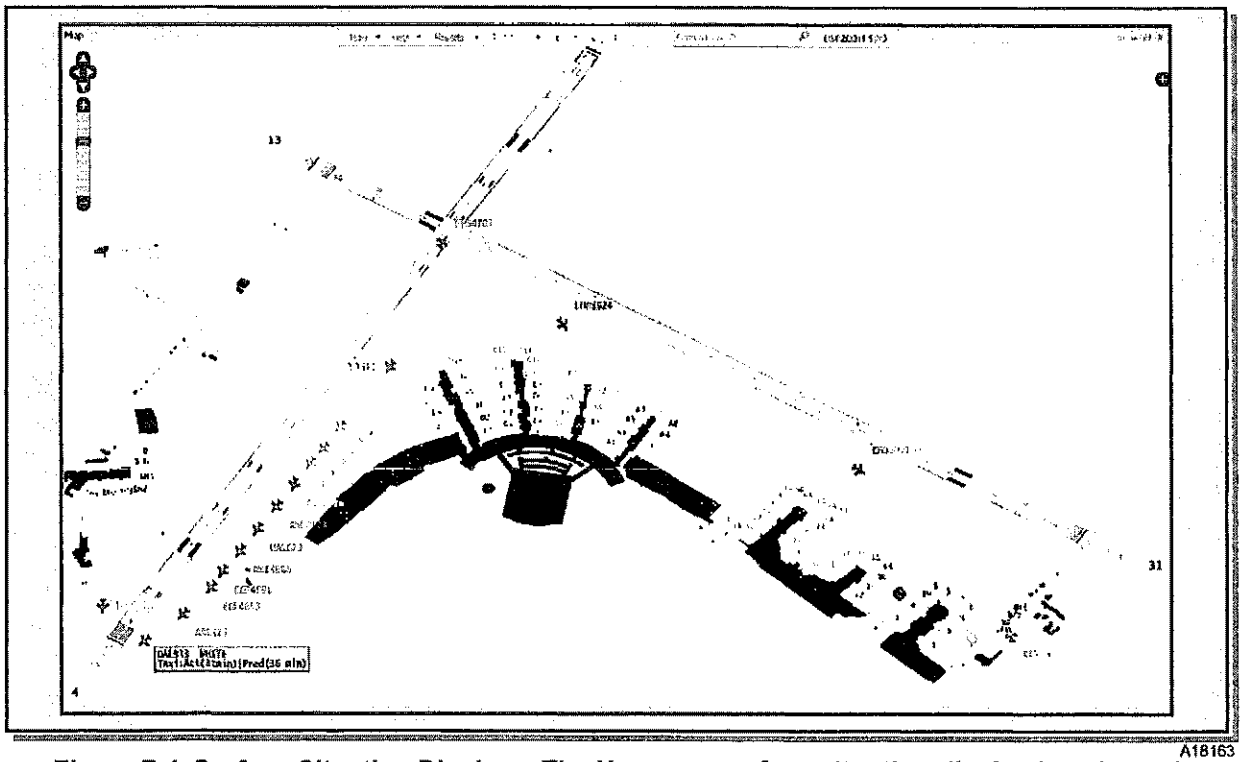

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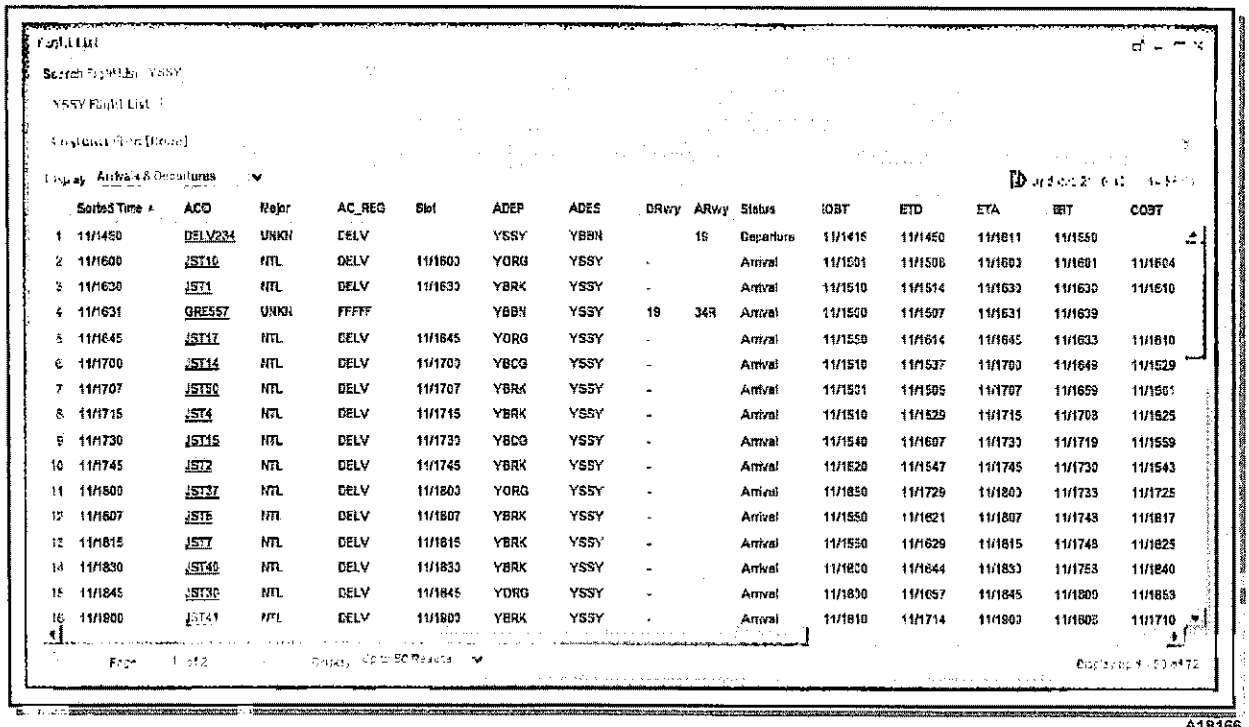
Figure F-4. Surface Situation Display – The Harmony surface situation display is a dynamic web-based view the provides full visibility into the current surface operation over the entire airport



	Sorted Time	ACID	Major	AC_REG	Slot	ADEP	ADES	DRwy	ARwy	Status	IOBT	ETD	ETA	IBT	COBT
1	11/1450	DELV234	UNKN	DELV		YSSY	YBBN		16	Departure	11/1416	11/1450	11/1811	11/1550	
2	11/1600	JST10	NTL	DELV	11/1600	YORG	YSSY	-		Arrival	11/1501	11/1506	11/1603	11/1601	11/1604
3	11/1630	JST1	NTL	DELV	11/1630	YBRK	YSSY	-		Arrival	11/1510	11/1514	11/1633	11/1630	11/1610
4	11/1631	GRE557	UNKN	FFFFF		YBBN	YSSY	19	34R	Arrival	11/1500	11/1507	11/1631	11/1639	
5	11/1645	JST17	NTL	DELV	11/1645	YORG	YSSY	-		Arrival	11/1550	11/1614	11/1645	11/1633	11/1610
6	11/1700	JST14	NTL	DELV	11/1700	YBCG	YSSY	-		Arrival	11/1510	11/1537	11/1700	11/1649	11/1529
7	11/1707	JST30	NTL	DELV	11/1707	YBRK	YSSY	-		Arrival	11/1501	11/1505	11/1707	11/1659	11/1601
8	11/1715	JST4	NTL	DELV	11/1715	YBRK	YSSY	-		Arrival	11/1510	11/1529	11/1715	11/1708	11/1625
9	11/1730	JST15	NTL	DELV	11/1730	YBCG	YSSY	-		Arrival	11/1540	11/1607	11/1730	11/1719	11/1559
10	11/1745	JST2	NTL	DELV	11/1745	YBRK	YSSY	-		Arrival	11/1520	11/1547	11/1745	11/1730	11/1543
11	11/1800	JST37	NTL	DELV	11/1800	YORG	YSSY	-		Arrival	11/1550	11/1729	11/1803	11/1733	11/1725
12	11/1807	JST6	NTL	DELV	11/1807	YBRK	YSSY	-		Arrival	11/1550	11/1621	11/1807	11/1743	11/1817
13	11/1815	JST7	NTL	DELV	11/1815	YBRK	YSSY	-		Arrival	11/1550	11/1629	11/1815	11/1748	11/1825
14	11/1830	JST40	NTL	DELV	11/1830	YBRK	YSSY	-		Arrival	11/1600	11/1644	11/1830	11/1753	11/1840
15	11/1845	JST30	NTL	DELV	11/1845	YORG	YSSY	-		Arrival	11/1600	11/1657	11/1845	11/1800	11/1853
16	11/1800	JST41	NTL	DELV	11/1800	YBRK	YSSY	-		Arrival	11/1610	11/1714	11/1900	11/1808	11/1710

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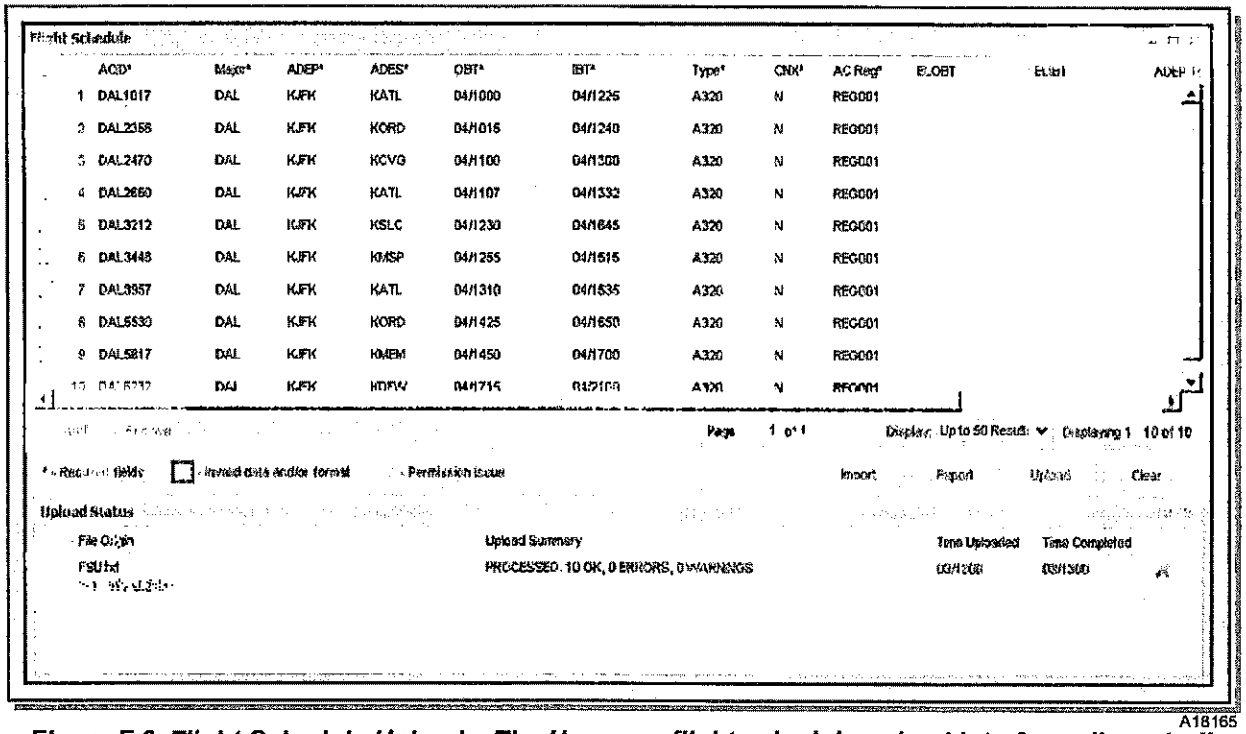
Figure F-5. Web-Based Flight Lists – Harmony provides users with access to web-based flight lists with configurable columns



Flight Schedule

	ACID*	Major*	ADEP*	ADES*	OBT*	IBT*	Type*	CNX*	AC Reg*	EOBT	EIBT	ADEP
1	DAL1017	DAL	KJFK	KATL	04/1000	04/1225	A320	N	REG001			
2	DAL2358	DAL	KJFK	KORD	04/1015	04/1240	A320	N	REG001			
3	DAL2470	DAL	KJFK	KCVG	04/1100	04/1300	A320	N	REG001			
4	DAL2650	DAL	KJFK	KATL	04/1107	04/1332	A320	N	REG001			
5	DAL3212	DAL	KJFK	KSLC	04/1230	04/1645	A320	N	REG001			
6	DAL3448	DAL	KJFK	KMSP	04/1255	04/1515	A320	N	REG001			
7	DAL3957	DAL	KJFK	KATL	04/1310	04/1535	A320	N	REG001			
8	DAL5530	DAL	KJFK	KORD	04/1425	04/1650	A320	N	REG001			
9	DAL5817	DAL	KJFK	KMEM	04/1450	04/1700	A320	N	REG001			
10	DAL6232	DAL	KJFK	KDFW	04/1715	04/2100	A320	N	REG001			

Page 1 of 1 Display: Up to 50 Results Displaying 1 - 10 of 10

* = Required fields Invalid data and/or format Permission issue Import Report Upload Clear

Upload Status

File Origin	Upload Summary	Time Uploaded	Time Completed
FSU.txt	PROCESSED: 10 OK, 0 ERRORS, 0 WARNINGS	08/1300	08/1300

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Figure F-6. Flight Schedule Upload – The Harmony flight schedule upload interface allows bulk upload of aircraft operator flight schedules, which are validated for required fields and data formatting

management capability mitigates predicted imbalances in JFK surface demand and capacity by holding flights at the gate or holding areas. A sample screen showing departure flow management outputs is shown in Figure F-7. This screen provides several departure flow views, including (from left) pending flights, available release times, aircraft with assigned release times, and a view identifying open and occupied time regions for crossing Departure Fixes.

The user can display operational constraints through a web-based screen as shown in Figure F-8. The airport configuration, expected arrival and departure rates, and departure fix constraints are automatically determined from the NTML. Arrival and departure rates and departure fix constraints can also be manually updated or created for cases where the NTML is not updated in a timely manner, or not entered in a standard format.

Additionally, user alerts are provided for key events, including gate conflicts, and excessive taxi delays. Figure F-9 shows the user interface for taxi alerts. Alerts notifications are provided visually, audibly for web browsers that support audible outputs, and via email or text message.

Aircraft operators, using the screen as shown in Figure F-10, can perform CFT substitutions for their flights to improve the efficiency of their operation while still maximizing the overall efficiency of JFK operations. By adjusting the CFTs of flights within their control, the pressure on the departure runways is maintained while aircraft operator delays or business rules can be accommodated. Substitution decisions are supported by providing aircraft operators access to the predicted taxi delay and along with eligibility with the latest runway, airport, and departure fix constraints.

The interface for on-line collaboration (chat function) will be provided by OpenFire, a highly customizable COTS product providing secure communication sessions. All sessions will be recorded, including time stamps and users associated with each message, for subsequent playback.

System data, including inputs and derived data, are stored in a data warehouse that is sized to accommodate at least 2 years of data for supporting operational reports, analysis, and playback. The same user interface is used during playback as in normal operations.

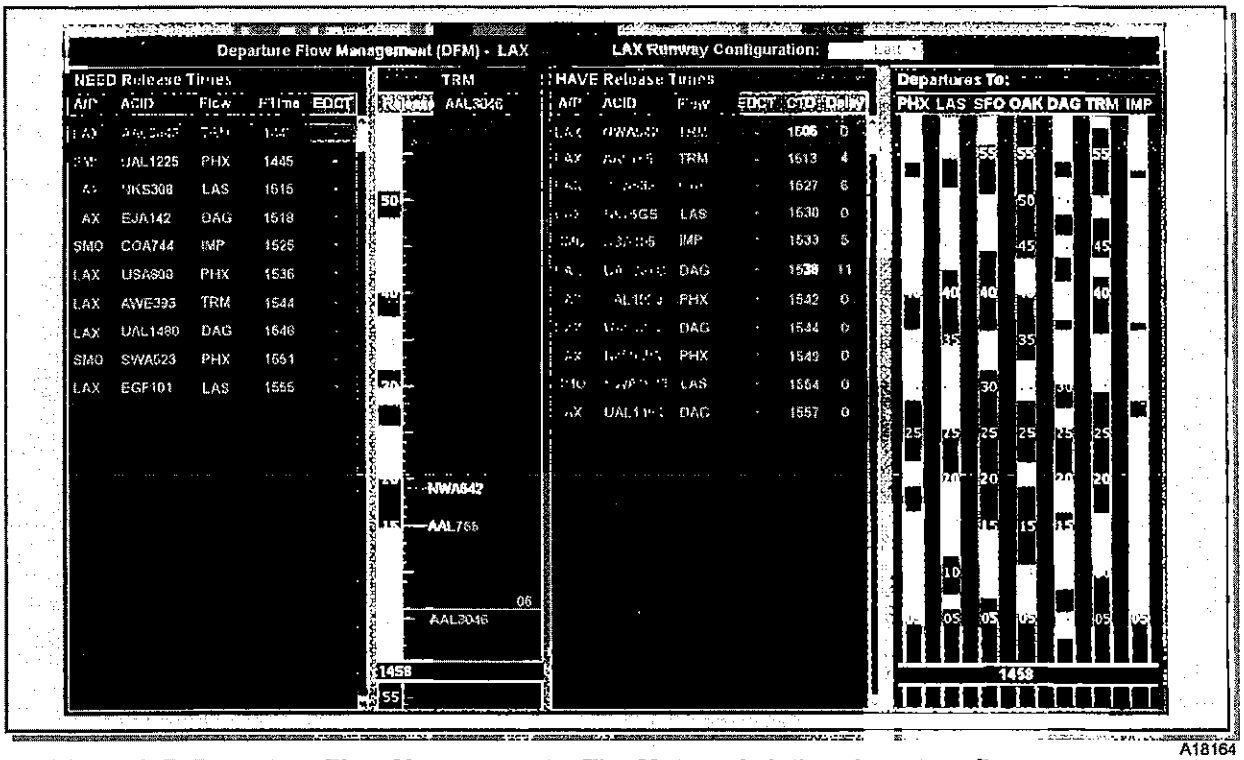

Figure F-7. Departure Flow Management – The Metron Aviation departure flow management system provides a wide array of DFM functions and views

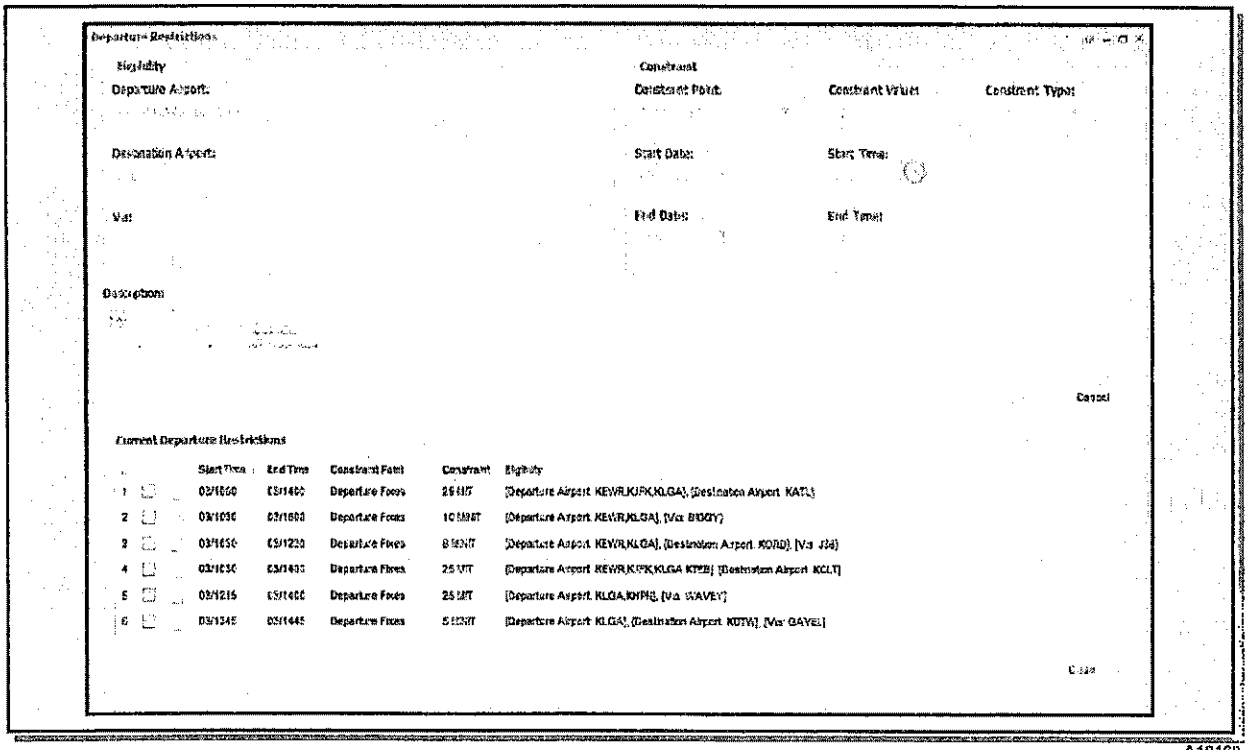

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Figure F-8. Operational Constraints – Harmony captures and displays relevant FAA initiatives, including future scheduled and current airport configurations, departure restrictions and Ground Delay Programs/Ground Stops (GDP/GSs)

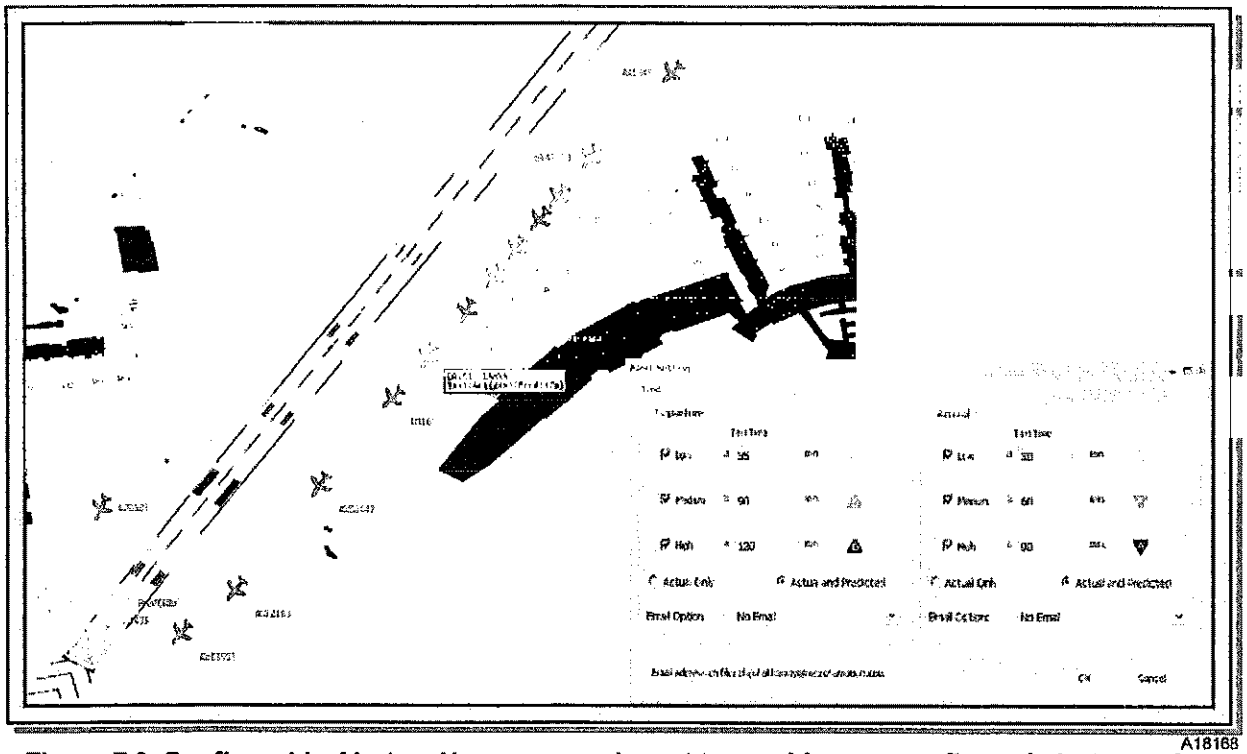

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Figure F-9. Configurable Alerts – Harmony can be set to provide user-configured alerts, such as taxi-out times, that exceed a user threshold

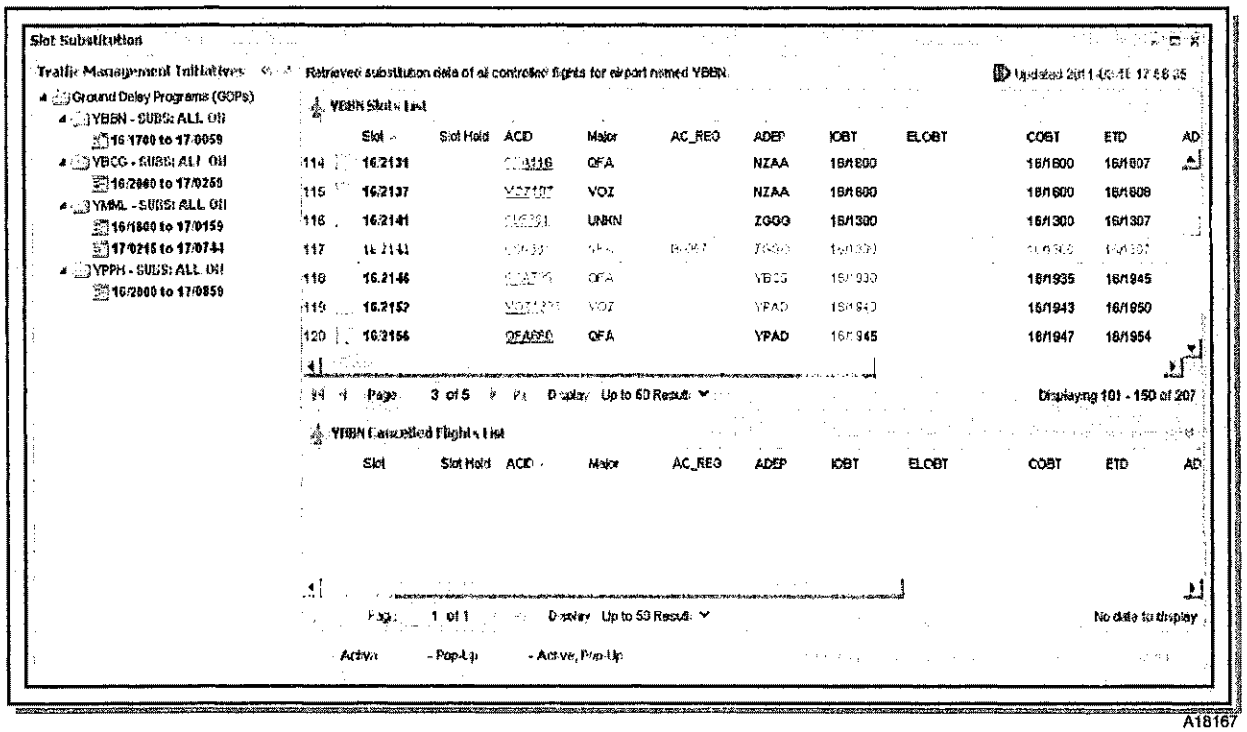

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Figure F-10. Flight Swapping and Substitution – The Harmony flight swapping and substitution screen allows aircraft operators to cancel flights, make substitutions or swap flights under their control

Saturation graphs, as shown in Figure F-11, can be created at any time for a wide range of user-selectable parameters. In addition, daily Summaries of Operations, including information on weather, runway configuration, TMI programs, hourly metrics on the departure queue(s) length, hourly statistics on numbers of actual departures and arrivals, and lists of noncompliant aircraft, are standard reports that will be automatically created daily.

Our support staff will:

- Support and maintain adherence to the procedure, including quarterly meetings that review and update the procedures.
- Attend and participate in bi-weekly user interface meetings at JFK.
- Provide 24x7 user support.
- Administer new users.
- Track and report service irregularities to the Port Authority and Port Authority authorized recipients.
- Report, track, and resolve problems encountered by users.

Compliance to each RFP Section C requirement for both Phases A and B is shown in Section F.1.3.

F.1.1.4.4 Functional Requirements of Enhanced System – Phase B (C.4.D)

The Phase B Surface Management function will be delivered with the Phase A function in a single delivery. Reference Section F.1.1 for Phase A and B capabilities, and schedule clarification.

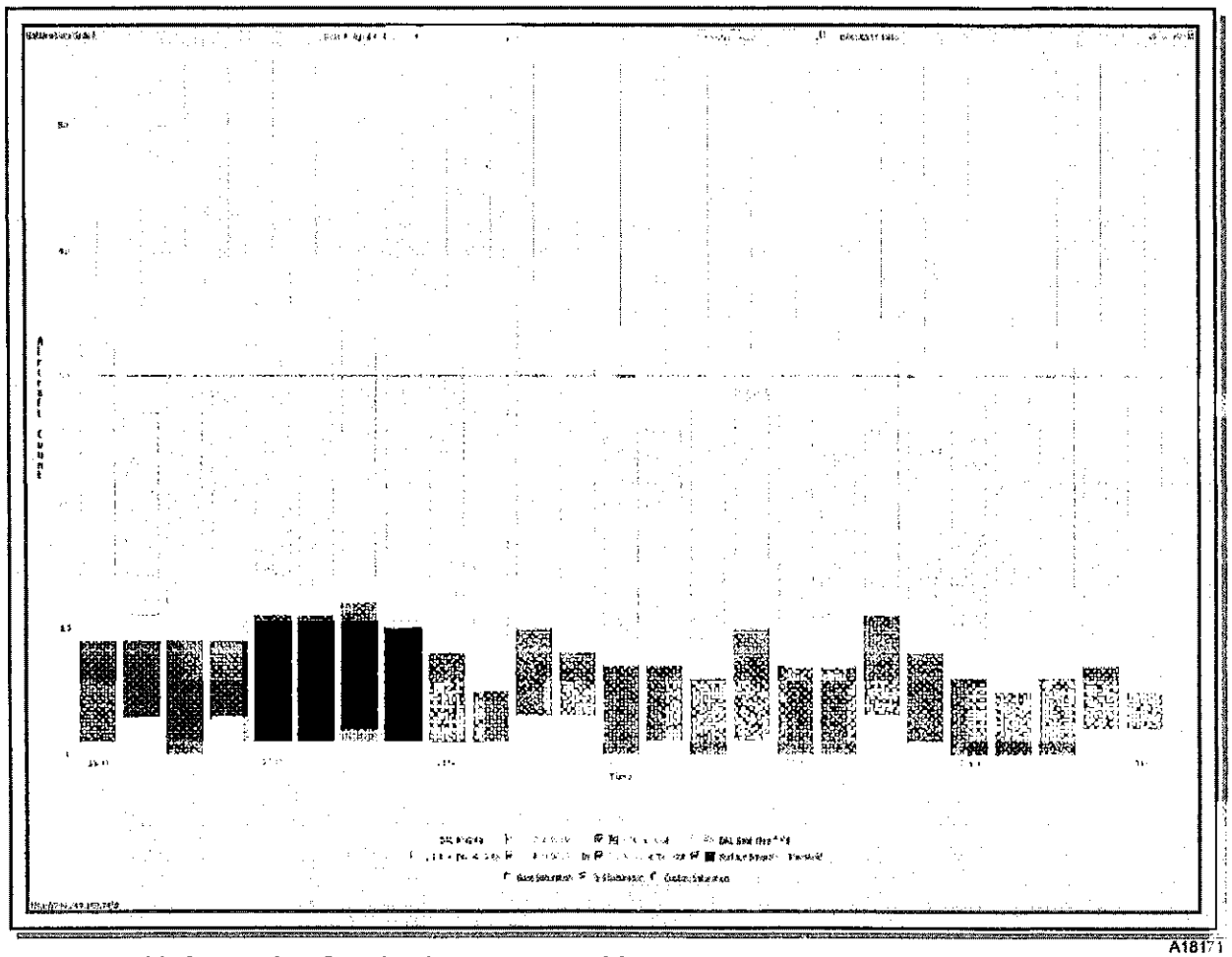

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Figure F-11. Saturation Graph – Harmony provides saturation graphs for a wide range of airport parameters

F.1.1.4.4.1 General Requirements for Enhanced Operations (C.4.D.1)

The following additional enhancements to will be provided to meet the Port Authority requirements:

- ***Forecast Airport Configuration*** – Accurate assessment of operational constraints is critical to providing efficient departure management CFT times. The SMS will be updated to use forecasted weather conditions and adapted rules based on historical configurations to predict changes to the operational airport configuration, and the corresponding airport throughput rates used in the departure management predictions. This approach will provide a weather based forecast of the airport capacity (e.g., throughput rates) for use by the system. Forecast airport departure demand is also provided.
- ***Demand Imbalance Alerts*** – Based on continual monitoring of current and predicted JFK capacity (arrival and departure rates), the system will provide an automated alert to users when there is an expected imbalance between demand and capacity. The alert is configurable at the system level to determine the time window and imbalance parameters used for the alert.
- ***Synchronized Playback*** – Playback of surveillance data with synchronized replay of selected chat sessions will be provided. In addition, the user will have the capability to save the displayed replay in MPEG-2 format using COTS software on the client workstation.

- ***Operational Performance Scorecard*** – Operational performance and analysis of the contributing factors is important for effective application of SMS. We will work with the Port Authority to develop a performance measurement "Scorecard" that can facilitate assessment of the operational performance at JFK and individual users of the airport. The "Scorecard" will also reflect the timeliness of external inputs and aircraft operator compliance to CFT times.
- ***De-icing Operations*** – De-icing significantly impacts the departure rate and can lead to surface congestion due to the imbalance of arrivals compared to the reduced departure rate. The surface predictions and CFT departure management algorithms will be updated to incorporate de-icing operations. Harmony supports the adaptation of de-icing stations and locations, identification of aircraft processed based on parking gate, and service times of the de-icing station based on aircraft size and the number of steps of the de-icing operation (one-step or two-step). When a de-icing operation is required, the JFK SMS user identifies de-icing and storm severity, which are then used in scheduling algorithms for CFT times. Surface surveillance data is used to monitor entry and exit to the de-icing station for updated departure predictions.
- ***Delay Reason Logging*** – The system will provide a drop-down list for the JFK users to optionally input a "delay type time-stamp" from an adaptable list of 20 possible types to log an operational event for an aircraft such as a reason for a delay.
- ***Future Departure Demand*** – A graphical status display will be added that provides an accurate snapshot of the departure demand at JFK. The display will provide the expected demand as a function of future time, including all aircraft predicted to use each runway. The display will also include a delay measure associated with the demand at each runway, either as a time delay value or an aircraft count.
- ***Region of Interest Reporting*** – Monitoring and reporting of aircraft that occupy or travel through a defined Region of Interest (ROI) will be added. The ROIs are adapted areas and may include taxiways, runways, holding areas, parking areas, approach corridors, gates, concourses of gates, and other definable sections of movement and nonmovement areas.
- ***Fuel and Emission Modeling*** – Use metrics from past operations as input to model fuel and emission impact of current and proposed operational procedures.

F.1.1.4.4.2 Integration with External Systems (C.4.D.2)

Our solution includes external interfaces that are established for ASDE-X, ASDI, ADL, NTML, and Aircraft Operators. These interfaces provide the majority of the external interfaces necessary for system functionality. The following additional external interfaces will also be integrated:

- ITWS for METAR/TAF, and RVR for textual displays of surface winds, visibility, and conditions
- Pilotweb for NOTAMs to determine runway and/or taxiway closures

F.1.1.4.4.3 Function to Receive and/or Distribute Data Elements (C.4.D.3)

The following specific data sources and data elements will be used by the system:

- ***Adaptation Data*** – The baseline Harmony product allows entry of adaptation data to describe airport layout, including runways, taxiways, ramps, and gates.
- ***Surface Surveillance Data*** – Surface surveillance data will be provided by ASDE-X data feed from the FAA. This includes coverage of aircraft and vehicles on the movement area and in the nonmovement areas where coverage exists.
- ***TFMS Data*** – The system will accept flight data, takeoff and landing times, and TMI data from TFMS via ADL and ASDI. The system will be capable of sending aircraft operator estimates for gate departure, runway departure, runway arrival, and gate arrival to TFMS via the FAA protocol.

- ***TMA Data*** – It is our understanding that TMA data from ZNY ARTCC is not available based on FAA policy. In lieu of this, the system will obtain equivalent data for arrival time estimates at terminal fixes and runways from the existing ADL interface.
- ***Weather Data*** – The system will accept weather data from ITWS. This includes METAR, TAF and RVR to be provided as text to the users. To our knowledge, RAPT has no available external interface.
- ***Operator Supplied Data*** – Aircraft operator supplied data accepted by the system consists of flight plan, flight schedule, Off Block Time (OBT), Landing Time, In Block Time (IBT), gate assignments, earliest ready to taxi time, boarding time, and any updated estimates to these values. Prioritization is achieved by the operators through substitution. Boarding time can be used to derive a "ready for taxi" estimate.
- ***Other Data*** – Our JFK SMS solution does not require any additional external interfaces for this functionality.

F.1.1.4.4.4 Graphical User Displays (C.4.D.4)

We will enhance the Graphical User Interface (GUI) screens to include additional features as required. Each item is specifically addressed below:

- ***Flight Data*** – Many of the flight data items are already available in the user displays. We will add the additional flight attributes including: Heavy designator, Mode S, Mode 3A, arrival runway predictions, turn around time, return to gate flights, de-icing service times, and departure runway ordering.
- ***Base Map*** – This capability is included.
- ***Base Map Adaptation*** – This capability is included.
- ***Base Map Characteristics*** – The characteristics of the base map are enhanced to provide an indication of closed taxiways or runways as reflected in NOTAMs.
- ***Base Map User Interface*** – The User Interface will include rotation as specified by the user.
- ***Situation Display*** – Display of nonaircraft vehicles and an indication of gate occupancy will be added. Additionally, the situational display and associated user interfaces will be enhanced from to include user control of hiding runway configuration data, aircraft, nonaircraft vehicles, and indications of gate occupancy.
- ***Data Tags*** – The Data Tag associated with each Aircraft Icon will be enhanced to include user control of hidden fields. Extra fields will be available in the data tag, including FAA Field 10 and airborne aircraft altitude. Configurable data tags for arrivals and departures, and data tag definitions for aircraft on the surface or airborne, will be provided. The user will be able to hide specified fields within the data tags and to toggle the data tag on or off for all flights or for any individual flight.
- ***Expanded Detail Window*** – This functionality will be enhanced: the user will be able to hover the mouse over an aircraft icon to access a configurable set of data items associated with the flight. A flight details page will be accessible from the aircraft data tag to access a complete set of attributes associated with the flight. A user entry capability will be added to allow a user to override the predicted surface destination (e.g., gate, runway) which is then used by the algorithms for subsequent processing of taxi time estimates.
- ***Additional Characteristics of Base Map*** – User preference settings will be savable and retrievable to configure windows on one or more screens. The search criteria will be enhanced to include a group of flights that share an attribute, including but not limited to aircraft type, air carrier, departure fix or destination airport. An off-line capability will be provided to edit and add visual layers, including

text and graphical components. The color configuration of the layers and internal objects will also be modifiable off-line.

- ***Icons*** – The aircraft icon types will be expanded distinction of small, large, and heavy aircraft to include any remaining categories required by the Port. Additionally, the icons will be configurable per user based on a set of predefined icons. The icons will also provide user-configurable colors based on flight state. With the addition of nonaircraft vehicles, the user will be able to configure the icon and color for the specified vehicle classes. Each user will be provided with independent functionality to display or hide nonaircraft vehicles.
- ***Gates*** – Each gate and parking stand will have an indication of whether the gate is vacant or occupied based on a combination of ASDE-X surveillance data and software logic to bridge the time period when an aircraft transponder is turned off from gate arrival until gate departure. We will work with Port Authority to determine an appropriate indicator to show that a parking gate/stand will be occupied at a time in the future based on arrival demand predictions and gate assignments.
- ***Timelines*** – Timelines that illustrate Pending flight Arrivals and Departures will be added. The timeline displays are configurable by the user and may reference departure runways, arrival runways, arrival fixes, or departure fixes. Aircraft identifiers will be shown on the timeline based on the corresponding predicted crossing time of the timeline reference point.
- ***Weather Display*** – Weather display functionality will be added. METAR, TAF, and RVR textual data will be available to users. The weather data will be included in the data warehouse and available for reporting and playback functionality. At this time, an external interface for RAPT data is not available from the FAA. At such a time that this data is available, we will work with the Port Authority to determine the appropriate incorporation of this data into the JFK SMS.
- ***Tabular Data*** – The tabular data provides extensive flight-specific attributes for all flights. This will be enhanced to provide summary counts and statistical metrics of the current operations. This will include the number of taxiing flights (inbound and outbound), number of flights taxiing for more than a configurable time, number of flights at gates, number of gates that are vacant and occupied, average taxi time over the recent operations, and a count of aircraft planning to depart in a configurable time period.
- ***Alerts*** – The alerts, which are provided in a context-specific location on the base map, will be enhanced to draw the user's attention by flashing and audible alarms. Generic alerting will be added to allow users to monitor an existing system data element against the user defined threshold. Surface taxi monitoring can potentially identify an alert if the aircraft enters a runway that is different than the predicted runway or does not taxi to the assigned holding. However, taxiway conformance monitoring is dependent on knowledge of the ATC taxi intent. Use of a priori taxi paths will result in false alarms; therefore, unless an FAA interface is available that provides the taxi instructions from ground control, alerts for taxiway conformance will not be provided.
- ***Configuration of Alerts*** – Configuration of Alerts to JFK users will be added. Users will be able to save alert settings including user-defined alerts as part of their preference set. Manual icon coding is addressed in the Icons paragraph above, and depiction of departure demand requirement is covered in the Tabular Data Display paragraph above.

F.1.1.4.4.5 Transmit Modeled OFF Times (C.4.D.5)

In the current interface between aircraft operators and TFMS, aircraft operators can provide updated estimates for gate departure, takeoff, landing, and gate arrival times. Use of this interface is for authorized aircraft operators or their approved designee. Since the JFK SMS contains this interface, SMS-modeled OFF times can be provided to TFMS as an update to any aircraft operator predicted take off time. Prior to the system's sending these updated predicted OFF times, each aircraft operator would need to authorize the JFK SMS to provide this data to TFMS.

F.1.1.4.5 Reporting Requirements (C.4.E)

The reporting capability of the Surface Management System leverages COTS technology to produce reports rich in graphical and textual content that will provide the users with necessary information to evaluate the effectiveness of surface operations.

The reporting capability allows the user to request a specific report, selection criteria and sort order from a set of predefined standard reports. It also provides the capability to generate ad hoc reports with fields, selection criteria, and sort order selected by the user.

The reporting application consists of a report server that interfaces with the operational data stored in the database. The reports generated by the report server can be saved in a predefined format or displayed to the user in a browser. The architecture of the reporting application is presented in Figure F-12.

The reporting application is capable of operating either on data stored in the operational database or from data stored in the archive database. The operational database maintains 24 months of data for user to access at any time, and data older than 24 months is loaded from the archive database.

The reporting application provides a means for the user to either display or save the reports in one of the following supported formats:

- Extensible Markup Language (XML)
- Hyper Text Markup Language (HTML)
- Microsoft Word (DOC, DOCX)
- Microsoft Excel (XLS, XLSX)
- Comma Separated Value (CSV)
- Text (TXT, RTF)

The reporting application also provides a mechanism to periodically schedule generation of reports. These reports will then be stored on disk or be sent to a predefined user email address.

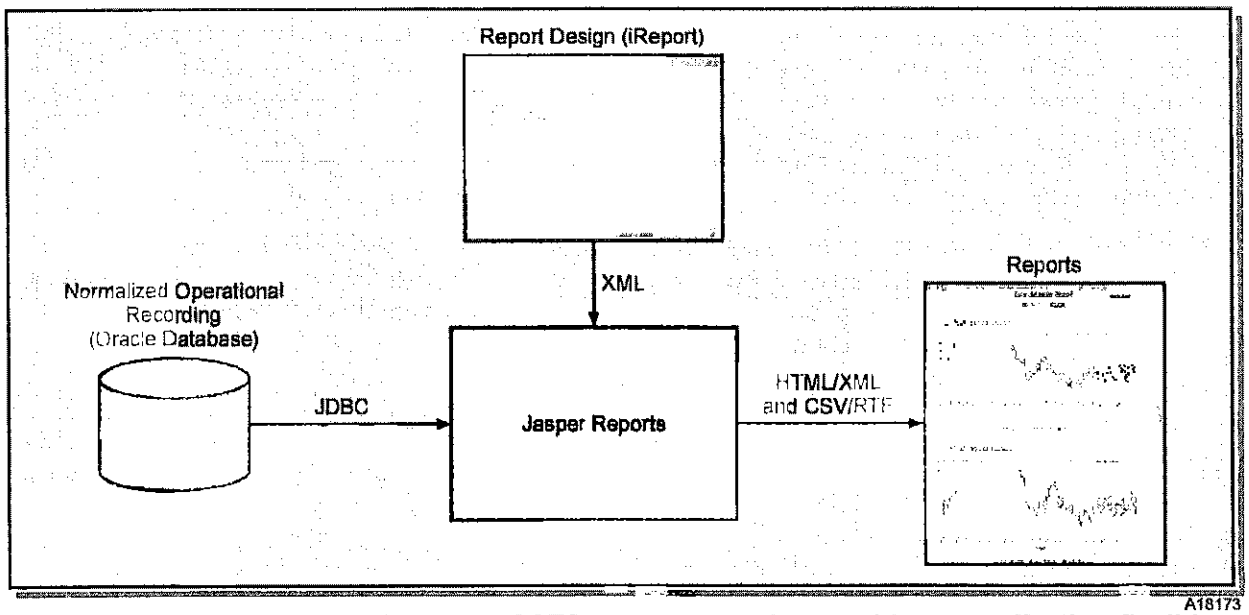

Figure F-12. Reporting Architecture – COTS report generation provides cost effective, flexible, operational analysis for JFK users

F.1.1.4.5.1 General Report Requirements (C.4.E.1)

The report server accepts the report format as an input. The report format is created off-line using a report designer, which provides flexibility in configuring the heading, type of data, and any graphics that should be shown in a particular report. The reports generated on-demand and displayed in the user browser can be saved and printed using the browser menus.

Access to reports will be restricted by the user's authorization. For this purpose the report server interfaces with the user authorization function to determine the data the user is authorized to.

F.1.1.4.5.2 Standard Reports (C.4.E.2)

The system supports the following type of standard reports that may either be requested on-demand or be automatically generated periodically:

- ***Arrival and Departure Report*** – This report provides the number of arrival and departure flights for a specific airline/runway for a specified period of time. A sample report is shown in Figure F-13.
- ***Movement Area Report*** – This report provides information for a flight or flights in the movement area. This applies for both departing and arriving flights.
- ***Taxi Time Report*** – This report provides information for a departing flight or flights from the time it left the gate to wheels-up and for an arriving flight or flights from wheels down to the time it arrived at a gate.
- ***Wheels Up and Down Report*** – This report provides for a departing flight or flights the wheels up time and for an arriving flight or flights the wheels down time. The time pertinent information associated with the flight will also be included.
- ***Planned Versus Allocated Taxi Time Report*** – This report presents the time the aircraft is ready for taxi (the planned time) versus allocated call for taxi time and shows the difference. A sample of this report is shown in Figure F-14.
- ***Allocated Taxi Time Report*** – This report presents the allocated call for taxi time and the wheels up time and show the difference.
- ***Gate Utilization Report*** – This report provides information on Gate Utilization. A sample gate utilization report is shown in Figure F-15.

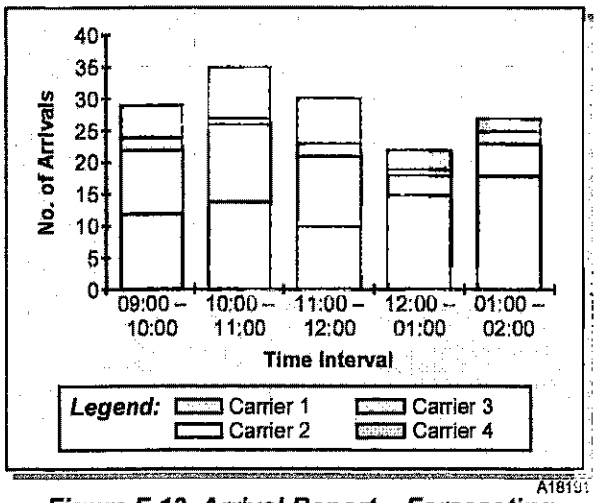

Figure F-13. Arrival Report – Forecasting arrivals by time enables operators to effectively manage flight operations

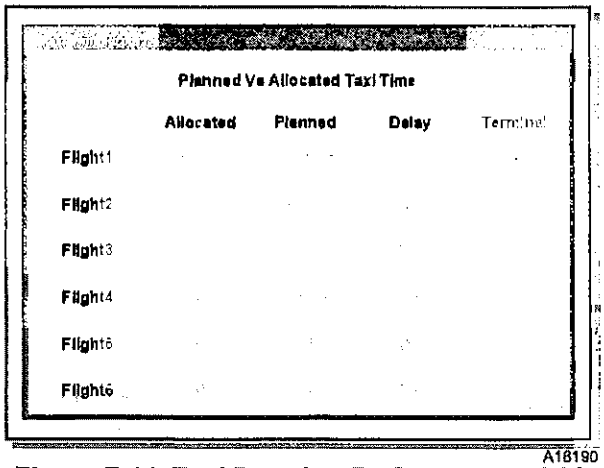

Figure F-14. Taxi Duration Performance – This report allows the user to identify unplanned taxi delays by flight to identify and correct issues with operational procedures

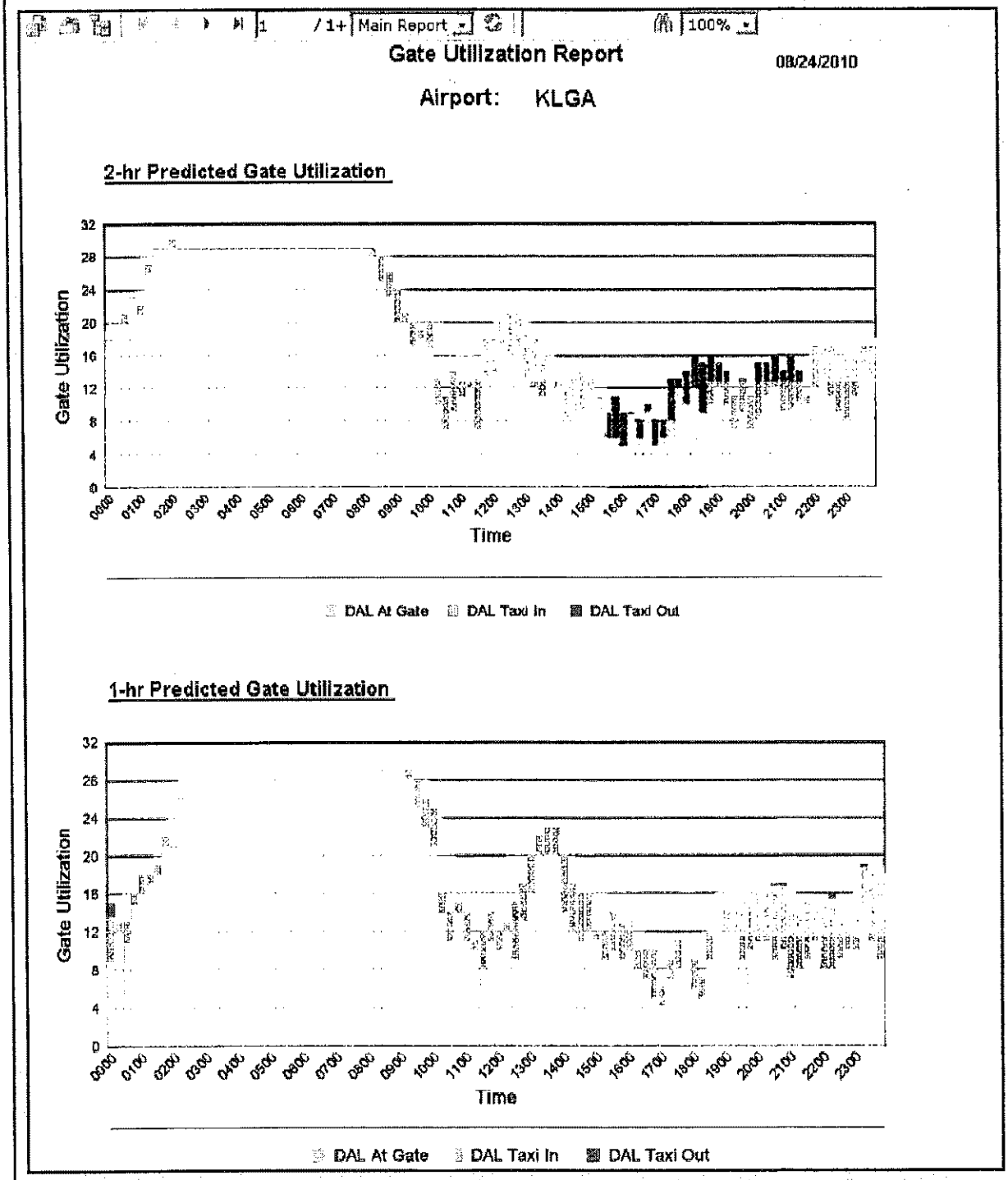

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Figure F-15. Gate Utilization Report – User reports enable JFK users to manage their resources efficiently

- ***Departure and Arrival Delay Report*** – This report provides information regarding the scheduled departure time and actual wheels up for departing flights. For arrival flights it shows the scheduled arrival time and the actual arrival time.
- ***Runway Utilization Report*** – This report presents the runway utilization presented by hours, days, months, or years.
- ***Metering Area Usage Report*** – This report presents statistical information on metering area usage.

F.1.1.4.5.3 Database Query Reports (C.4.E.3)

The system also supports ad hoc report generation using user supplied criteria for data selection, filter values, fields included, and sort order. Data element names used in the browser's base map, are used as the field names in the ad hoc report request.

Additional custom reports are provides on request by the Port Authority. Labor associated with generating these reports are additional but conform to Section F.1.1.10.6.

F.1.1.4.5.4 Summary Windows (C.4.E.4)

The system provides a summary window upon user request to display current and predicted metrics and trends. The summary reports include:

- ***Region of Interest Summary*** – Aircraft within each ROI
- ***Surface Display Summary*** – Delay for each ROI
- ***Airport Demand Summary*** – Current and predicted arrival and departure rates
- ***Runway Configuration Summary*** – Current airport configuration
- ***Arrival and Departure Sequencing Summary*** – Airport/runway sequence of aircraft with ETA/ETD
- ***Taxi Time Summary*** – Aircraft taxi times, and runway/airport, total, minimum, maximum, and average taxi time with current trend
- ***Active Flight Summary*** – Current flights with ETA/ETD

F.1.1.5 General System Design Requirements (C.5)

F.1.1.5.1 Overview of Application (C.5.A)

The application is partitioned into three tiers to isolate data, business logic, and presentation, while SOA and web-based interfaces provide an open platform for extension with maximum interoperability for airport users and the web technologies they use.

The bulk of the capability provided is based on the Harmony for airlines product provided by Metron Aviation. Additional features are integrated into this product to meet specific requirements for the PANYNJ.

Functional Architecture

The system context and external interfaces are shown in Figure F-3. The system is partitioned into groups and functions as shown in Figure F-16.

The Data Services (DS) group provides functions for receiving data from external sources, recording the data for playback, applying updates to the persistent database, notifying other functions of data updates, and accepting state changes from other functions. It includes functions for maintaining flight data, surveillance data, airport data, airspace and route data, weather data, and optionally, ADS-B reports from an independent sensor at JFK. All these functions with the exception of the weather and ADS-B track fusion functions are already included in the Harmony product.

The Business Applications (BA) group provides functions to monitor the surface, predict take off times, and schedule call for taxi times to maximize the departure rate, and minimize the departure queue length at JFK. It includes functions to monitor runway assignments based on surveillance, extract events

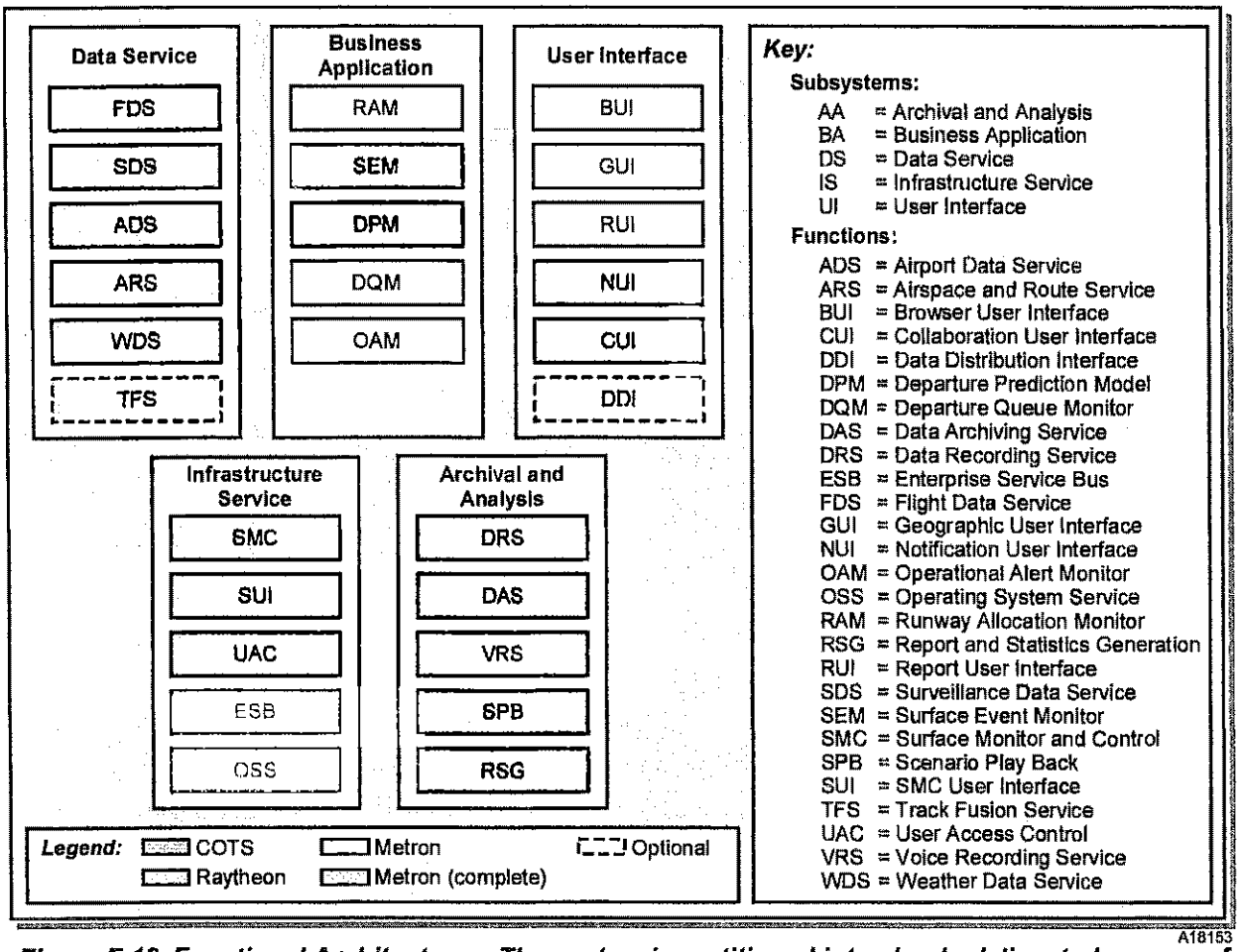

Figure F-16. Functional Architecture – The system is partitioned into clearly delineated groups of functions, enabling delegation to separate teammates

from surface surveillance, monitor taxi routes, refine taxi estimates, and monitor gate assignments for conflicts. The surface event extraction, departure prediction model, and departure queue manager are already included in Metron Aviation products.

The User Interface (UI) tier provides functions to accept and authenticate user connections, provide flight schedules, including gate assignment and call for taxi times, provide geographic displays showing current surface and airborne traffic, and accept user requests for standardized and ad hoc database reports, graphs and summary windows. It includes functions for user notification via email, and user collaboration via chat. An optional data distribution interface can provide XML/JMS data distribution to user automation systems if desired. The browser interface, graphical interface, report interface, and notification interface functions are already included in the Harmony product.

The Infrastructure Services (IS) group provides infrastructure functions that support the other application functions within the system. This includes the operating system, Enterprise Service Bus (ESB), user access management, monitor and control, and its user interface. The monitor and control function is used to start/stop the system, and monitor performance and faults as it is operating.

The Archival and Analysis (AA) group provides functions that record data to disk for synchronized playback, functions for archiving the operational database, and functions for generating standard and ad hoc reports through database queries.

Data flows for two operational scenarios are described to illustrate how these functions interact:

- Departure with rationed CFT:
  - FDS receives the flight plan from ADL (TFMS).
  - FDS receives the gate assignment and estimated off block time from the airline.
  - DPM receives the flight update from FDS, allocates a runway, estimates the unrestricted taxi route, estimates the off time, and estimates the fly out time to the departure fix and updates the flight data maintained by FDS.
  - SDS receives surface tracks from ASDE-X (SWIM).
  - DQM predicts departure queues as a function of time, identifies when the length exceeds parameters, rations call for taxi times for congested flights, and updates the flight data maintained by FDS.
  - BUI receives updates from FDS and updates the display for all users.
  - GUI receives updates from SDS and FDS and updates the display for all users.
- Arrival with gate conflict:
  - FDS receives the updated flight plan with ETA from ADL.
  - FDS receives the assigned gate and flight status from the airline.
  - SDS receives the airborne track from ASDI and updates the flight maintained by FDS.
  - DPM receives the updated flight from FDS and calculates arrival, approach, landing, and taxi in times, and updates the flight data maintained by FDS.
  - OAM receives the updated flight from FDS, determines if there is a gate conflict and its duration, and updates the flight data maintained by FDS.
  - NUI receives the gate alert from FDS and sends email to the appropriate distribution list.

Software Architecture

The software architecture is shown in Figure F-17. The software components shown represent an executable group of function that is deployed as a single unit on a single physical platform. The hardware configuration is shown in Section F.1.1.5.3.

The user browser component represents the user's web browser (e.g., Internet Explorer, Firefox, Chrome, etc.) located on the user's workstation. This component is external to the system but shows how user software interacts with SMS software components.

The Apache web server, with three instances of Tomcat, is hosted on the application server and handles all user requests and updates. There is one tomcat instance each for the HarmonyServer, GeoServer and ReportServer application components.

The Harmony server component includes the DS and BA function groups, and handles all system and user inputs. The GeoServer component receives updates from the HarmonyServer and renders the user display using D-HTML and JavaScript. The ReportServer component receives users request for reports and queries the database and renders the results for the user.

The DatabaseServer component is hosted on separate physical servers within the data centers, and provides SQL access to the Oracle databases. The operational database supports live operations as well as queries against current data.

Having separate software components for the application, presentation, reports, and the database ensures that the software architecture is scalable to meet increased demand in the future.

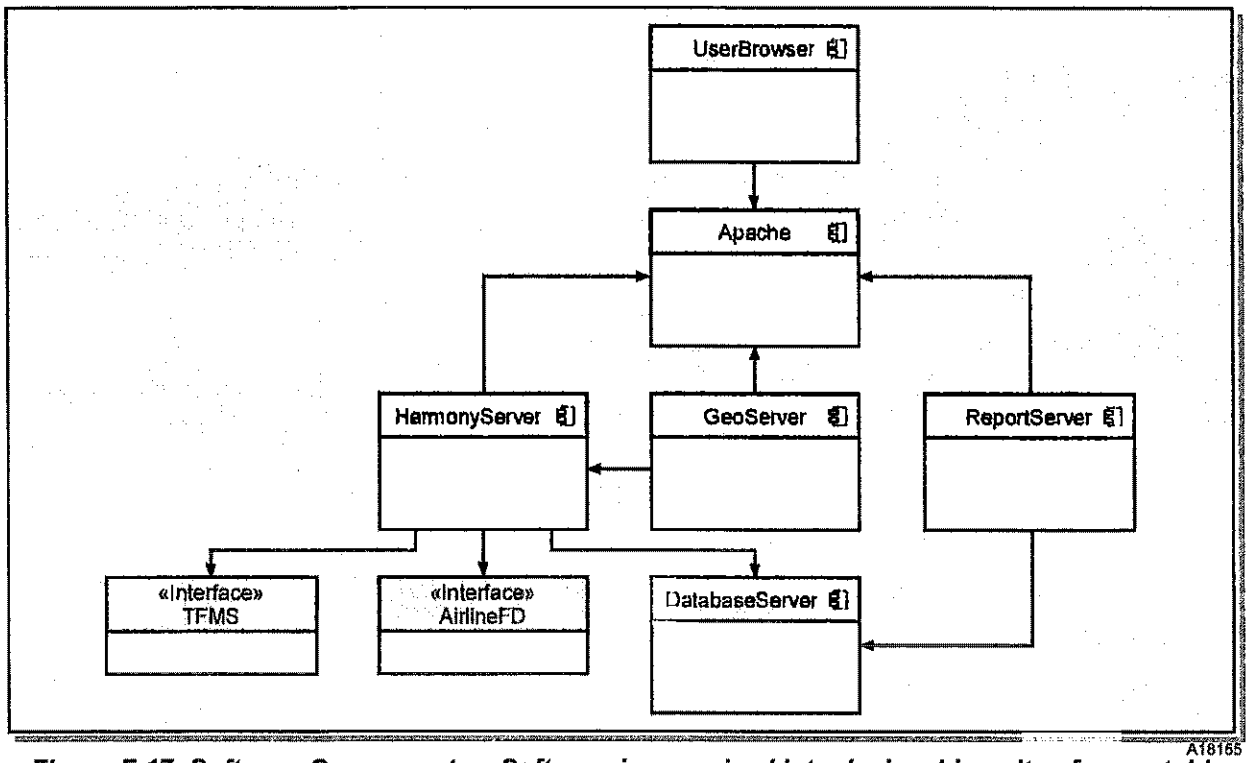

Figure F-17. Software Components – Software is organized into deployable units of executable code, enabling future scalability

Secure Access

Secure access to protect operational data is provided at several layers: an Adaptive Security Appliance (ASA) is provided to limit access to specific ports and user network addresses; Virtual Private Network (VPN) is provided to authenticate connections and encrypted packets at the network layer; Transport Layer Security (TLS) protocols are used to encrypt data streams at the transport layer; and user authentication is provided to establish user access and data rights. An overview of our security approach is described in Section F.1.1.5.2.

Continuous Operations

Our approach provides full redundancy within and between diverse data centers, resulting in an operational availability that exceeds 0.9999 and continuous operations in the event of component failure. Our fault tolerant architecture is described in Sections F.1.1.5.3 and F.1.1.6.2.

Consistent User Interface

A consistent user interface is provided to all users of the system using dynamic HTML and java script. This allows system users with workstations provided by different hardware vendors, with different operating systems, and different web browsers, to have a consistent look and feel. The GUI provided is described in Section F.1.1.5.5.

Open System Architecture

The FAA interfaces are established by the FAA and vary in implementation technology. The ASDE-X and ASDI interfaces are defined by XML schemas and are published via the internet using JMS technology. The ADL is also defined by an XML schema, but the transport is currently TCP over a dedicated link to the WJHTC. The NTML interface is ASCII free form text, and the transport is also TCP over a dedicated link. These interfaces are open in that the FAA publishes, maintains and controls the interface.

We will assist the PANYNJ in establishing and maintained the airline interface as a standard. We propose an interface that is defined by an XML schema, with messages to support airline connection to the SMS, airline publication of flight schedule, status and gate, and data reconstitution after failure. For consistency with the FAA and SWIM, JMS should be used as the transport, with Openwire as the message level protocol. By providing a standard interface to the airlines, costs for developing and testing airline unique and proprietary interfaces is avoided. However, if assistance is needed in updating airline systems to this standard interface, we are capable of developing airline unique adapters.

If a system-to-system interface for outputs becomes necessary to support airlines or future consumers of the SMS, a data distribution component can be added to publish system outputs directly to airline, Port Authority, or FAA systems. The interface provided will be defined by an XML schema, and use JMS for publishing data. A SOAP interface is provided for requests and response interactions. This optional component leverages SWIM technology developed for TDDS.

F.1.1.5.2 Security Requirements (C.5.B)

Security solutions provided by the Raytheon team pro-actively addresses technical, managerial, and operational aspects of both physical and cyber security to protect the systems we build from a continually evolving threat environment.

F.1.1.5.2.1 Data Security (C.5.B.1)

Data security is a strong point of the Raytheon team's solution based on years of experience delivering systems to the defense community as well as critical infrastructure systems for customers such as the FAA.

The system provides secure access and protection of operational data against intrusions and internal misuse through multiple layers of defense. The first line of defense is the Adaptive Security Appliance (ASA) which acts as a firewall, intrusion prevention system, router and load balancer.

The ASA protects the systems within the data center from unauthorized access from unknown IP networks and connection attempts on unauthorized ports. The only connections established from outside the data center are from users which have authenticated themselves through the web server, or VPN connections used for maintenance, and external data inputs such as airline systems providing flight schedule and status information. All other connection attempts are denied, logged and notification sent to the operations staff. The ASA also provides a proactive, full featured intrusion prevention service to stop malicious traffic, including worms and network viruses before they affect the system. Utilization is monitored by both the system and the data center provider to detect denial of service attacks, with alerts sent to the operations staff.

The ASA also provides web VPN technology, allowing users to connect to the web server using HTTPS. This uses TLS/SSL protocols and transparent data encryption to the authorized user.

User login with encrypted password is used to authenticate the user and determine appropriate access rights based on the user's group. Only data that is configured for the associated group is provided to the user. User names and encrypted passwords are maintained in a distributed LDAP server residing on both application servers and in both data centers. User maintenance is provided by operations staff. All user interactions, including successful and unsuccessful login are recorded.

F.1.1.5.2.2 Physical Security (C.5.B.2)

Our data center locations are physically secured and manned 24x7 with trained security professionals. Physical access to the data center facilities, computer equipment, media and documentation is limited to properly authorized individuals. A layered physical security approach is employed including the use of biometric locking mechanisms and man-traps as well as secure enclosures for the system hardware. The data center facilities are also maintained and monitored for acceptable operating conditions including fire

protection, cooling, humidity and electrical backup systems. The data center locations utilized are SAS 70 Type II audited to ensure that the facilities have the proper security, environmental protection and policies and practices in place.

F.1.1.5.2.3 Security Submittal (C.5.B.3)

The following highlight Cyber Security elements of the Security Submittal, provided after contract award, which will specify features, policies and practices utilized to secure the JFK SMS system.

Information Systems Security Engineering (ISSE) Process

We utilize the Information Systems Security Engineering (ISSE) process when developing security architectures for the system. This process addresses the security needs of system owners and users by providing a structured plan for implementing and validating Information Assurance (IA) architectures and ensures that security is planned for, and properly implemented through each step of the Systems Development Life Cycle. Dedicated ISSE practitioners will work alongside the core engineering team during each step in the development of JFK SMS to ensure that systems are secured from cyber attack through the use of security controls and mechanisms.

- ***Establishing Information Assurance*** – IA products integrated into JFK SMS will be selected based on their ability to mitigate the risk of successful cyber attacks. Encryption technologies are implemented to ensure the Confidentiality of information while in transit or at rest, while allowing decryption for packet inspection of traffic entering and leaving the network perimeter of JFK SMS.

  IP addressable technology within JFK SMS architecture will be hardened against cyber attack using DISA Security Technical Implementation Guides (STIG) and NSA Security Configuration Guides (SCG) as appropriate. These guides define the standards to which IA controls must be built into and configured for both JFK SMS software and systems. For which, Raytheon is committed to building IA into from the ground up.

- ***Security Architecture*** – The Security Architecture for JFK SMS networks will be designed to provide a high level of confidence in the Information Security for network infrastructures, information systems, data, interfaces and users at designated classification or access levels; while ensuring that the quality of IA implemented is commensurate with Government best practices.

  This includes mechanisms for the unique identification all users, for the authentication of users using strong password policies, for granting users access to only the information they are authorized access to, and for the protection of data from unauthorized disclosure, modification, or deletion while in transit, at rest or while being processed. Auditing of all relevant security activities is also built into the IA architecture, and will include recording and auditing of events such as: logon, log off, failed login attempts and unauthorized access to, modification of, or deletion of data on JFK SMS.

- ***Enabling Information Assurance Cycle*** – Information Assurance is critical to the successful implementation of networks and information systems operating within JFK SMS. Basic security functionality as described in the paragraphs above should be present, and continually built upon as other processing, storage or connectivity capabilities are added. This is true whether or not the full capability is implemented at the inception of JFK SMS network capabilities, or incrementally delivered as the system grows and matures.

  Ensuring effective levels of Information Assurance requires a cyclic, continuous process that consists of Defending systems through the implementation of well planned security measures, Monitoring systems for intrusions or security violations, Reacting to security events so that systems may be protected, and Assessing the overall effectiveness of security measures that were put in place. Through diligent execution of this Information Assurance Cycle, high levels of confidence can be held that JFK SMS data and systems remain secure.

F.1.1.5.3 System Architecture (C.5.C)

Familiarity with the FAA's current and planned NAS architecture, along with implementation experience on SWIM TDDS, STARS, ERAM, and TFMS is leveraged to integrate the SMS to receive FAA operational data, and securely provide enhanced situational awareness to JFK users via the internet.

Quality Attributes

Quality attributes are nonfunctional features of the system that are used to make design decisions regarding the implementation. Often maximizing one quality attribute will negatively impact others, so it is essential to prioritize them to reflect stakeholder goals. Stakeholders include the PANYNJ, the FAA, aircraft operators, users, operators and maintenance personnel.

A prioritized list for JFK follows:

- ***Cost*** – The system provides a tangible benefit to the stakeholders that may be measured in dollars; absorbing delays at the gate saves fuel and avoiding gate conflicts saves labor. It is essential that this cost benefit remain significantly higher than the initial cost of deployment, and the recurring cost of operation. This attribute is maximized by using COTS software and hardware for the solution, avoiding the high cost and risk of custom development. Providing operational metrics is paramount to supporting the business case.
- ***Availability*** – For the system to provide benefit to its users, it is essential that it remain operational at all times. Redundant hardware and software is provided with automatic failover, and remote fault monitoring and notification is provided to minimize any potential down time. Scheduled maintenance will be performed on redundant hardware while the primary hardware remains operational, and will be schedule for off-peak hours as well.
- ***Survivability*** – It is essential that the system continue to operate and provide user benefit in the face of disaster. Redundant data centers are used, one located in Boston and the other Houston, to minimize the impact of a regional disaster. Diverse communication links with access to multiple backbones are used to avoid any single point of failure in the network.
- ***Interoperability*** – The many users for the system use a diverse set of computer technologies for their workstations and internet connection. Using web-based interfaces supported by the leading internet browsers maximizes interoperability with the user community. Likewise, SOAP and XML/JMS interfaces are used wherever possible to maximize interoperability with automation systems.
- ***Performance*** – To provide benefit to the users, the system must meet latency and utilization requirements. The performance of the system will be continuously monitored both by automation and personnel. Any key performance parameters that are exceeded are reported, analyzed and addressed.
- ***Scalability*** – One of the goals of the system is to improve operational throughput on the JFK surface to attract additional flights (and revenue) to JFK. After the system is deployed and operational, demand will increase with time. The system software is partitioned into components integrated using an ESB so that the system may be distributed across several hardware platforms in order to meet this additional capacity.
- ***Extensibility*** – After initial deployment, the PANYNJ may identify additional features that would benefit the users at JFK. The software is designed using SOA to easily support insertion of additional capability without requiring redesign of existing components.

Operational Context

The system is deployed in two remote data centers, securely connected to the users via the internet as depicted in Figure F-18.

The users, whether located at JFK, at the AOCs, or elsewhere, use their internet browser to connect to the application server using the published HTTPS address for the system. DNS will resolve this to the IP address of the primary data center, or when down, the IP address of the backup data center. The ASA

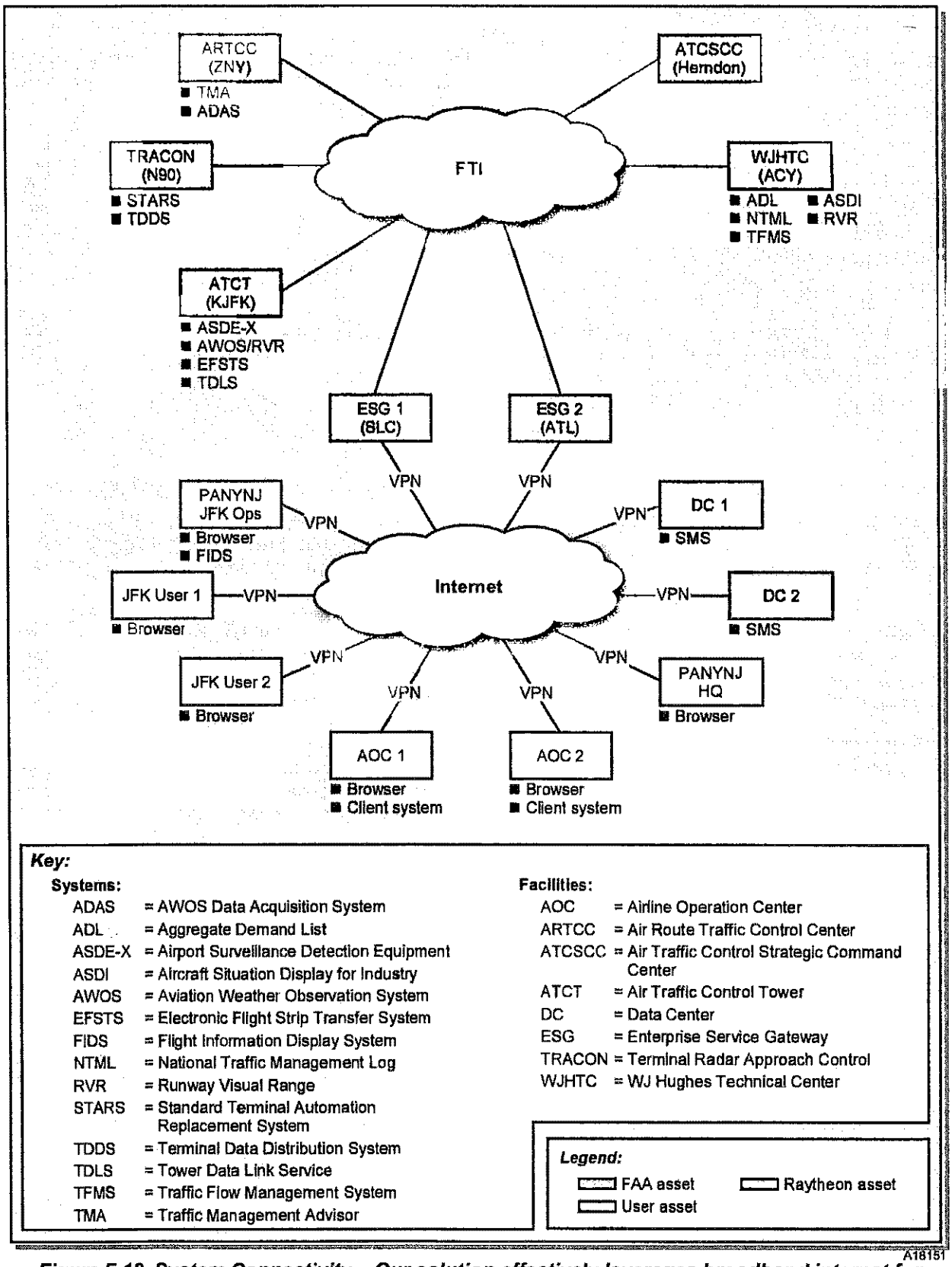

Figure F-18. System Connectivity – Our solution effectively leverages broadband internet for connecting to the FAA, airline and JFK users

within the primary data center will terminate the TLS (SSL), perform NAT and route HTTP requests to the active application server. Once connected, the users will receive screen updates on a fixed period, and may enter status updates or requests via the GUI rendered by the browser.

For ASDE-X and ASDI inputs from the FAA, the active application server uses JMS to connect to the FTI Enterprise Service Gateway (ESG) using an encrypted VPN connection established through the internet. Aircraft tracks from the JFK ASDE-X DDU flow through the SWIM TDDS system, where they are encapsulated within XML and published to TFMS running at the WJHTC. TFMS filters sensitive flights, and republishes this data to SMS via the ESG. Likewise, flight data, events and tracks from the HCS located at ZNY are sent to TFMS running at the WJHTC via the HADDS interface, where TFMS filters sensitive data and republishes as XML to SMS via the ESG.

For ADL and NTML inputs from the FAA, the active application server establishes a TCP connection to the ESG using dedicated T1 links. Flight data, demand data, and airport configuration are sent as ASCII message from TFMS running at the WJHTC to the SMS via the ESG.

For airline data originating from the AOC, the airline automation system establishes a JMS connection to the primary application server (and backup application server) to provided flight schedule, status and gate updates. An adapter can be created for existing systems, but a standard interface will be established for accepting these inputs.

Hardware Architecture

The operational hardware within the primary data center is show in Figure F-19.

Redundant edge routers, ASAs, and Ethernet switches are provided for connectivity. The edge routers terminate the links to diverse internet backbone providers as well as dedicated T1 links to the FAA. The ASA provides firewall, port forwarding, SSL encryption, NAT, and load balancing capabilities. The switch provides 1G Ethernet connectivity to all physical servers and devices within the data center. An availability analysis of this configuration is provided in Section F.1.1.6.2.

One physical server is provided for the application software, and another for database access. A redundant physical server is provided for each. The database is clustered across servers. A SAN is provided with fiberchannel connections to all servers. On each physical application server, VMWARE is used for virtualization for the web server and playback server. On the redundant application server, VMWARE is also used to host an administration server. By using virtual machines, the application may easily be scaled to multiple physical servers if necessary.

The backup data center includes a single application and database server for disaster recovery. Synchronization of operational data, and data center failover are discussed in Section F.1.1.10.10. A test string is also included in the backup data center so that upgrades may be tested while the system remains operational.

F.1.1.5.3.1 Redundancy (C.5.C.1)

Redundant networking, application servers and database servers are provided within the primary data center as described above. When a primary component fails, the system will automatically switch to the backup component without requiring manual interaction. Diverse communication links to separate internet backbones are used to avoid any single point of failure. Once the failed system is restored, it will automatically become the new standby system.

F.1.1.5.3.2 Fault Tolerance (C.5.C.2)

Component status is continuously monitored by the system and when a fault is detected, notification is automatically sent to support personnel. Additionally, if the fault results in failure of a critical component, the backup component is activated as described in Section F.1.1.5.3.1. The fault is then manually investigated before the failed component is returned to service.

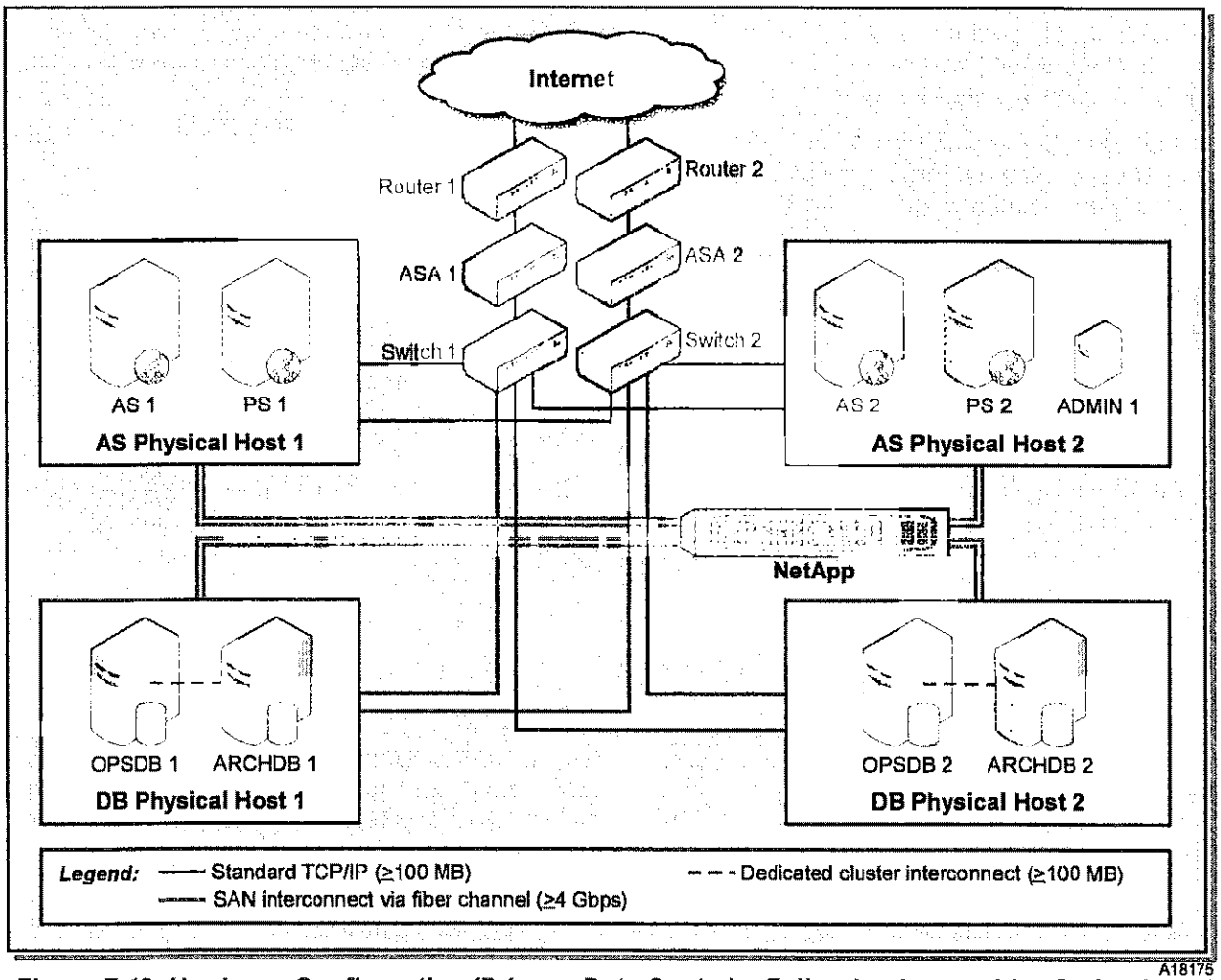

Figure F-19. Hardware Configuration (Primary Data Center) – Full redundancy with a fault tolerant architecture provides an operational availability exceeding 99.99%

F.1.1.5.3.3 Diversely Located Secondary System (C.5.C.3)

A redundant data center is provided to ensure continued operations in the event of a catastrophic event affecting the primary data center. This secondary data center includes networking equipment, application servers, and database servers. Database snapshots of both the operational and archive databases are periodically sent from the primary data center to the secondary data center to minimize data loss upon such a failure.

The secondary data center also includes an application and database server for testing system upgrades as well as testing operators and users using simulated data.

F.1.1.5.3.4 Web-Enabled (C.5.C.4)

Users access the system securely through the internet using their internet browsers supporting DHTML and JavaScript technologies running on normal workstations or laptops with broadband connectivity to the internet.

F.1.1.5.4 Database Requirements (C.5.D)

The depth of Metron Aviation's database knowledge and Raytheon's integration resources enables the implementation of a database architecture utilizing best of breed technologies providing maximum data protection, availability, and proven disaster recovery solutions. The databases will be powered by Oracle

RDBMS engines encapsulated by the application software. The use of Oracle technologies with a RedHat Linux platform provides a proven enterprise level solution that is certified to function together. Additionally, the system is implemented with an Oracle Real Application Cluster (RAC) back-end using a NetApp Network-Attached Storage (NAS) device that provides the highest levels of availability and Disaster Recovery functionality.

F.1.1.5.4.1 Data Ownership (C.5.D.1)

Data ownership is discussed in Section F.1.4.5.

F.1.1.5.4.2 Data Integrity (C.5.D.2)

Data integrity is achieved both with system level controls and database integrity measures. The system level controls include administrative controls, disaster recovery processes and IT configuration control processes. Database integrity measures are achieved through database integrity constraints, application codes and database triggers.

F.1.1.5.4.3 Database Setup (C.5.D.3)

As part of system deployment, we will configure and optimize the database to work with the SMS application, expected capacities, and user load.

F.1.1.5.4.4 Database Replication (C.5.D.4)

As described in the system architecture, the primary and secondary database systems are located in separate physical data centers. The database is replicated between data centers leveraging Oracle replication technologies such as Data Guard and Streams as well as NetApp snapshots. These are high availability and disaster recovery solutions that protect the data and databases, both operational and archived, from failures, human error and data corruption.

F.1.1.5.4.5 Data Storage, Archive and Restore (C.5.D.5)

The Port Authority can expect database maintenance policies and procedures to be designed and implemented to provide the highest available and maximum performance. The system will provide on-line storage of a rolling 2 years of data without degradation in system performance. Utilizing an agreed upon long-term archiving process, data that is rolled off the 2-year on-line database each month during will be available to authorized users for reporting, analysis and playback for an additional period of 3 years. This archival process is performed during off-peak hours.

F.1.1.5.4.6 Database Backups (C.5.D.6)

The system will utilize the latest Oracle and NetApp Enterprise backup solutions to ensure data integrity, availability and recoverability. All necessary enterprise backup and recovery procedures will be implemented to ensure systems and data can be recovered within agreed upon timeframes. The backup and recovery procedures will cover all data, application and system files and will be configured to provide a full backup weekly with daily incremental backups.

F.1.1.5.4.7 Testing the Restore Procedure (C.5.D.7)

A complete test system along with isolated database is provided for testing system upgrades. This system is also used for verifying that system backups can be successfully restored. This test will be conducted annually and results documented.

F.1.1.5.4.8 Data Analysis (C.5.D.8)

The capability for data analysis by authorized users is provided using the standard and ad hoc reporting function provided through the web-based interface. This capability is described in Section F.1.1.4.5.

F.1.1.5.4.9 Data Playback (C.5.D.9)

The capability to playback recorded inputs is provided to authorized users through the web-based interface. The user may select the time period for playback, and a new instance of the application is spawned on the playback server that will read the corresponding system inputs from the database, and process the data normally, providing outputs to the user's browser as in the operational system. The user may create and manipulate windows, but all system commands that would otherwise change data are inhibited.

F.1.1.5.4.10 Data Extraction (C.5.D.10)

The capability for data extraction in XML format is provided by the reporting function described in Section F.1.1.4.5.

F.1.1.5.5 Screen Display and User Control (C.5.E)

The Harmony product displays information to the user using a web-based solution entirely accessible through modern, standard browsers that exist in the marketplace today. A dynamic display of surface traffic is provided with rapid updates of data items entirely through the web browser (Figure F-20). The only dependency for the user is to have a supported browser, a broadband internet connection, and valid security credentials that authenticate access to specific system capabilities.

The system provides a consistent look and feel throughout all windows for both the real-time displays and reports (Figure F-21). The screen design utilizes the standard desktop with multiple windows (on

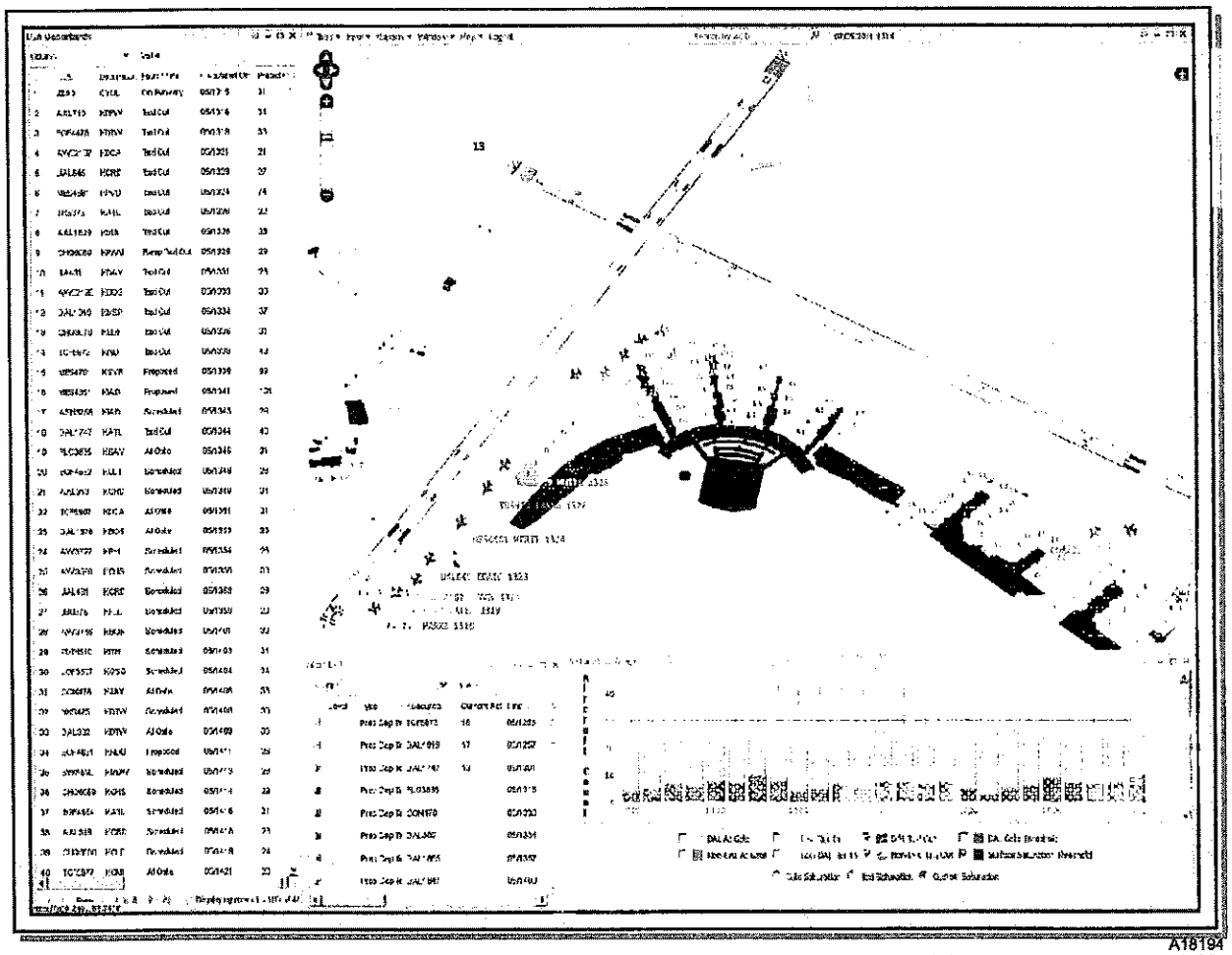

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Figure F-20. Harmony Surface Display – A web-based display provides rapid updates to the JFK user through a standard web browser

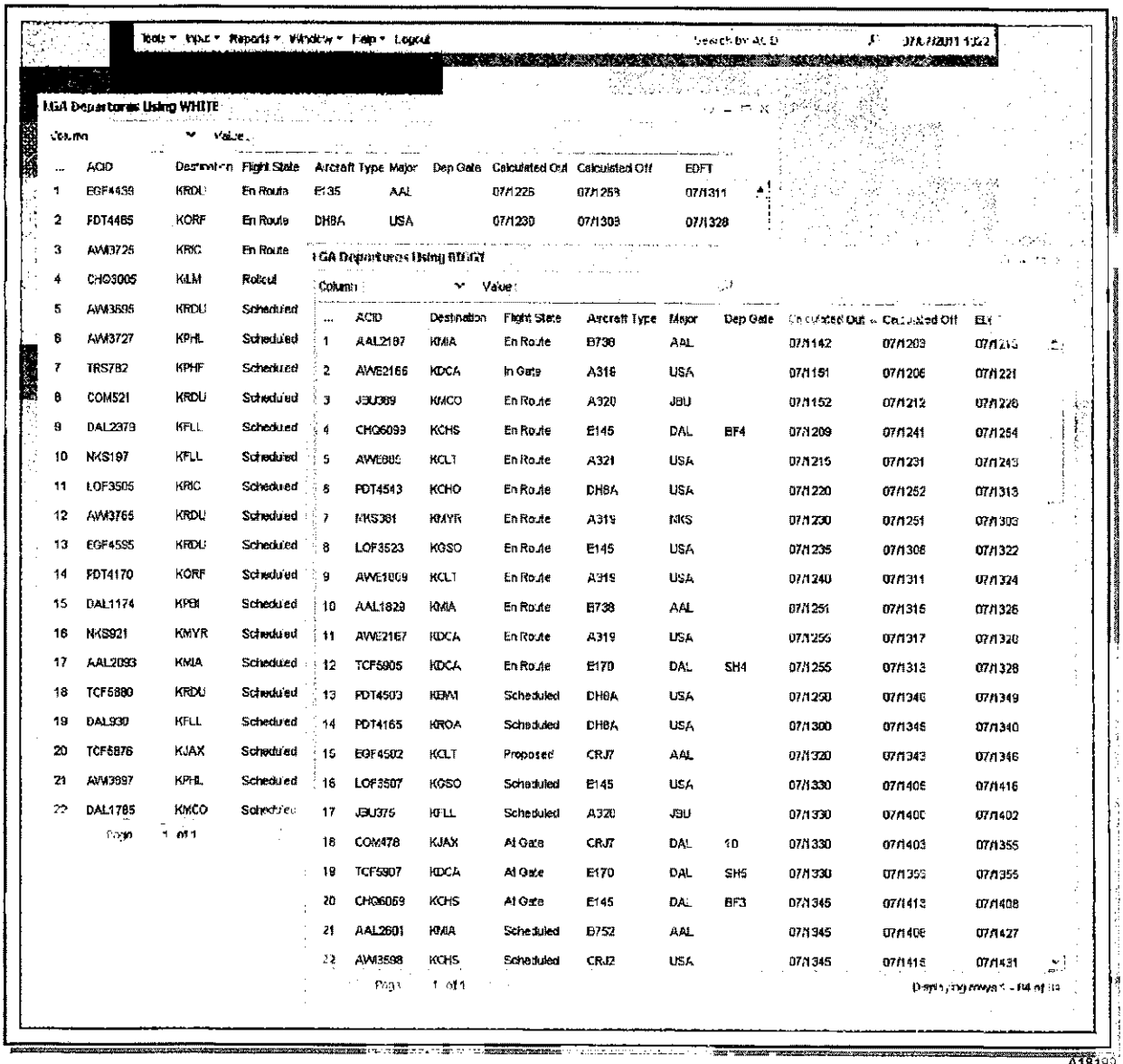

Figure F-21. Sample Reports – A consistent report look and feel is provided for ease of use

multiple monitors) provided by the browser. All windows have standard names on the title bar which provide the context of the information displayed. Each window can also be uniquely named by individual users. This user specific naming is retained the system across user sessions.

The system provides real-time updates to multiple windows of information at the same time (Figure F-22). The system can support more than four concurrent displays on the same workstation and is limited only by the performance constraints of the workstation. Additionally, a "pop-out" capability is provided for any window so that the windows can be arranged across multiple workstation monitors if so desired.

F.1.1.5.6 Access Privileges (C.5.F)

Access control to the system is role based. Baseline functionality of the Harmony product supports creation of an unlimited number of user groups, each with custom access. Each user is assigned one or more user groups granting them the access to specific resources.

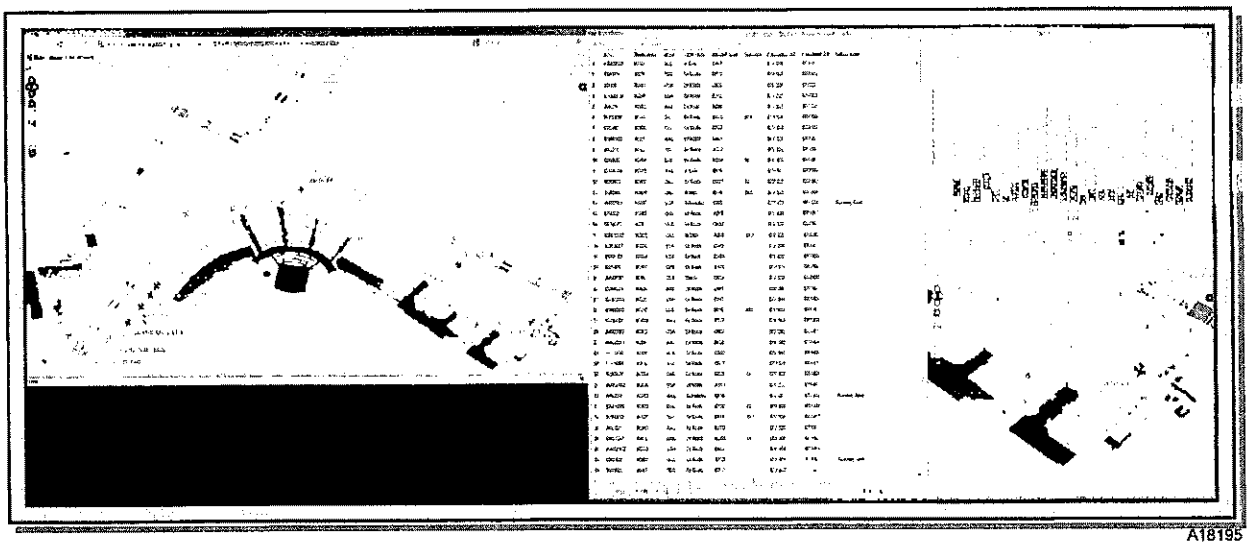

Figure F-22. Multiple Windows – Concurrent updates to multiple windows on multiple monitors provide complete situational awareness

This functionality will be used to create the nine specific levels of access defined by the Port Authority:

1. Monitor airline data
2. Monitor terminal data
3. Monitor airport data
4. Modify airline data
5. Modify terminal data
6. Modify airport data
7. Flight tracking data
8. Application administrator
9. System administrator

For example, a group can be created which only has access to monitor the situational display (Level 7) and another can be created to modify airport data (Level 6). An application administration group will be created with access to the user management and access control functions (Level 8). An example of the user administration function and group assignment is shown in Figure F-23.

This function supports the definition of read-only and read-write privileges for access to airline, terminal, and airport data. Individual users with airline privileges may also be restricted to data from specific airline(s). For example, a user may be assigned permissions which include all American Airlines and American subcarrier flights. This would allow the user to view protected flight fields and modify operational data for these flights.

All users, groups, and access permissions are managed with a simple to use GUI.

F.1.1.5.7 Event Logging (C.5.G)

The system records all system level changes and maintenance activities including user log in and log out, changes made to operational data, changes to the system files, configuration, settings, and user permissions. The entire infrastructure is monitored, including database servers, application servers, virtual machines and network devices.

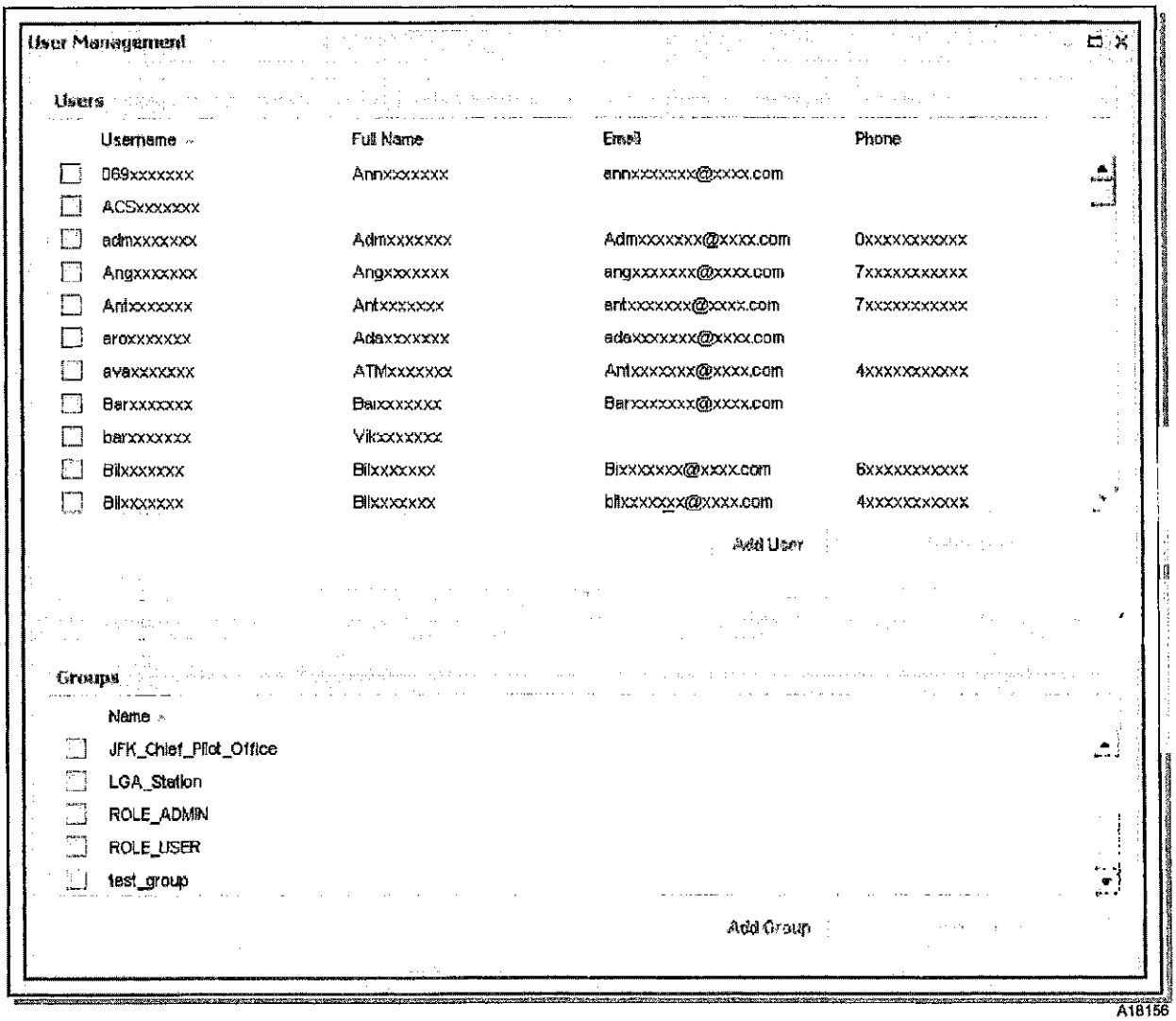

Figure F-23. User Administration – Flexibility in user group assignment protects proprietary data

Logging of system changes is accomplished using the Tripwire Enterprise IT configuration control application to ensure complete and reportable infrastructure configuration management. Logging of user changes to operational data is already performed by the Harmony application.

F.1.1.5.8 State of Common Usage (C.5.H)

The latest COTS hardware and software utilizing open interfaces and industry standard protocols is used to ensure vendor and technology independence. This allows components of the system to be upgraded as technology evolves without widespread impact to the underlying software implementation.

The hardware of the system is shown in Figure F-19 and consist IBM 3650M3 servers for the application and database servers, with NetApp SAN for storage.

The servers run Red Hat Enterprise LINUX, an open, POSIX compliant operating system maintained by Red Hat. The database servers are running Oracle Enterprise Edition supporting database clusters and replication. Hyperic is used along with SNMP for monitoring and controlling devices, platforms and software components.

The software is written in Java using JDK 1.5 and is highly portable between hardware architecture and operating system. All application interfaces use open standards whenever supported by the external FAA

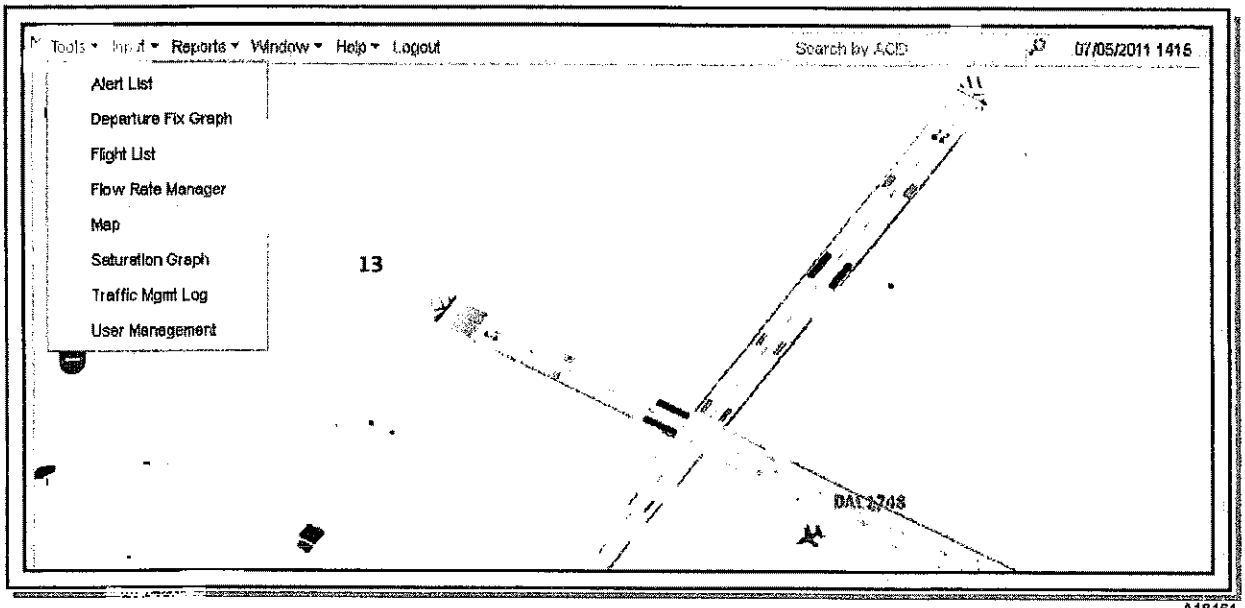

Figure F-24. Graphical User Interface (GUI) – Harmony provides quick, easy access to all system features

system. The system interfaces are show in Figure F-3. The FAA's interfaces are defined as a de facto standard and are as follows: ADL is ASCII over TCP, ASDI is XML over TCP, NTML is HTTP over TCP, and ASDE-X is XML over JMS. The airline interface will be defined to be open to support any airline, and will be XML over JMS with OpenWire as the wire protocol standard. This enables the airlines to use different implementations of JMS. The SMS will use the ActiveMQ open source implementation from Apache.

All hardware and software components are industry-standard, with up-to-date versions, and comply with industry best practices.

F.1.1.5.9 Graphical User Interface (C.5.I)

The Harmony Graphical User Interface (GUI) is highly intuitive and provides quick, easy access to all system functions (Figure F-24). The user interface has a convenient and accessible menu system that provides access to all system functions, and is designed to minimize the use of submenus so that users do not have to select from nested submenus to find major system functions.

The menu bar is visible above all other windows and provides a quick mechanism to find and restore minimized windows. In the main toolbar there is an item called "Window" which contains a reference to all open windows for the user (Figure F-25). Another ease of use feature provided by the menu bar is a quick search function allowing the user to identify a specific flight in all windows by entering part of its callsign and flight number.

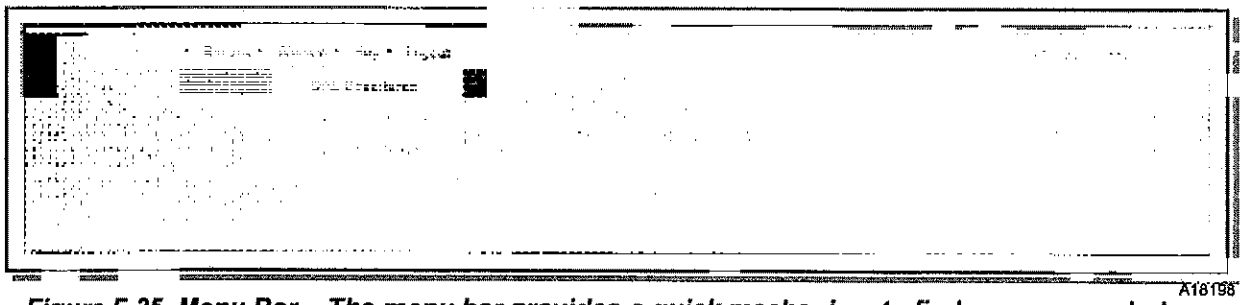

Figure F-25. Menu Bar – The menu bar provides a quick mechanism to find necessary windows and data

When data entry is required, the system performs dynamic validation of data entered and gives feedback on entered values (Figure F-26). This feedback is highlighted when incorrect data is entered. In this way, the system provides quick, convenient information back to the user to make user interaction with the system as simple as possible.

Throughout the interface, there is extensive usage of "tool tips" technology to provide helpful hints to the user; these hints appear as a user hovers the mouse pointer over command buttons within the interface. The Help menu in the main menu bar also provides convenient access to the User Guide so that users can quickly look up descriptions of system functionality or data.

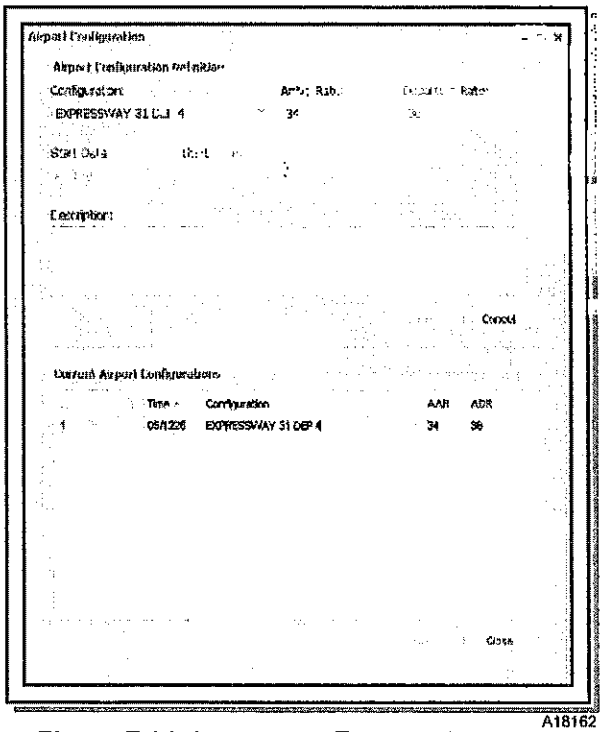

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Figure F-26. Data Entry Form – The system performs dynamic validation of user-entered data to ensure accuracy

F.1.1.5.10 Startup (C.5.J)

System startup is fully automated: each system instance within and between data centers start automatically and read local configuration files before entering the operational mode. Startup is controlled via scripts that ensure proper initialization and synchronization of all processes and servers. Upon completion of initialization, the system is ready to accept user connections via their browser.

As a web-hosted solution, system startup for users consists of logging in to the system via a supported browser with internet connectivity to the primary application server.

F.1.1.5.11 Shutdown (C.5.K)

System shut down refers to the process of stopping the SMS application in either the primary or backup data center. This will occur independently: when the primary system is stopped and the backup system is still running, the backup system will automatically become primary.

Shut down will occur in an orderly manner; file and database caches are written prior to shutdown to avoid loss of any pending changes to operational data.

Only authorized users (i.e., system administrator, application administrator) can command a system shutdown. Prior to stopping the system, they will send notification of the pending shutdown to all connected users.

As a web-hosted solution, user shutdown of the connected browser or corresponding workstation has no effect on the operation of the system for other users.

F.1.1.5.12 Change Management (C.5.L)

All design and development changes are tracked and maintained. We use an on-line database tool to track, report, fix, approve and verify changes to the application.

We will establish a Configuration Control Board (CCB) to manage change and ensure impact assessment and analysis of proposed changes to minimize impact on JFK users. The CCB will review and approve all change requests to the system, and approve new releases of the technical baseline. The CCB typically includes the program manager, lead system engineer, lead software engineer and quality assurance. Others members are included as needed and may include the technical director, architect, and operations manager.

Our change management process accommodates PANYNJ approval before development and deployment of new baseline capabilities.

As software errors are identified in the operational system, effective problem management is structured to ensure timely identification of the problem and the proper resolution to minimize adverse affects on the JFK users.

F.1.1.5.13 System Sizing (C.5.M)

The system is sized to meet current demand and is highly scalable to accommodate future demand. The hardware configuration is shown in Figure F-19 and is selected to meet latency, utilization and availability requirements as specified in Section F.1.1.6.

The application sever includes a separate instance of Tomcat for the Harmony server, presentation server, and report server as shown in Figure F-17. As demand increases in future years, these components may be distributed among several physical servers within the data center. Likewise, if additional utilization is required on the database servers, access to the archive database may be moved to a separate host in the data center.

The Harmony for Airline product deployed at LGA for Delta Air Lines currently supports 150 concurrent users, each with a 3-second update period. The bandwidth required for data inputs is 300 kbps for ASDE-X, 150 kbps for ADL, and 25 kbps for NTML. The bandwidth required for each user is 55 kbps. Given that metrics for this fielded product are readily available, the data can be used to scale the JFK solution to an appropriate size to meet both capacity and performance requirements with very little risk.

The JFK implementation is sized to support 400 concurrent users, and inputs corresponding to the operational traffic at JFK.

F.1.1.6 Performance Requirements (C.6)

F.1.1.6.1 General Performance Requirements (C.6.A)

The system consists of commercially available hardware and software elements, which are fully consistent with the system's design and operation. A proven implementation is currently deployed and operating at LGA for Delta Air Lines. Metrics from this existing system were used in sizing the servers and disk space for JFK to ensure that all performance requirements are met while the system operates under maximum loading with 400 concurrent users.

Raytheon has a long track record of developing complex, distributed systems with stringent response time and spare capacity requirements. Classic examples are in the air traffic control domain, but also in military communications and security. Our experience in these areas ensures our ability to perform an accurate analysis during the system design, to meet the following performance requirements:

- The user display is updated within 10 seconds of user request (except for reports).
- The application uses a maximum of 50% of random access memory and disk storage in the provided servers.
- The application uses a maximum of 50% loading on individual processors in the Raytheon-provided servers.
- The system supports 400 concurrent users on different workstations without any degradation of system performance.

F.1.1.6.2 System Availability (C.6.B)

The system uses a redundant, fault tolerant architecture with a required operational availability of 99.99%. The system architecture is described in Section F.1.1.5.3. An initial availability analysis was conducted using the specific hardware configuration, servers, and communication equipment planned for deployment.

The basis for this availability estimate is show in Figure F-27. Redundancy exists within the data center for communication links, and power, as well as between data centers. Redundancy also exists between communication links, routers, and switches within the JFK OC. The analysis accounts for three of five workstations being available at the JFK OC.

An end-to-end calculation of operational availability is shown in Figure F-28. This analysis conservatively assumes a 72-hour combined MTTR and MLDT. However, spares are planned at both data centers and the JFK OC to minimize down time and meet a 1-hour MTTR.

During periods of outages, disruption and maintenance, periodic status updates are emailed to approved users highlighting the impact to the service. See Section F.1.1.10.1.7 for a description of maintenance actions to correct any system outages.

F.1.1.7 Users and Training (C.7)

Raytheon delivers a comprehensive menu of training solutions and services based on proven training expertise and processes that help our customers achieve measurable operational advantages, improved readiness and enhanced performance, while optimizing efficiencies and reducing costs. Consequently, our capabilities and solutions are adaptable and scalable in order to meet the diverse training needs of the PANYNJ.

F.1.1.7.1 Types and Quantity (C.7.A)

We recognize that there are multiple user communities that will need training, including PANYNJ staff and up to 300 representatives of the various air carriers that operate at JFK. Our objective is to provide the

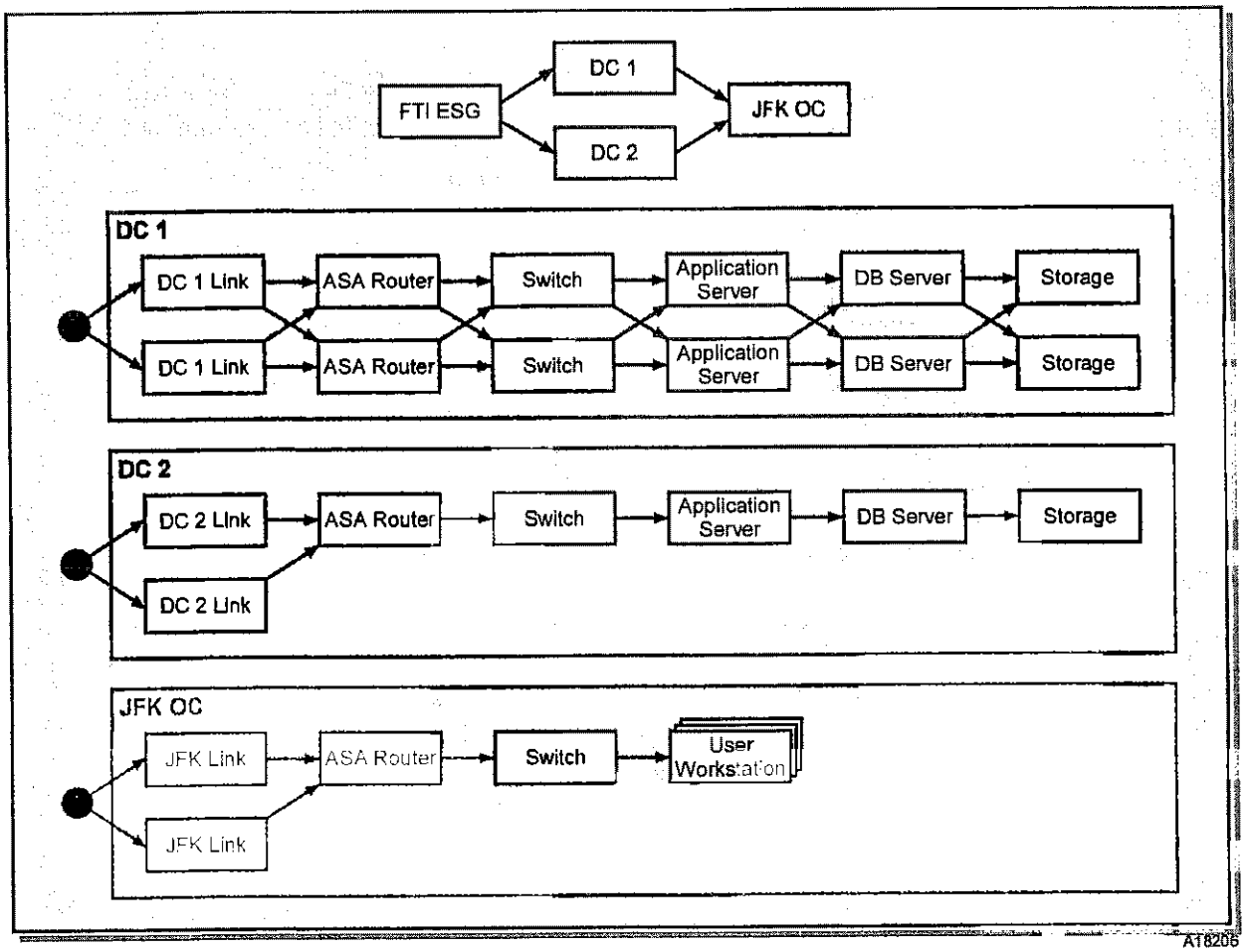

Figure F-27. Availability Block Diagram – Redundancy is provided within and between data centers

Facility	Item	Description	Redundant?	Availability	Cumulative Availability
DC 1	NL	Redundant links	-	0.999971900000	
	NF	Network ASA	Yes	0.999999788024	0.9999717
	NS	Network switch	Yes	0.999999947006	0.9999716
	ASAP	AS and software	Yes	0.999999216469	0.9999709
	DS	Database server	Yes	0.999999723564	0.9999706
	SS	SAN server	Yes	0.999999923993	0.9999705
	FP2	Redundant power	-	0.999999790283	0.9999703
DC 2	NL	Redundant links	-	0.999971900000	0.9999719
	NF	Network ASA	No	0.999558477237	0.9995304
	NS	Network switch	No	0.999788280129	0.9993188
	ASAP	AS and software	No	0.999114827302	0.9984342
	DS	Database server	No	0.999577380463	0.9980122
	SS	SAN server	No	0.999742923248	0.9977557
	FP2	Redundant power	-	0.999999790283	0.9977555
OC	NL	Redundant links	-	0.999971900000	0.9999719
	NF	Network ASA	Yes	0.999999788024	0.9999717
	NS	Network switch	Yes	0.999999947006	0.9999716
	WS5	Workstations (3 of 5)	-	0.999999591310	0.9999712
	FP2	Redundant power	-	0.999999790283	0.9999710
-	DC	Data centers	Yes	0.999999444171	0.9999994
	OC	JFK OPS center	No	0.999971016649	0.9999705

Figure F-28. Operational Availability – Our configuration meets the requirement of 99.99% easily using high quality components and redundancy

users community the necessary level of training with a range of options that can be exercised, as desired by the PANYNJ.

F.1.1.7.2 Training (C.7.B)

Our training approach develops course content and training as applied to the SMS configuration at JFK. We will provide an integrated training plan that specifically reflects and is tailored to the hardware and software configuration, and system operations at JFK.

For more details on our approach to training, see Section F.1.4.6.

F.1.1.7.3 Training Time Constraints (C.7.C)

On-site training will be completed prior to the 14-day operational tests.

F.1.1.8 Acceptance and Testing (C.8)

Raytheon is responsible for all test activities, and is supported by teammates as needed. Metron Aviation will provide inputs into the test plans and procedures, and RTSC will support the hardware installation and operational testing.

The overall test approach is shown in Figure F-29. Factory Acceptance Testing (FAT), Site Acceptance Testing (SAT) and Operational Testing of the initial system will be conducted using equipment in the primary data center. However, a test string in the backup data center is used for testing subsequent fixes and upgrades so that the operational system is not impacting by testing.

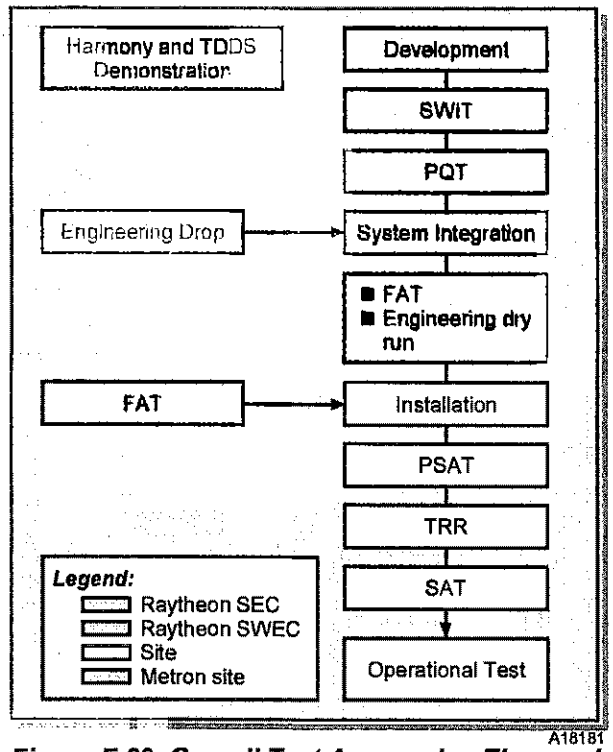

Figure F-29. Overall Test Approach – Thorough testing at every stage ensures a quality system that meets operational needs

System test is requirements-driven, employing four levels of testing as shown in Figure F-30. The test status (untested, passed, failed) for each requirement is maintained in a DOORS database to provide real-time test status to the test team and the PANYNJ. We follow standard QA processes and procedures certified to CMMI Level 5, and tailored to the JFK SMS program, to ensure quality. A pre-acceptance test plan will be established and used internally covering the factory, site and operational test stages.

To minimize risk, our plan is structured to establish an integrated system as early as possible and to verify that it meets all requirements. Tests that are planned to be executed multiple times (such as FAT and Site acceptance) will be staggered so that any issues can be found during the first conduct and procedures developed to avoid them at subsequent stages. All tests will be governed by the Acceptance Test Plan as approved by PANYNJ. When tests are ready to commence, the PANYNJ will be notified of schedules to allow them to witness the tests. Test results are documented by a formal test report submitted to PANYNJ in accordance with the RFP, and are subject to PANYNJ approval.

F.1.1.8.1 System Inspection and Tests (C.8.A)

Our Integration and Test Approach is as follows:

- Early verification of components and subsystems at Metron Aviation and at Raytheon
- Pre-Acceptance Testing of subsystems at both our facilities
- System Integration and Factory Acceptance Test of each system at the Raytheon facility in Marlborough, MA
- Installation and Integration at the data centers, verification of interfaces with existing FAA and airline systems
- Site Acceptance Test
- Operational Acceptance Test

Each test event is preceded by dry runs to verify procedures and test scenarios so that any issues may be corrected prior to formal test. The development flow and individual assignments for each function that need to be integrated are shown Figure F-16.

Pre-Acceptance Testing

The Pre-Acceptance Test Plan defines the activities and tasks needed to verify that all subsystems satisfy their allocated requirements, and work together as an integrated system that satisfies each Functional and Performance Requirement. The tests are executed per detailed test procedures. We will notify PANYNJ prior to the test and welcome them to attend the test.

Metron Aviation provided subsystems will be integrated and tested together at their facility using simulated FAA and airline interfaces. Once integrated and tested, Metron Aviation provided subsystems are

Test Level	Purpose
Pre-Acceptance Testing	Ensures system is ready for acceptance testing; all software and hardware components are tested individually, then integrated and tested as a system; an Internal Pre-Acceptance Test Plan and Procedures will be developed and employed by Raytheon Team during this phase
Factory Acceptance Testing	Ensures all functional and performance requirements are satisfied using equipment and configurations; this makes certain system is ready for site installation; system integration and testing occurs at Raytheon facility in Marlborough, MA; testing is conducted in accordance with PANYNJ-approved test plans and procedures
Site Acceptance Testing	Ensures system components, equipment and interfaces are properly configured at PANYNJ-approved data centers and system performs as intended; testing is conducted in accordance with PANYNJ-approved test plans and procedures
Operational Testing	Ensures system is operationally suitable for JFK SMS mission; key performance requirements are demonstrated (e.g., 400 simultaneous users, 16 simultaneous users can access system, 8 of which are remote); testing is conducted in accordance with PANYNJ-approved test plans and procedures

Figure F-30. Test Levels – Raytheon's proven formal test process ensures JFK SMS meets its mission objectives

shipped to the the Raytheon's facility in Marlborough, MA, for integration. Actual interfaces between Raytheon and Metron Aviation subsystems are tested using simulate system inputs. The integrated system pre-acceptance test will then be conducted at the Raytheon facility. The system interfaces to be simulated are shown in Figure F-3.

Acceptance Testing

An Acceptance Test Plan conforming to Raytheon Standards, and defining all Factory Acceptance, Site Acceptance and Operational tests for the data centers will be written and submitted to PANYNJ for comment and approval 21 working days prior to the scheduled start of the test.

Factory Acceptance Testing

The Factory Acceptance Test will be conducted per the approved Acceptance Test Plan and will cover the activities to be carried out using the actual system to be delivered. All major system components will be assembled and available for inspection and tested in accordance with the Test Plan. The system will be tested at the Raytheon facility using simulated inputs. Factory Acceptance Testing will be performed by team personnel and witnessed by PANYNJ. Following successful completion of the Factory Acceptance Test, the system is installed at the data centers and integrated with external systems.

Site Acceptance Testing

Site Acceptance Tests will be conducted per the approved test plan using equipment at the data centers. Site testing will repeat the Factory Acceptance Tests, but will exercise the complete system comprising all installed components plus the actual external interfaces that had previously been only simulated. Testing shall demonstrate end-to-end connectivity and include a stress test to demonstrate that the system meets its performance requirements. Raytheon has extensive experience installing new or replacement systems into airports and other operational facilities, and we understand that a new system's installation priority is always secondary to the facility's ongoing operations. Off-hour activities can be planned as needed to ensure a noninterfering installation. We have found that start-up activities can be accomplished using "listen only" feeds from existing devices, and we plan such an approach here.

F.1.1.8.2 14-Day Operational Test (C.8.B)

After Site Acceptance Testing, and with PANYNJ approval of the test report, Raytheon will begin a 14-day operational test at the data centers to demonstrate that the system meets the functional and performance requirements under full operating conditions. The Primary and Secondary servers will be active during each of these tests. As per the RFP, PANYNJ personnel will operate the system during the operational tests with support from our team as needed.

F.1.1.8.3 Submittal Requirements for Testing (C.8.C)

An acceptance test plan including individual test performed and corresponding test results, database reports, request for approval, certification of test results, and test report will be provided to the PANYNJ as described in the RFP.

F.1.1.9 Submittal and Documentation Requirements (C.9)

The integrated master schedule (IMS) includes the submittal and documentation requirements, enabling traceability and effective program control to reduce schedule risk

Documentation will be submitted to the Port Authority's Project Manager for project management, design, testing, operational documentation and plan submittals, and as-built drawings. These items are included in the IMS, and therefore are part of the program status and reporting.

F.1.1.9.1 General Submittal Requirements (C.9.A)

The Port Authority's Project Manager will have a minimum of 10 working days to review each submittal and resubmittal. The submittal format will be 8.5 inches by 11 inches, with the exception of such items as the IMS (project plan and schedule), and PERT charts which require a larger format.

F.1.1.9.2 Submittal Schedule (C.9.B)

Figure F-31 shows the submittal schedule. This schedule includes the quantity and frequency for each item as well as the delivery method. All durations are calendar days unless noted as working days.

F.1.1.10 Maintenance of the System (C.10)

Our maintenance plan is a broad system sustainment program that provides high quality and low risk life cycle support to the SMS users and facilitates continuous operations of the SMS system.

There are many facets of system maintenance and including both preventive as well as corrective maintenance activities in a nonintrusive and transparent manner to the users so as to provide full system availability to the Port Authority.

Our maintenance approach provides maintenance of SMS software and hardware supporting operations at JFK without any additional cost to the Port Authority such as parts, labor, shipping costs, etc. The highlights of the plan are:

- All maintenance operations are performed in a timely manner without compromising the operational availability of the system.
- All preventive maintenance operations are performed in a manner transparent to SMS users in terms of system performance.
- The maintenance operations cover all components of the system such as the hosted hardware, application software, networking and labor.
- A 24-hour/7-day on-call user support portal is provided consisting of telephone, email and fax contact information to enable JFK users to seek help on system usage and/or report operational issues.

F.1.1.10.1 Maintenance Requirements (C.10.A)

System maintenance commences immediately after successful completion of the 14-day acceptance test:

- ***Maintenance Period*** – Our maintenance plan will be in effect during the warranty period immediately after the operational acceptance signoff of the fully deployed SMS. This period can be optionally extended after the warranty period at an additional cost.
- ***Maintenance and Support Tasks*** – The maintenance and support tasks to be performed at contractor expense (parts, labor, tools, equipment, software, travel, signage, shipping costs, etc.) include (but are not limited to) the following:
  - Host, operate and maintain the system in a secure and protected environment in order to meet functional, performance and availability requirements
  - On-call remedial and scheduled preventive maintenance in order to meet the availability requirements
  - Correct defects in the furnished applications software
  - Apply and validate critical updates to COTS software to ensure that the system performs in accordance with requirements within 10 days after the vendor release patches and updates to the operating system, database and other third party software that used in the system
  - User support to administer the application
  - System administration (per RFP Exhibit 4)
  - On-call help desk support by telephone during 24 hours per day, 7 days per week
  - Update and test disaster recovery plan and procedures on an annual basis

Sequence No.	Title	SOW Paragraph No.	Frequency/Timing	Copy Quantity		
				Paper	Email	CD
A001	Project Plan and Schedule	IX B1	■ ***Phase A/B Submittal*** – Within 5 days after contract award; 10 working days to review	1	1	
A002	Progress Schedule Reporting	IX B2.1	■ ***Submittal*** – Every other week in Microsoft Project format		1	
A003	Status Meeting Agenda and Report	IX B2.3	■ ***Submittal*** – 48 hours prior to status meeting (at least weekly)		1	
A004	System Diagrams	IX B3	■ ***Preliminary Submittal*** – Within 21 days after contract award; 10 working days to review ■ ***Final Submittal*** – Update and submit after review; 10 working days to review/approve ■ ***As-Built Submittal*** – Within 10 working days of completion of Phase A/B system acceptance test as identified in IMS	6	1	
A005	Security Practices and Policies	IX B4	■ ***Phase A/B Submittal*** – Within 10 days after contract award; 10 working days to review ■ ***As-Built Submittal*** – Within 10 working days of completion of Phase A/B system acceptance test	6	1	
A006	System Documentation	IX B5	■ ***Preliminary Submittal*** – Within 10 days after contract award; 10 working days to review ■ ***Final Submittal*** – Update and submit after review; 10 working days to review/approve ■ ***As-Built Submittal*** – Within 10 working days of completion of Phase A/B system acceptance test as identified in IMS	6	1	
A007	System Hardware Documentation	IX B6	■ ***Preliminary Submittal*** – Within 21 days after contract award; 10 working days to review ■ ***Final Submittal*** – Update and submit after review; 10 working days to review/approve ■ ***As-Built Submittal*** – Within 10 working days of completion of Phase A/B system acceptance test	6	1	
A008	Operations Manual	IX B7a	■ ***Preliminary Submittal*** – 10 working days to review ■ ***Final Submittal*** – Update and submit after review; within 21 calendar days prior to start of Phase A/B system acceptance test; 10 working days to review/approve ■ ***As-Built Submittal*** – Within 10 working days of completion of Phase A/B system acceptance test	6	1	
A009	Application Administration Manual	IX B7b	■ ***Preliminary Submittal*** – 10 working days to review ■ ***Final Submittal*** – Update and submit after review; within 21 calendar days prior to start of Phase A/B system acceptance test; 10 working days to review/approve ■ ***As-Built Submittal*** – Within 10 working days of completion of Phase A/B system acceptance test	6	1	
A010	System Administrator's Manual	IX B7c	■ ***Preliminary Submittal*** – 10 working days to review ■ ***Final Submittal*** – Update and submit after review; within 21 calendar days prior to start of Phase A/B system acceptance test; 10 working days to review/approve ■ ***As-Built Submittal*** – Within 10 working days of completion of Phase A/B system acceptance test	6	1	
A011	Disaster Recovery Plan	IX B8	■ ***Preliminary Submittal*** – Prior to completion and acceptance of Phase A/B system acceptance test; 10 working days to review ■ ***Final Submittal*** – Update and submit after review; 10 working days to review/approve	6	1	

Figure F-31. Submittal Schedule – This schedule identifies the quantity, frequency and delivery method for each submittal, providing timely insight into project accomplishments

Sequence No.	Title	SOW Paragraph No.	Frequency/Timing	Copy Quantity		
				Paper	Email	CD
A012	Audit Report (SAS70)	IX B9	■ ***Phase A/B Submittal*** – Prior to the completion and acceptance of Phase A/B system acceptance test; 10 working days to review	6	1	
A013	Training Plan	IX B10a	■ ***Preliminary Submittal*** – 10 working days to review ■ ***Final Submittal*** – Update and submit after 1st review; not less than 21 days prior to intended start of training; 10 working days to review	9	1	
A014	Training Materials	IX B10b	■ ***Preliminary Submittal*** – 10 working days to review ■ ***Final Submittal*** – Update and submit after 1st review; not less than 21 days prior to intended start of training; 10 working days to review ■ ***As-Built Submittal*** – Within 10 working days of completion of training as identified in the project schedule	6		1
A015	Training Report	VII B	■ ***Phase A/B Submittal*** – Upon completion of training programs	1		
A016	Change Management Form and Procedures	IX B11	■ ***Phase A/B Submittal*** – Prior to start of the 14-day operational test; 10 working days to review; Raytheon will provide standard change management plan	6	1	
A017	Database Documentation	IX B12	■ ***Preliminary Submittal*** – 10 working days to review ■ ***Final Submittal*** – Prior to start of 14-day operational test; 10 working days to review/approve ■ ***As-Built Submittal*** – Within 10 working days of completion of Phase A/B system acceptance test as identified in IMS	6	1	
A018	Acceptance Test Plan	VIII C1	■ ***Preliminary Submittal*** – 10 working days to review ■ ***Final Submittal*** – Not less than 21 days prior to start of Phase A/B system acceptance test; 10 working days to review/approve	6	1	
A019	Acceptance Test Procedures	VIII C2	■ ***Preliminary Submittal*** – 10 working days to review ■ ***Final Submittal*** – Not less than 21 days prior to start of Phase A/B system acceptance test; 10 working days to review/approve	6	1	
A020	Pre-Acceptance Test Report	VIII C6	■ ***Phase A/B Submittal*** – Not less than 10 calendar days prior start of Phase A/B system acceptance test	6	1	
A021	Acceptance Test Report	VIII C7	■ ***Phase A/B Submittal*** – After completion of Phase A/B system acceptance test; 10 working days to review	2		
A022	Schedule of Preventive Maintenance	X A4.3	■ ***Phase A/B Submittal*** – 14 days prior to warranty start date; 10 working days to review ■ ***Future Submittals*** – 1 year after previous (on anniversary); 10 working days to review	6	1	

Figure F-31. Submittal Schedule – This schedule identifies the quantity, frequency and delivery method for each submittal, providing timely insight into project accomplishments (continued)

- ***Operational Availability*** – The maintenance plan is designed to provide operational availability that exceeds 99.99% with a MTTR of critical component failures of less than 1 hour and on-site spares to avoid any MLDT. Critical components are defined as any component within the system in which the failure will result in the system not providing service any of the JFK users. For the five workstations provided for operator use in the JFK OC, three of five must be operational at all times. A MTTR of 72 hours with on-site spares is used to minimize support cost to the Port Authority.

- ***Maintenance Work*** – We will submit to the Port Authority Project Manager a schedule of preventive maintenance activities and description of preventive maintenance procedures 14 days prior to the Warranty Start Date, and annually thereafter. Upon acceptance by the Port Authority's Project Manager the scheduled maintenance work will be initiated.

  We will be responsible for purchasing and maintaining sufficient spare parts for maintenance throughout the contract period. All maintenance work will be performed by qualified personnel selected and trained by Raytheon and its partners.

At the end of each preventive maintenance period, we will submit an action summary report highlighting what maintenance was performed and the final status to Port Authority.

- ***Maintenance Description*** – All maintenance will be performed in accordance with the equipment vendor's maintenance directives. All inspections, diagnostics and repairs will be reported to the Port Authority contracts manager in the standard format. The maintenance performed includes:
  - Scheduled Preventive Maintenance – All necessary actions to correct system malfunctions and restore it back to normal operations will be performed by Raytheon and its partners. All necessary actions to prevent future failures, to extend life of the system, disk maintenance, backup and preservation of log files, and review of log files will be performed during preventive maintenance operations.
  - On-Call Remedial Maintenance – The preventive maintenance plan provides for a portal with contact information including telephone number and email address for the JFK users to report issues or problems with system. This portal will be staffed 24 hours a day, 7 days a week throughout the contract period.

    Within 24 hours of each reported on-call problem, Raytheon will provide written documentation of the reported problem and all actions performed related to the maintenance call to the Port Authority.

    Raytheon and its partners, with the help of electronic issue management software, will track the issue as it proceeds towards resolution. As soon as the malfunction is reported by the user via the customer support portal, an initial notification of a potential corrective action will be electronically sent to the Port Authority program manager.

    Raytheon and its partners will deploy trained personnel to resolve the issue. If the resolution needs to be implemented by the end user, an electronic document indicating how to implement the corrective action will be transmitted to Port Authority and the user.

    If the corrective action requires testing to validate the resolution, we will send the final test report to the Port Authority before installing the correction to SMS.
  - Error correction, system diagnostics and system repairs
- ***Loss of Service*** – When a system failure or outage results is loss of service, we will dispatch trained personnel to diagnose, debug, repair, replace and correct any malfunctioning components to restore full operations within the time(s) stipulated in Section F.1.1.10.3.3.
- ***Error Correction*** – Errors due to flaws in the design and coding of the application software, or supporting COTS software, will be investigated, fixed, and tested. If the error results in a loss of service, the malfunctioning software component will be patched within the time(s) stipulated in Section F.1.1.10.3.3.

  The corrected software will be tested using the additional test string using both simulated, and operational data where feasible, so as to not interfere with normal operations. We then will prepare a test report and submit it to the Port Authority for review and approval before the corrected software is installed into the SMS baseline.

F.1.1.10.2 Time to Respond (C.10.B)

We will contact the Port Authority program Manager within 15 minutes of a malfunction being reported through Raytheon's on-call support portal. This time period is independent of time to repair indicated in Section F.1.1.10.3.

F.1.1.10.3 Time to Repair (C.10.C)

We will correct issues with the system as follows:

- ***On-Call Remedial Maintenance*** – We will respond, correct and return the system to full operations within 60 minutes from the time a loss of service is reported through the on-call portal. This time period is includes the time to respond identified in Section F.1.1.10.2.
- ***Validate and Correct Applications Software with Patches and Updates to Third Party Software*** – We will apply and validate critical software patches to third party software used by the system to ensure that the SMS system performs in accordance with the requirements. These critical patches and updates will be applied within 10 business days after they are made available by the COTS software providers.
- ***Error Correction*** – Raytheon and its partners will deploy trained personnel and complete application of COTS software patches and updates within 10 business days from the date of notification of SMS system malfunction. The application of COTS software patches and updates will consist of activities to diagnose, debug, test, repair, replace and correct all malfunctions required for the system to perform in accordance with the requirements.

F.1.1.10.4 Failure to Meet Service Level Agreements (C.10.D)

F.1.1.10.4.1 Failure to Repair (C.10.D.1)

Raytheon guarantees that it can and will obtain the operational availability at or above the percentages stipulated and will complete the on-call remedial maintenance within the time(s) stipulated for repairs to maintain operational availability of the overall system. This does not include repair of failed components that are redundant.

F.1.1.10.4.2 Failure to Correct Error (C.10.D.2)

Raytheon guarantees that it can and will obtain the operational availability at or above the percentages stipulated and will complete the error correction(s) within the time(s) stipulated for correction of those errors required to maintain operational availability of the overall system. This does not include correction of errors that do not affect system availability.

F.1.1.10.4.3 Failure to Validate and Correct Third Party Software Patches and Updates (C.10.D.3)

Raytheon agrees that it can and will obtain the operational availability at or above the percentages stipulated and will update and validate COTS software within the time(s) stipulated for validation and correction of third party software patches and updated where the patch is necessary to maintain correct system operation or fix critical security vulnerabilities.

F.1.1.10.5 Upgrades and Enhancements (C.10.E)

The Maintenance Plan provides for 10-day electronic notice to the Port Authority regarding application of patches and upgrades to third party software. The notice will outline the upgrade/patch procedure and indicate any potential disruptions due to that procedure. It will also indicate consequence of nonapplication of the upgrade/patch to SMS continuous operations. All upgrades/patches will be performed after approval by the Port Authority.

All upgrades to SMS application software will be sent to the Port Authority electronically 10 days in advance. This notice will contain:

- Description of the work to be performed
- Duration the upgrade process
- Change in functionality of SMS, if any
- Estimated change in SMS performance, if any

The work will commence 24 hours after approval by the Port Authority.

This approach is also applicable to upgrades that are priced options or supplemental work released during SMS contract period.

F.1.1.10.6 Supplemental Work (C.10.F)

Our Team has the depth of knowledge and resources necessary to enable timely responses and execution of all requests for Supplemental Work. When requested by the Project Manager, the Port Authority can expect a concise, well-timed response that includes a description of the work to be performed, detailed labor estimates by labor category, lump sum price, schedule for the work, and an analysis of the potential impact to the system performance and operations.

F.1.1.10.7 Hours of Scheduled Maintenance (C.10.G)

Any scheduled preventative maintenance will be performed between the hours of midnight and 0500 ET. Users will be notified in advance of any scheduled maintenance. When scheduled maintenance is performed, affected user will be notified when the maintenance starts and when the maintenance has concluded and normal system operation restored.

F.1.1.10.8 System Administration (C.10.H)

System administration includes routine operations and monitoring of the system components, as well as implementation of corrective actions necessary to correct failures or avoid loss of service.

Routine operations include monitoring the system for faults and that components are operating within utilization thresholds. It also includes data replication, data archiving, and scheduled software upgrades, such as operating system, database, and application software upgrades and security patches.

System Monitoring

The SMS system is monitored by Raytheon personnel on a round-the-clock basis. Two aspects of the system are monitored:

- Operational health
- System performance

As a part of operational health monitoring, individual components such as servers, storage and networking equipment are monitored and health information is continuously written to log files. Faults and exceeded thresholds are displayed to the operator and sent as email to on-call staff. Logged health data is reviewed on a daily basis for anomalies and appropriate corrective actions are taken, if necessary.

Both data centers are continuously monitored for environmental status, such as temperature, humidity and quality of power. When necessary, corrective action will be executed to clear the anomaly and avoid loss of service.

We will provide reports of system performance on a monthly basis. These reports identify issues encountered and corrective actions performed.

Support Portal

Raytheon will provide a 24-hour/7-day user support portal through telephone, email and fax for routine operational requests such as resetting passwords and adding new users. These system administration requests will be completed in a timely fashion as specified in the SLA.

User Accounts

We will maintain and manage the list of authorized users of the SMS at JFK. Additions, deletions and changes to this list can be effected by the Port Authority by contacting Raytheon through the SMS user support portal.

Security Monitoring

Raytheon actively monitors the system for security violations and affects a remedy immediately. All attempted security violations are logged and made available to the Port Authority for perusal on a monthly basis.

Maintenance Quality Audit

Raytheon, in cooperation with its partners, reviews maintenance work performed on a periodic basis to ensure the work is performed in accordance with the terms of the contract including compliance with and at a level consistent with acceptable industry's best practices.

Service Level Agreement Compliance

In order to comply with the Service Level Agreement (SLA) of the contract, we review work performed against the SLA clauses. We provide audit reports of these reviews to Port Authority on a monthly basis.

F.1.1.10.9 Training (C.10.I)

We provide supplemental on-site refresher training, scheduled to occur twice a year as requested by the Port Authority, using training material provided as part of the initial training, consisting of approximately 100 hours of training each 6 months. Refresher training is also offered to users working in the airline industry in accordance with the approved training plan for off-site users.

Our approach to training is described in more detail in Section F.1.4.6.

F.1.1.10.10 Disaster Recovery (C.10.J)

The Disaster Recovery Plan (DRP) for the SMS mitigates service disruptions due to a catastrophic event by establishing procedures for continued operations using redundant data centers, located in separate regions of the country (Boston and Houston), with diverse connectivity to multiple internet backbones.

The DRP uses a multilayered disaster recovery framework well suited for remote service providers of mission critical services that is transparent to disasters, both natural as well as manmade. It categorizes disruptions in a hierarchy so that each type of disruption can be addressed by a specific solution. Figure F-32 shows this hierarchy and its constituents.

Disaster Recovery Plan Summary

The SMS servers are hosted at Tier 3 data centers that are specifically designed to protect against natural disasters such as fire, floods, storms, etc. They are also protected using special security measures to

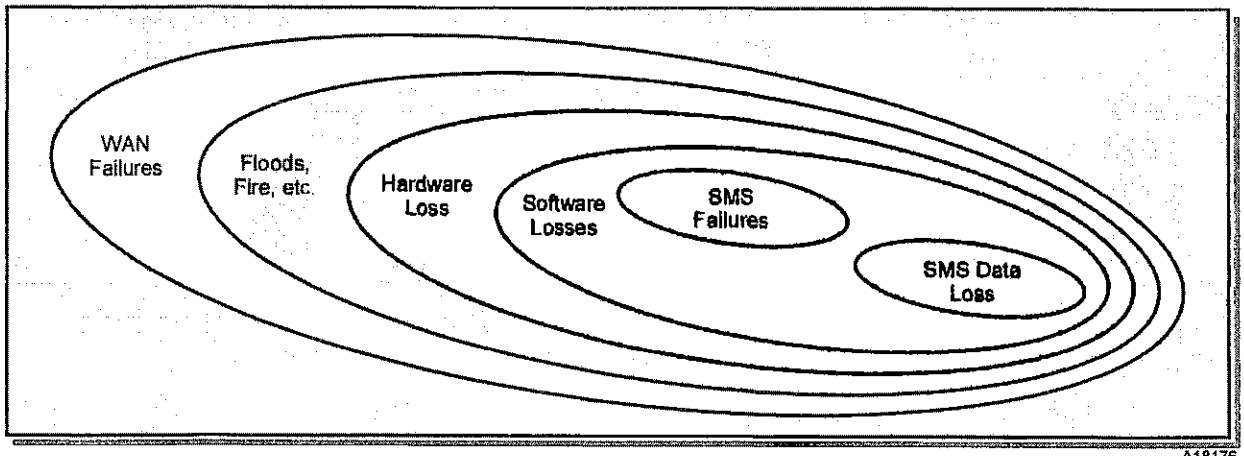

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Figure F-32. Disruption Hierarchy – Our Disaster Recovery Plan categorizes disruptions so that each may be addressed appropriately

prevent manmade catastrophes. The security measures include 24x7 manned main access, biometric authentication, mantraps, etc. The data centers also provide high available power and environmental controls.

One complete SMS with redundancy is provided in the primary data center, while an additional system is provided in the backup data center. In the unlikely event that one data center is destroyed, or there is a complete hardware failure of the primary system, the backup system will automatically take over providing near-continuous operations for the JFK users. To avoid data loss on failover, the databases are replicated between sites.

DRP Features

Features of the DRP are:

- The DRP indicates how different types of natural and manmade disasters are addressed using industry standard methodology to facilitate use of well-known and common disaster recovery procedures.
- Specific corrective procedures targeted for different disasters are described, including qualification of the personnel involved in these procedures, their roles and responsibilities.
- The preventive procedures, such as periodic SMS data backup, are described along with their periodicity, including resources needed to execute these procedures.
- The DRP contains a Business Impact Analysis that provides the maximum data disruption and time-to-restore full functionality and identifies alternative business continuity means
- A Personnel Management structure, containing roles to be played by different people in procedures and their minimum skill level and/or technical qualification.
- The DRP provides data recovery in case of disaster with a backup system which enables transaction integrity upon failover
- The DRP will be annually updated to ensure that it stays current with respect to equipment, training level of personnel and is tested to ensure that it effectively addresses any disaster.

DRP Organization

While the system is designed to be fault tolerant and redundant so minimize the effect of component failure, the DRP will prepare the Port Authority for catastrophic failure. We will work with the Port Authority to review the possible disaster scenarios and severity levels, analyze their potential effects on the system, and develop plans to ensure Port Authority can quickly recover the operations even from the most catastrophic situations.

We will work with the Port Authority to outline contingency plans to mobilize maintenance personnel, equipment, materials and spare parts to rapidly affect repairs that might be required in a situation where the system is completely or partially disabled due to an event or disaster.

The general organization of the plan will be as follows:

1. Purpose
   a. Goals and objectives of the plan
   b. Benefits
2. Scope of the plan
   a. Planning assumptions
   b. Facilities and resources included in the plan
3. Nomenclature
   a. Recovery terms
   b. Definitions and acronyms

4. Disaster severity definition
   a. Catastrophic
   b. Serious
   c. Major
   d. Limited
5. Operations recovery procedures
   a. Time frames in which essential operations and business functions must be resumed
   b. Sequence of operations recovery events and individuals responsible for activity including specific activities required for particular levels of disaster severity, including:
      i. Notifications
      ii. Preliminary evaluation
      iii. Activate operations recovery personnel
      iv. Coordinate with emergency personnel
      v. Evaluate recovery options and issue detailed directives
      vi. Assigned tasks
      vii. Project schedule/timeframe
      viii. Coordination required
      ix. Identify any required relocation activities
      x. External/internal status updates
      xi. Escalation procedures
6. Identify items required for backup of critical functions, including:
   a. Alternate work sites
   b. Hardware/software
   c. Personal computers
   d. Necessary software packages
   e. Documentation
   f. Peripherals
   g. Databases
   h. Emergency equipment
   i. Communications
   j. Transportation
   k. Supplies
   l. Security
   m. Operations and procedures manuals
7. Office/facility business site restoration procedures
   a. Assess damage
   b. Identify restoration responsibilities
   c. Develop restoration plan/time frames
8. Business Resumption Plan (BRP) update procedures
   a. Responsibility for updating and communicating BRP changes
   b. Frequency of review/update

Testing

The DRP is rigorously tested by Raytheon with fully deployed equipment. The disaster recovery procedures, designed for the express purpose of mitigating risk, are exercised to ensure each fulfill the overall disaster recovery requirements.

F.1.2 Preventive Maintenance

A comprehensive preventive maintenance plan, including plans for actively monitoring and reporting system performance and key component failures is described in Section F.1.1.10.

F.1.3 Requirements Compliance

A matrix of requirements that will be fully implemented, partially implemented or not implemented, along with explanation and rationale are included in Figure F-33.

F.1.4 System and Service Features

F.1.4.1 Data Centers

Our data center provider, Internap, is an industry leading expert who combines secure SAS 70 Type II facilities, N+1 redundancy for power and cooling, along with patented robust network backbone technology, to provide the best value and lowest risk for hosting the JFK SMS.

Each data center location is physically secured and manned 24x7, with trained security professionals. Physical access to the data center facilities, computer equipment, media and documentation is limited to properly authorized individuals. A layered physical security approach is employed from the use of CCTV monitors, electronic keycards with pin codes, biometric scanners and man-traps as well as secure enclosures for the system hardware. The data center facilities are maintained and monitored for acceptable operating conditions including fire protection, cooling, humidity and electrical backup systems. The data center locations are also SAS 70 Type II audited to ensure that the facilities have the proper security, environmental protection and policies and practices in place. Additional information on security is addressed in Section F.1.1.5.2.

Fully redundant power is provided at each data center location, with Power Distribution Unit diversity, independent AC systems, battery backup, Uninterruptible Power Supply (UPS) and on-site generators with guaranteed fuel contracts. Additionally, the N+1 design for both power and cooling enables uninterrupted service by safeguarding against equipment failure.

Our data center provider, Internap, has an extremely robust network backbone. Internap's Performance IP, based on their patented Managed Internet Route Optimizer™ (MIRO) technology service, uses a multiprovider approach, to determine the most efficient route across up to 11 major internet backbones. This level of backbone redundancy, performance and value is unmatched by other data center providers. It allows our solution to provide highly reliable connectivity with consistent low latency to the JFK users.

The data center locations have been selected such that they are diversely located to support disaster recovery operations. In the event that there was a disaster at the primary facility, operations would resume using the backup site. The proposed location of the primary data center is at Internap's Boston, MA, facility. In addition to the features already discussed, this site is in close proximity to Raytheon's Marlborough, MA, facility, enabling fast on site engineering response should the need arise. For geographical diversity, the backup data center is proposed to be located in Internap's Houston, TX, facility.

In addition to all the redundancy and fault tolerance designed into the data center and network architecture, the core system itself uses a fault tolerant architecture which is further described in Section F.1.1.5.3.

F.1.4.2 Services Provided

A detailed description of the service provided is described in Section F.1.1.4.3.

Requirement Paragraph	Requirement Text	Compliance	Compliance Comments
C.1.A	Summary of Services	Full	-
C.1.B	References	Full	-
C.2.A	Implementation Schedule	Full	-
C.2.B	Base Date of Operational Use	Full	-
C.3	Requirements for Staffing	Partial	Staffing plan does not include option for FCC-licensed operator to interface via radio with aircraft due to liability concerns with providing direction to operational aircraft.
C.4.A	General Description of Services	Full	-
C.4.B	Description of Work	Full	-
C.4.C.1	Departure management capability utilizing rationing principles	Full	Rationing principals will be based on existing FAA TFMS and Metron traffic flow products updated to address specifics of SMS needs.
C.4.C.2	Allocate "call-for—taxi" times (CFT's) based on set rules and protocols using rationing principles and calculation under the guidance of the Port Authority.	Full	CFT determinations specific to SMS requirements will be based on Metron experience with Harmony for Airlines surface predictions and FAA TFMS and Metron Traffic Flow rationing principles.
C.4.C.3	Automatically populate scheduled flight information through a Port Authority approved source, such as ETMS (Enhanced Traffic Management System) into the departure management capability of the System. Additionally, the Service shall have the capability to manually input and add flights, which are not automatically populated. Such type flights may include non-scheduled, ad hoc, ferry flights and general aviation flights.	Full	Primary source will be ADLs. A web-based capability will also be provided for aircraft operators to bulk upload flight schedule data (create, modify, cancel) to increase advance notice about operations. A single flight create option for manual additions will also be provided.
C.4.C.4	Automatically populate a "call-for-taxi" time based on Port Authority approved parameters.	Full	CFTs as derived from Requirement IV-C.2 will be provided to users via web displays.
C.4.C.5	As conditions and demand require, monitor and process substitution requests for eligible flights based on Rationing principles and other variables deemed appropriate by the Port Authority.	Full	System will provide capability for an airline to cancel their flights, make substitutions or swaps of flights they have control over, and reuse canceled slots.
C.4.C.6	Provide an interface enabling instant communication, textual and otherwise, with all parties (i.e. a chat function) for information sharing or another Port Authority approved method.	Full	A highly customizable COTS chat server (OpenFire) that can provide secure communication sessions will be provided.
C.4.C.7	Gain knowledge of and distribute the forecasted operational plan for the airport, airspace, expected arrival and departure rates and runway usage, expected/known delays, weather forecast, and challenges either by participation in strategic teleconference with the FAA or an approved equivalent source.	Full	The processing of NTML will automatically populate airport configuration, ADR, AAR, and departure restrictions. Support personnel will monitor the FAA strategic teleconference and the NTML-determined values to validate and update as appropriate.
C.4.C.8	Monitor status of departure queues by runway and departure fix, and current taxi-out times, then predict and mitigate imbalances prior to development.	Full	CFT times determined by the Departure Management function are the result of prediction and mitigation of imbalance. Mitigation is performed by holding flights at the gate or the use of the holding areas. Updates to the predictions based on aircraft operator input, ASDE-X, and ASDI represent the monitoring component, and periodic updates to the CFTs incorporate the latest predictions in the solution.

Figure F-33. Compliance Matrix – Our proposed solution meets the Port Authority operational needs

Requirement Paragraph	Requirement Text	Compliance	Compliance Comments
C.4.C 9	Provide a graphical, dynamic, user-friendly snap shot indicating the actual and forecasted departure demand of the airport. This graphic shall include current and forecasted, configurable delay criteria.	Full	"Configurable delay criteria" is associated with the graphic of current and forecasted delay. Since delay can be measured by a variety of metrics, we will offer user interface mechanisms to select the delay metric and reference of interest to the user. For example, the reference could be the gate, runway, or departure fix, and the metric could be based on comparisons of any of the following: CFT algorithm based control time compared to the initial schedule information used in the rationing; CFT algorithm based control time compared to the latest estimates provided by the airlines or derived from ASDE-X data; actual event compared to control time; and actual event compared to initial schedule information used in the rationing.
C.4.C.10	Monitor aircraft that are experiencing excessive time off the gate or stand and provide configurable alerts to notify the flight operator or other approved User of the flight status.	Full	-
C.4.C.11	Provide carriers access to current taxi delays. This is to assist in gate planning decisions regarding whether to take departure delays at the gate or in a metering location.	Full	-
C.4.C.12	Recommend departure delay parking locations as requested by ramp controllers ("metering" locations are subject to approval by the Port Authority). An example of the metering locations is provided in Exhibit 7, Available Holding Spots Overall, The "metering locations" provided in Exhibit 7 are subject to change.	Full	The Departure Management algorithms to determine CFT include the use of Holding Areas to allow aircraft to start taxiing away from the gate without heading to the departure queue. The algorithm uses the holding areas based on configurable parameters for the amount of arrival gate overlap allowed before using the holding area, adaptation for holding area assignment based on gate and departure runway, the maximum number of aircraft allowed in the holding area, and the desired maximum length of the departure queue for each runway.
C.4.C.13	If departure delay is taken at the gate, movement area metering location, or other non-movement area metering location, continue to actively manage flights in the program.	Full	-
C.4.C.14	Data and shared information shall be warehoused and made easily accessible and available for retrieval, analysis and playback.	Full	Playback will be performed by a separate Server with a different URL (which is a separate system instance) from "real-time" service. Stored surveillance data will be replayed.
C.4.C.15	The System shall provide the capability to view live, current data and archived, warehoused data, both on separate screen displays and in reports.	Full	-
C.4.C.16	Provide live flight tracking of inbound and outbound flights from the surface to 10,000 feet and within a 100-mile radius of the airport for 15 Port Authority Users.	Full	ASDI data feed will be used for full 100 mile radius.

Figure F-33. Compliance Matrix – Our proposed solution meets the Port Authority operational needs (continued)

Requirement Paragraph	Requirement Text	Compliance	Compliance Comments
C.4.C.17	Automate alerts for critical events such as: aircraft arriving at key locations both Enroute and/or on the ground (such as a metering location or arrival fix), arrival aircraft assigned to a gate that is currently occupied, and when the taxi time of an aircraft exceeds a user—defined number of minutes. Users shall select the method of notification, to include, but not limited to: on screen display highlighting the aircraft that triggered the alert condition, audible workstation alarm and electronic methods such as email, text message, etc.) to an individual or groups.	Full	Alerts for arrival fix crossing will be based on the ASDI feed. Alerts for arriving at a Holding Area will be provided based on use of ASDE-X data. The Aural alert will work only if user has aural-capable Browser.
C.4.C.18	Provide a Graphical User Interface displaying surface surveillance. This feature shall display real-time information and have historical playback capability.	Full	-
C.4.C.19	The system shall automatically retrieve published airline schedules from a Port Authority approved source for 48 hours in advance of the current time and should save any changes i.e. cancellations, time changes, etc.) input by the Users. The Airline schedules shall be displayed in an orderly manner, based on the scheduled time of departure.	Full	Data is initially retrieved automatically from ADLs. The system will provide aircraft operators with a web-based flight schedule bulk upload capability to support up dates to data 48 hours in advance.
C.4.C.20	The Users shall have the capability to input a time reflecting the earliest time that an aircraft can be ready to taxi for departure. The System shall receive this information and allocate taxi times respectively.	Full	-
C.4.C.21	The Users shall have the capability to swap flights under their control to self-prioritize based on the rationing principles set forth.	Full	-
C.4.C.22	Warehouse and make easily accessible data and shared information as presented in the Metrics section of this document, to produce approved, appropriately designed reports.	Full	System will warehouse all data required for reports as described in the proposal.
C.4.C.23	Use any other supporting tools provided for use by the PANYNJ, FAA, Air Carriers, Terminal Operators or other Users deemed appropriate by the Port Authority.	Full	As clarified by the Port, FIDS will be used as a supporting tool for schedule data.
C.4.C.24	The system shall provide the capability to add flights to the schedule. Examples of such flights include but are not limited to non-scheduled, ad hoc, ferry flights and general aviation flights.	Full	In addition to a flight schedule upload capability for bulk create/ modify/cancel of flights, the system will support a single flight creation function.
C.4.C.25	Support and Maintain adherence to the Code of Conduct established by the Port Authority.	Full	This is purely a process requirement.
C.4.C.26	Conduct quarterly meetings to review said Code of Conduct and support changes.	Full	-
C.4.C.27	Attend, participate in and support User Interface meetings on a bi-weekly basis at JFK.	Full	Changes recommended by User Interface meetings must go through a formal change request process prior to implementation.
C.4.C.28	Provide 24 x 7 User support to provide information regarding system functionality and troubleshooting.	Full	-
C.4.C.29	Administer new Users.	Full	-
C.4.C.30	Track and report service irregularities to the Port Authority and Port Authority authorized recipients. Describe the process for reporting, tracking and resolving problems encountered by Users.	Full	-
C.4.C.31	Terminology and nomenclature used to describe the data elements in the Service shall support interoperability with current Surface Management Systems to the extent practical and shall be approved by the Port Authority.	Full	-
C.4.C.32	Issue Daily Summaries of the operation including the following information: weather, runway configuration, ATC programs, hourly snapshots of the number of aircraft in the departure queue(s), hourly stats (i.e. number of actual departures and arrivals vs. the three-month average), list of non-compliant aircraft, and Summary of the operation.	Full	Daily Summaries will be a "Report" component that will be created based on the daily data.

Figure F-33. Compliance Matrix – Our proposed solution meets the Port Authority operational needs (continued)

Requirement Paragraph	Requirement Text	Compliance	Compliance Comments
C.4.D.1.a	Forecast airport capacity and demand information for the JFK operation and surrounding airspace in a rolling time window, for a minimum of four hours ahead.	Full	This is a mix of automatic and manual processes as described in C.4.C.7.
C.4.D.1.b	Provide alert notifications that correspond to specific operational events.	Full	Alert specifics are detailed later.
C.4.D.1.c	Automatically alert Users when there is an expected imbalance between capacity and demand for both arrival and departure traffic. User shall have the ability to configure whether the alert is visual, aural or both.	Full	Aural alert will work only if user has aural-capable Browser.
C.4.D.1.d	Provide a 'chat' function or other approved means of facilitating instantaneous communication between Users.	Full	See C.4.C.6.
C.4.D.1.e	Have a feature to provide instant replay of specified historical time periods, synchronizing both surface surveillance, chosen local radio frequencies, and the respective time frame of the taxi time allocation and chat functions. The System shall have the capability to save a copy of the recorded playback in a MPEG-2 format.	Partial	The playback functionality is via a separate URL to the 15 users licensed for flight tracking software. Recorded data inputs are replayed for surveillance along with chat. Since we will not include staff to operate a "Metering Frequency," we believe voice recording is not relevant to the operational SMS mission, so radio playback is not included in the replay capability.
C.4.D.1.f	Contractor shall develop a performance measure, "Scorecard" to facilitate assessment of overall airport operational performance and the performance of individual Users. This Scorecard shall assess accuracy and timeliness of shared data and performance including routine compliance measurement/analysis. The format and content of this Scorecard shall be proposed by the Contractor and approved by the Port Authority.	Full	Scorecard is a "Report" component. Raytheon will propose a format, accept Port Authority comments, and modify the report per the comments.
C.4.D.1.g	Surface surveillance may be dependent on Federal Aviation Administration (FAA) system, e. g., ASDE-X, TFMS, ADS-B, or it may rely on an approved alternative(s) that provide(s) information comparable to data available through ASDE-X.	Full	Surface surveillance will be based on ASDE-X.
C.4.D.1.h	If wholly independent of FAA systems, unless otherwise agreed to by the PANYNJ, the surveillance or alternatively approved infrastructure shall be refreshed and/or upgraded a minimum every two (2) years.	N/A	Not applicable, since ASDE-X will be used.
C.4.D.1.i	Provide a secure, web-based environment available to authorized, geographically dispersed Users.	Full	SSL and VPN-based security will be used.
C.4.D.1.j	Forecast the projected airport throughput rates based on historical performance and current and forecasted conditions, including weather, flight schedule demand, traffic management initiatives and other operational constraints.	Full	The system will use forecasted weather conditions and adapted rules based on historical configurations to predict changes to the operational airport configuration. When an airport configuration change is predicted to occur, the corresponding airport throughput rates used in the departure management predictions will be set based on adopted historical values for the configuration.
C.4.D.1.k	Estimate departure delay time during irregular operations such as de-icing.	Full	-
C.4.D.1.l	The system shall have a feature that allows metering to individual runways and departure fixes to optimize aircraft sequencing to best meet the demands and priorities of FAA programs, as well as airfield and airspace constraints and opportunities.	Full	-

Figure F-33. Compliance Matrix – Our proposed solution meets the Port Authority operational needs (continued)

Requirement Paragraph	Requirement Text	Compliance	Compliance Comments
C.4.D.1.m	Provide the capability to allow a User to match a "delay type time-stamp" for an Aircraft to log an operational event such as a reason for a delay. There shall be a list of 20 delay type time-stamps available in a drop-down style menu. These data elements will be stored, accessible and available to appropriate Users for reporting purposes.	Full	-
C.4.D.1.n	Provide a status window graphically displaying delay length in time and/or number of aircraft for each runway. This display is to provide an accurate snapshot of the departure demand at the airport.	Full	-
C.4.D.1.o	Enable the Users to swap their own flights provided the change is within the agreed upon rationing principles set forth.	Full	-
C.4.D.1.p	System must be capable of displaying predictive aircraft taxi times, to include, but not limited to: i. From runway touchdown to the ramp; ii. From the ramp to the gate; iii. From the gate to the taxiway; iv. From the taxiway to departure; v. Display aircraft taxi times, to include, but not limited to: vi. From the gate to the taxiway vii. From the taxiway to the metering location, hard stand de-icing pads. From the metering location, hard stand or de-icing pads to departure viii. From the gate to departure (For example, the system should provide estimated taxi times (from the gate to departure (wheels»up)) for aircraft ready to push back from the gate. ix. Provide monitoring and reporting of aircraft that occupy or travel through a defined Region of Interest (ROI). Examples of ROIs include airport taxiways, runways, holding areas, parking areas, approach corridors, gates, concourses of gates, and other definable sections of movement and non—movement areas.	Full	ROIs are entered in Harmony as adaptation data by specifying region boundaries in lat/long.
C.4.D.2	Integration with External Systems – The System shall integrate with external systems to receive and distribute key Data Elements in accordance with the Scope of Work. Flight Plan Data Elements, Additional Data Elements and potential sources are listed in Exhibit 2, Data Element Sheet. The Service shall, at a minimum, integrate with the external systems listed in Exhibit 6 or another Port Authority approved equivalent.	Full	The system will integrate with the following external interfaces: ASDE-X, ASDI, TFMS ADLs, NTML, ITWS (TAF, METAR, RVR), Aircraft Operators, FIDS, and Pilotweb. This data set will meet all functional requirements.
C.4.D.3	Receive and Distribute Data	-	-
C.4.D.3.a	Adaptation data	Full	-
C.4.D.3.b	Surface surveillance data	Full	ASDE-X will be used.
C.4.D.3.c	TFMS data - Data received from TFMS shall include flight plan information, takeoff time (DZ message), Traffic Management Initiative (TMI) data, etc. The data made available to TFMS shall include predicted taxi time, wheels off time, etc.	Full	Data accepted from TFMS will be: Flight data and TMI data. Data sent to TFMS will be: aircraft operator updated estimates for gate departure, runway departure, runway arrival, and gate arrival. Note: This requires approval by the aircraft operator.
C.4.D.3.d	TMA data - Data received from TMA shall include arrival time estimates at arrival fixes and runway thresholds, and identification of arrival runway assigned to the arriving aircraft if available.	Full	It is our understanding that TMA data for JFK is not available based on FAA policy. We will obtain this data from ADLs.

Figure F-33. Compliance Matrix – Our proposed solution meets the Port Authority operational needs (continued)

Requirement Paragraph	Requirement Text	Compliance	Compliance Comments
C.4.D.3.e	Weather data - Data received shall include Integrated Terminal Weather System (ITWS) data, and Aviation Routine Weather Report (METAR), Corridor Integrated Weather System (CIWS), wind direction and velocity reports, Runway Visual Range (RVR), and Terminal Aerodrome Forecast (TAF) data and Route Availability Planning Tool (RAPT) or any other Port Authority approved equivalent.	Full	The following Weather data will be input to the system: METAR, RVR, and TAF (via ITWS). For TAF, METAR, and RVR, text data will be provided to users. To our knowledge, RAPT has no external interface.
C.4.D.3.f	NAS Operator data - The data received shall include estimated gate/stand time, boarding time, target off block time, flight prioritization, other readiness of flight indicators, etc.	Full	Specifically: Aircraft Operator data consists of: schedule data (call-sign, ADEP, ADES, OBT, IBT, Aircraft Type, terminal and gate assignments), earliest ready to taxi time, and any updated estimates to these values. Prioritization is achieved by the operators through substitution and not rationing. Boarding time can be used to update a "ready for taxi" estimate.
C.4.D.3.g	Other Data - This could include data from airport authority, such as Flight Information Display System (FIDS), etc.	Full	-
C.4.D.4	Graphical User Displays - The Contractor shall provide, at a minimum, graphical displays to enable the User to perform the functionality described below:	-	See specific requirements below.
C.4.D.4a	Combine and Process Flight Data This section lists below and describes the basic information that the System determines from the input data and then makes available to the User through information displays. Each individual component is not necessarily displayed directly to the User; rather the System combines this data into a set of informational displays presented on User terminals. The System shall process the data it collects, thereby generating both descriptive and predictive information about current and expected airport surface traffic situation and flows. This information shall include for each flight handled by the airport, the expected or predicted values for the quantities. These informational displays shall be updated frequently, in near real time, the frequency at which shall be approved by the Port Authority and will contain at a minimum the following information:	Full	We will define an aircraft operator data interface that can be used by airlines to provide data that includes the elements necessary to determine turnaround time (aircraft registration) and gate assignments.
C.4.D.4b	Base Map of Airport	Full	-
C.4.D.4c	Organize Airport Adaptation Data	Full	-
C.4.D.4d	Characteristics of Base Map	Full	Pilotweb will be the primary source of the subitem associated with marking closed runways and taxiways. If this is insufficient, marking of closed runways and taxiways as a dynamic element may require manual entry.
C.4.D.4e	User Interface to Base Map	Full	-
C.4.D.4f	Situation Displays	Full	-
C.4.D.4g	Data Tag Associated with Each Aircraft Icon	Partial	Repositioning of the data tag will be supported via user selection of predefined data tag orientations with respect to the icon. The system provides an automated default data tag orientation for each flight based on location on the airport surface to minimize data tag clutter and overlap. Note: Touch screen functionality is not provided.
C.4.D.4h	Data Tag and Expanded Detail Window	Full	-

Figure F-33. Compliance Matrix – Our proposed solution meets the Port Authority operational needs (continued)

Requirement Paragraph	Requirement Text	Compliance	Compliance Comments
C.4.D.4i	Additional Characteristics of Base Map	Full	Note: Editing the map layers is an offline function.
C.4.D.4j	Icons	Full	-
C.4.D.4k	Gates and Stands	Full	-
C.4.D.4l	Timelines	Full	-
C.4.D.4m	Weather data The Service shall be capable of receiving, processing, warehousing and displaying data from, at a minimum, the following systems or other Port Authority approved equivalents: a) RAPT - Route Availability Planning Tool b) MET AR - International standard code format for hourly surface weather observations c) TAF - Terminal Aerodrome Forecast d) RVR - Runway Visual Range Users shall have the capability to incorporate stored weather data from the above list or other Port Authority approved equivalents into reports and playback capability.	Full	We believe RAPT is not available due to lack of external interface or approval process from the FAA.
C.4.D.4n	Tabular Data	Full	-
C.4.D.4o	Alerts	Full	All alerting functions identified can be readily provided with the possible exception of taxiway conformance. This would require access to the intended taxi path. As clarified by the Port, there are currently no known coded taxi routes in use at JFK.
C.4.D.4p	Configuration of Alerts	Full	-
C.4.D.5	Transmitted Modeled OFF Times The System shall be capable of transmitting the OFF time estimates to the Traffic Flow Management System (TFMS) for each departing aircraft. The TFMS makes OFF time estimates on the basis of historical data, but has no mechanism to update those estimates to take account of recent and current surface traffic and flows and therefore the TFMS' estimates of OFF time are relatively static. By monitoring the surface traffic, the System calculates current, accurate estimates of OFF times and shall provide the OFF time estimates to the TFMS to supplement their data.	Full	-
C.4.E	The Contractor shall provide standard, requested and custom reports with the System in accordance with the requirements described herein. All reports, with the exception of the Summary Windows view, shall be provided in both implementation Phases A and B. Summary Window reporting requirements shall be available in conjunction with Phase B. The System shall provide the capability to export report data in a format that can be imported intostandard Microsoft 2007 Office suite of tools, including but not limited to the following formats: ■ Microsoft Word (* .Docx) ■ Microsoft Word 97- 2003 (* .Doc) ■ XML ■ Web pages (HTM, HTML, MHT and MHTML) ■ Microsoft Excel (* .xls) ■ CSV (MS-Dos), and ■ Text (MS-Dos). The System shall provide advanced data querying and reporting capabilities enabling Users to create textual and graphical reports from a database. Upon initial implementation, the System shall begin saving and storing 24 months of data, which shall be used to generate the Reports. Five	Full	ACARS data is typically available via the airline interface and via the TFMS ADLs.

Figure F-33. Compliance Matrix – Our proposed solution meets the Port Authority operational needs (continued)

Requirement Paragraph	Requirement Text	Compliance	Compliance Comments
	(5) years of stored data shall be available within two days of request. The System shall provide the flexibility to create, save, execute, and download comprehensive reports about the surface operation and utilization of airport resources. Users shall have the capability to obtain comprehensive statistics, including gate occupancy; the number of holdouts by fleet type, time of day, and concourse; average amount of time an inbound aircraft waits for a gate; taxiway occupancy; and runway occupancy. Similar information shall be obtainable about the Vehicles equipped with a tracking device. Reports shall be sortable by Airline, flight number, aircraft type, terminal or parking area, destination airport and location where the delay occurred (ramp, taxiway, metering location, etc.), originating airport and location where the hold out occurred (ramp, taxiway, metering location, etc.). The reports shall measure taxi times against official ACARS and 000I (Out, Off, On and In) times when available. In addition to the ability to generate reports "on demand," the System shall have a scheduling capability that enables Users to schedule the automatic generation of daily, weekly, monthly, quarterly, and yearly operational reports. The User who scheduled an report shall have the ability to configure the system to automatically receive the report via email once it is generated.		
C.4.E.1	General Reporting Requirements	-	-
C.4.E.1a	All reports shall be modified to reflect the configuration of the application furnished as part of this Contract. Headings should be standardized (Report Name, Airport, Date Report Run, Date Range of Report, Page Numbers, Column Headings on every page, Totals, etc.) and appear in a consistent manner throughout all presentation formats.	Full	-
C.4.E.1b	All reports shall be easily displayed and navigated on the User's access terminals, sent to a choice of any email address, network printer at the user's facility and saved to the User's desktop over the Authority's existing wide area network.	Full	Reports will be displayed on the user terminal, and a save and print capability will be provided. Saved reports can then be emailed using any email client the user prefers.
C.4.E.1c	Users shall have the ability to access and display Summary Windows to actively monitor the current status items. Summary Windows are described below in further detail.	-	See Summary Window detail starting with C.4.E.4.
C.4.E.1d	Access to detailed operational statistics is limited to the "owner" of the aircraft and the Port Authority. For example, members of one organization are not permitted to view taxi times of other organizations.	Full	-
C.4.E.1e	When a user selects any time field listed in a Report, the System shall launch into a playback of the event in a separate window on the Base Map. The playback feature shall synchronize a selected local frequency to enable the user to hear radio transmissions. The frequencies shall include those listed in the current Airport/Facility Directory, under John F Kennedy Intl JFK Communications.	Partial	The playback feature without voice will be provided but it will not be launched by time field selection.
C.4.E.2	Standard Reports	-	-
C.4.E.2a	Region of Interest Report (i.e. departure or deicing queue)- Provides a list of all aircraft that are currently within a selected, configurable ROI along with the time of entry, time of exit, and total occupancy time.	Full	-
C.4.E.2b	Arrival and Departure Summary- This summary shall provide a breakdown of the total number of departures and arrivals over a configurable time period for the airport in total, by runway and by individual Airline.	Full	-

Figure F-33. Compliance Matrix – Our proposed solution meets the Port Authority operational needs (continued)

Requirement Paragraph	Requirement Text	Compliance	Compliance Comments
C.4.E.2c	Movement Area Taxi Time- This report shall target taxi details for individual flights upon entry into the movement area to wheels-up or from wheels-down to exit from the movement area. Breakdown of minimum information includes: flight call sign, aircraft registration number, runway, wheels down date and time, at gate date and time, total taxi time, gate and terminal assigned, gate and terminal used, time the aircraft transitioned from the movement area into the non-movement area, direction (inbound or outbound), Mode 3A and Mode S information, model of aircraft, movement area time, origin and destination airports, ramp/ non-movement area time, runway occupancy time, taxiway used to enter/exit the ramp area, ship number, flight origination date, scheduled and actual out, off, on, in times, actual taxi in and out times and the marketing carrier.	Full	-
C.4.E.2d	Total Taxi Time - This report shall target taxi details for individual flights from movement off the gate or stand to wheels-up or from wheels down to arrival at gate or stand. Breakdown of minimum information includes: flight call sign, aircraft registration number, runway, wheels down date and time, at gate date and time, total taxi time, gate and terminal assigned, gate and terminal used, time the aircraft moved off the gate or stand, transitioned from the movement area into the non-movement area, direction (inbound or outbound), Mode 3A and Mode S information, model of aircraft, movement area time, origin and destination airports, ramp/non-movement area time, runway occupancy time, taxiway used to enter/exit the ramp area, ship number, flight origination date, scheduled and actual out, off, on, in times, actual taxi in and out times and the marketing carrier.	Full	-
C.4.E.2e	Wheels Up/Wheels Down - This report shall highlight for wheels up and wheels down times for individual flights. Minimum information includes: flight call sign, aircraft registration number, runway, wheels down date and time, direction (inbound or outbound), Mode 3A and Mode S information, model of aircraft, ship number, flight origination date, scheduled and actual out, off, on, in times, actual taxi in and out times, scheduled and actual gate, and the marketing carrier.	Full	-
C.4.E.2f	Planned Taxi Time vs. Allocated Taxi Time - This report shall measure the difference in time between the when an aircraft can be ready to call for taxi versus the taxi time assigned to the aircraft due to departure constraints. This information shall be sortable on a flight-by-flight basis, by first fix, by airline, by terminal or by total airport average over configurable amounts of time selected by the User.	Full	-
C.4.E.2g	Allocated Taxi Time vs. Wheels Up Time - This report shall indicate the difference in time between the Allocated Taxi Time assigned to an aircraft and the actual time that the aircraft's wheels leave the airport surface. This information shall be sortable on a flight-by-flight basis, by first fix, by airline, by terminal or by total airport average over configurable amounts of time periods selected by the User.	Full	-
C.4.E.2h	Gate Utilization - Amount of time between the vacating of departing aircraft from gate and the arrival time of the next AC at the same gate, including their associated time stamps, flight and gate information.	Full	-
C.4.E.2i	Departure Delay - Amount of time between the vacating of departing aircraft from gate and wheels up VS. the scheduled time. This report should highlight the flights that had a wheels up indication more than 45 minutes past the scheduled departure time, including their associated time stamps, flight and gate information.	Full	-

Figure F-33. Compliance Matrix – Our proposed solution meets the Port Authority operational needs (continued)

Requirement Paragraph	Requirement Text	Compliance	Compliance Comments
C.4.E.2j	Arrival Delay - Scheduled arrival time (block in) VS. actual arrival time (block in), highlighting flights that arrive (block in) more than 15 minutes past the scheduled arrival (block in) time, including their associated "wheels-on" indication, time stamps, flight and gate information.	Full	-
C.4.E.2k	Runway Utilization - Runway utilization by hour, day, month and/or year.	Full	-
C.4.E.2l	Metering Area Usage - Metering location usage including flight information, time stamps in and out of region to highlight length of stay in region, and a count of how many aircraft metered in such locations, by hour and by total, for more than two minutes.	Full	-
C.4.E.3	Database Query Reports In addition to the established predefined reports, the System shall feature an advanced database query reporting capability that generates reports based on customizable User-defined criteria. This shall be a free-form query capability where Users will be able to generate reports identifying the operational situations' and conditions that they would want to be aware of in real-time. For example, a Database Query Report could be run to identify stranded aircraft on the airfield, flights that required secondary deicing, unmet arrivals that had to wait at the gate, or flights that utilized a specific departure fix. Database Query Reports shall be executed by defining the query criteria within the same GUI that is employed by the configurable alerts in the Base Map. Already defined criteria shall be automatically shared between the Base Map and Database Query Reports so that reports can easily be run to review past alert situations. After the selection criteria are defined, report execution shall return the list of all matching aircraft, vehicles, or flights depending on the report subject. The details shown for each element shall be completely customizable so that Users can expeditiously access the information they need.	Full	-
C.4.E.4	Summary Windows Summary Windows shall provide Users the capability to display dynamic, real-time and forecasted status operation that is critical to their specific job function and needs. The System shall enable Users to choose trend indicators to illustrate whether the chosen values are increasing or decreasing and shall be capable of configuring the columns they want to see as well as the length of time that should be used to aggregate statistical trends (i.e. 30 minutes or greater, in multiples of 30).	Full	-
C.4.E.4a	Region of Interest Summary Region of Interest (i.e. Departure Queue, Deicing Queue) Summary shall enable Users to monitor aircraft that occupy a defined Region of Interest (ROI). ROIs include Airport taxiways, runways, holding areas, parking areas, approach corridors, gates, concourses of gates, and other definable area in the movement and nonmovement areas. This Summary Window shall provide a list of all aircraft that are currently within each ROI along with the time of entry, time of exit, and total occupancy time. Users shall have the ability to select the region they are interested in, along with the specific information to be displayed for each aircraft or vehicle in the region. The Summary shall also optionally display a sliding queue depth graph depicting the number of occupying aircraft.	Full	-

Figure F-33. Compliance Matrix – Our proposed solution meets the Port Authority operational needs (continued)

Requirement Paragraph	Requirement Text	Compliance	Compliance Comments
C.4.E.4b	Surface Delay SummaryThe Surface Delay Summary shall identify all established regions of interest and the corresponding delay. The delay shall be a calculated moving average of all delays recently incurred in each region respectively. Users shall have the ability to configure the table to show only regions with a delay above a certain threshold or to color code regions in the table with delays above a threshold.	Full	-
C.4.E.4c	Airport Demand Summary The Base Map Airport Demand Summary shall display archived, predicted, and summarized arrival and departure rates at JFK. The Service shall calculate and forecast the total number of arrivals and departures that have occurred, or will occur, in fixed size time intervals. For each time interval, the predicted or actual (depending on whether the interval is in the past or the future) rate is plotted alongside the scheduled rate to visually illustrate how JFK's traffic is progressing in relation to scheduled operations:	Full	-
C.4.E.4d	Runway Configuration Summary The Runway Configuration Summary shall graphically depict the current airport configuration. It shall be displayed as a simplified airport map with large colored arrows placed at the ends of the runways to indicate the current runway configuration. The colors shall be configurable and indicate if the runway is supporting arrivals, departures, or both. As the traffic patterns change, the arrows shall dynamically update to reflect the changes.	Full	-
C.4.E.4e	Arrival and Departure Sequencing Summary The System shall predict the expected sequence of operations for the entire airport or an individual runway. Using predictive methods, the Arrival and Departure Sequencing Summary shall display ET A and ETD information using a condensed graphical time line or other Port Authority Approved method. Users shall have the ability to add any number of predicted sequence charts to and arrange on a User's Base Map workspace.	Full	-
C.4.E.4f	Taxi Time Summary Taxi Time Summary shall display all active aircraft taxi times along with estimated total taxi time for the entire airport or a specific runway. In addition, the minimum time, maximum time, average time, and trend for the airport and each runway shall be shown.	Full	-
C.4.E.4g	Active Flight Summary The Active Flights Summary displays all active flights along with the corresponding ETA or ETD, and a colored shape indicating flight progress. The thresholds used to determine status shall be configurable as shall the color and shape.	Full	-
C.5.A	For both phases of implementation, the System shall provide the following: ■ Secure access and protection of Port Authority data against intrusions and internal misuse of data ■ Continuous operations in the event of a catastrophic failure ■ Consistent user interface ■ Interface with external systems through an open systems architecture	Full	-

Figure F-33. Compliance Matrix – Our proposed solution meets the Port Authority operational needs (continued)

Requirement Paragraph	Requirement Text	Compliance	Compliance Comments
C.5.B.1	Data Security The System shall provide secured access and protection of Port Authority data against intrusions and internal misuse of that data. The techniques used to secure access and protect the data shall include, but not be limited to the following: ■ Transparent Data Encryption ■ Compartmentalized system authorization ■ Secure transmission of data ■ Secure encryption of data ■ Strong, best practices password policy ■ Record all User activities	Full	SSL and VPN security will be used. The JFK SMS architecture will be hardened using DISA Security Technical Implementation Guides (STIGs) and NSA Security Configuration Guides (SCGs) as appropriate. Data in transit to and from the system will be securely and transparently encrypted using VPN/SSL security. Email and txt messages from the system will not be encrypted. All User activity that affects system data will be recorded.
C.5.B.2	Physical Security	Full	Done via process and procedure.
C.5.C.1	Redundancy;The System shall be redundant and configured to provide for continuous operation in the event of the failure of any single System component. The redundant operation shall include, but not be limited to, all central computer system, software, network and Internet components that are used to fulfill the requirements of the Contract.	Full	-
C.5.C.2	Fault Tolerance A fault tolerant computing solution shall be provided so that the system will continue to run upon detection of any type of failure. Once implemented, the hardware and application shall continue to operate if one server, the software or any single system component fails. Any failures occurring in the primary application server (or database server if used), shall cause the system to automatically switchover, without operator intervention, from their primary central components to the secondary/redundant components upon detection of a hardware or software failure in any primary component without any loss of data or user control. The System shall instantaneously switchover the software processing to maintain continuous System operation. The operation of the System shall be transparent to the operator during and after the switchover. The system shall display an alert to the operators of the failover on all of the User Workstations to notify them of the condition. Once the primary server or component is repaired to full operation, all data shall be recovered on the primary server without any loss of data during the outage. Restoration of the primary server(s) into the fault tolerant configuration shall be performed without any loss of data.	Partial	The system shall be capable of meeting or exceeding the 99.99% uptime requirement (availability does not include the loss of an external feed). Many failure scenarios will be handled by automation and redundancy at the network, hardware and application levels. However, depending on the failure scenario, an end user may be impacted by the failure. Below are specific examples of fault tolerance designed into the solution: ■ Data Center will provide access to multiple Internet providers to ensure Internet communication circuit redundancy and path diversity. ■ Hardware disk drives will be implemented utilizing RAID configurations with hot spares and redundant controllers to handle storage failure events ■ The Data Center will provide fully conditioned and redundant power including Uninterrupted Power Supplies and generators with N+1 redundancy. ■ Database subsystem is clustered, which means a single database node failure may not affect application availability. ■ Redundant application servers within each environment will allow for user fail-over without forcing a user to login again. ■ Disaster recovery fail-over to the disaster recovery data center will force a user to log back into the system.

Figure F-33. Compliance Matrix – Our proposed solution meets the Port Authority operational needs (continued)

Requirement Paragraph	Requirement Text	Compliance	Compliance Comments
C.5.C.3	The secondary/redundant components of the system shall be diversely located, both physically and logically, in an alternate computer site that is subject to Port Authority approval, to ensure continuity of operations in event a catastrophic event adversely affects the site where the primary components are located.	Full	-
C.5.C.4	Authorized Users shall access the application through a secure, web-enabled interface on normal desktop or laptop computers using standard Internet Browsers in their native operating systems, including, but not limited to, the following: ■ Internet Explorer, version 7 (and later) ■ FireFox 3 (and later) ■ Safari 4 (and later) ■ Chrome (all versions) ■ Opera 9 (and later)	Partial	System will be guaranteed to support only IE8, IE9, Firefox3, and Firefox4. Other browsers are undergoing compatibility testing. Note: IE7 cannot support the audible requirements of this proposal.
C.5.D.1	Data Ownership	Full	-
C.5.D.2	Data Integrity	Full	-
C.5.D.3	Database Setup	Full	-
C.5.D.4	The System database(s) shall be replicated onto the backup application server, (and/or backup database server if a separate server is used), which is located in a different data center for diversity in order to maintain System operation in the event that the primary application server (or primary database server if used) fails without loss of data or user control. The replication process shall be performed in real-time, replicate each transaction and validate that the replicated data is accurate and complete.	Full	-
C.5.D.5	The System shall provide online storage of data for a minimum of two (2) years of data without any degradation in System performance. For each month beyond the current two (2) years of storage, the system shall automatically archive the data for long-term storage to disk, and RW-DVD if requested by the user, and deleted from the online database storage. The System shall provide authorized Users with the capability to retrieve the archived data for reports, analysis and playback for a minimum period of five (5) years and removed from normal access once the User indicates they completed use of the archived data.	Full	-
C.5.D.6	Database Backups	Full	-
C.5.D.7	Testing the Restore Procedure	Full	-
C.5.D.8	The Contractor shall provide the User with the capability to analyze the data recorded by the System. The Contractor shall propose, for Authority approval, the methods of analysis	Full	We consider the method of analysis to be the use of reports, including the ad hoc database queries, defined in C.4.E.
C.5.D.9	The System shall provide the capability to playback recorded data in sync with recorded radio transmissions.	Partial	Recorded radio transmissions are not provided.
C.5.D.10	The System shall provide authorized Users with the capability to extract all Port Authority data in an appropriate hierarchical XML format that matches the business model of the application. The Contractor shall propose an XML structure, for Authority approval, based on the design of the application.	Full	-
C.5.E	The System shall provide critical information on all screens to provide a context for users of the application (i.e. state Facility for which data being reported). Report headings shall be standardized, and shall appear in a consistent manner throughout all presentation formats of the application on both the real-time Screen or in archived Reports. The System shall support a minimum of four (4) active windows operating concurrently and update the data in each window in accordance with the approved data refresh rate. The System shall also support the use of multiple monitors connected to the system unit of each workstation.	Full	-

Figure F-33. Compliance Matrix – Our proposed solution meets the Port Authority operational needs (continued)

Requirement Paragraph	Requirement Text	Compliance	Compliance Comments
C.5.F	Security shall be role-based and the application software shall support a minimum of eight (8) levels of application access security, including one (1) for system administration, totaling nine (9) access security levels, and be capable of storing a user passwords, associated access levels and access permissions/restrictions for the number of users specified in Attachment C, Section 5, M., System Sizing. The access level shall determine which functions the User can implement, as indicated below. The System shall allow each User's profile to be configured to allow Read-Only, Read & Write, or No Access permissions/ restrictions to, at a minimum, the following resources: ■ airport terminal data ■ ramp area data ■ air line data, and ■ special system capabilities, such as the display of real time flight tracking for 15 P ANYNJ Users User access permissions/restrictions to application functions and resources shall be configured by the Contractor and approved by the Port Authority's Project Manager. The application software shall provide the capability to allow the Application Administrator to examine, modify and print the list of user access permissions/restrictions and functions associated with each access level and each of the above resources the User can access. This capability shall enable the Application Administrator to change the user access privileges assigned to each access level, and change the permissions/restrictions each User "may"/"may not" access online to the above resources, without requiring a compilation or regeneration of the application software.	Full	While user account management is supported by the system, system level administration functions are managed at the server level and not incorporated into the SMS for access via web-based interfaces.
C.5.F.1	Application Access Levels a. Level One - Monitor-Only Airline Data b. Level Two - Monitor-Only Terminal Data c. Level Three - Monitor-Only Airport Data d. Level Four - Modify Airline Operational Data e. Level Five - Modify Terminal Operational Data f. Level Six - Modify Airport Operational Data g. Level Seven - Flight Tracking Data h. Level Eight - Application Administrator	Full	-
C.5.G	The System shall record all system activity and maintain the activity log for subsequent reporting. The System shall record all events and changes made by the users. Each record shall contain, at a minimum, the User name, time, date and location from which the event/activity occurred, and include the event or activity performed. The record shall include, but not be limited to the following information: ■ Log in and log out activity by each user, ■ All events and changes made by the users to operational data, ■ All changes made to the setup or configuration. Description for each change shall include the values of the data both before and after the changes were applied.	Full	-
C.5.H	Furnished hardware, equipment, software, database and communications protocols shall be in a "state of common usage," or industry-standard, and shall be an open architecture. Computer software shall consist of all system, application, and utility software required to meet the requirements of this Contract. All off-the-shelf software shall be industry standard. The Contractor shall submit the latest commercially available release/version of all hardware and software products in general use prior to System acceptance and comply with the industry's best practices.	Full	A current fully supported release of all products will be provided prior to System acceptance. As clarified by the Port, this may include software and hardware made commercially available within a year.

Figure F-33. Compliance Matrix – Our proposed solution meets the Port Authority operational needs (continued)

Requirement Paragraph	Requirement Text	Compliance	Compliance Comments
C.5.I	A user-friendly graphical user interface (GUI) shall be furnished that is ergonomically designed to facilitate user operation in an intuitive manner and to minimize operator actions for information retrieval and system operation. The user shall be able to invoke any action or command with no more than three (3) mouse clicks and any additional required data. The user interface shall be designed with streamlined business display screens to facilitate easy data entry and general viewing. Navigation tools/menus/keys shall be prominently displayed and provide consistent, easy movement within and between screens. All control and reporting features shall have a logical hierarchical arrangement to engage the user through such features as pull-down menus, interactive graphics, dialog boxes, touch screens or other user-friendly means. The user interface shall prompt the operator with instructions or for additional information when user entry is required. The user interface shall not require the operator to memorize command sequences to perform operator controls. Context sensitive help or another form of on-line documentation for all functions and operations shall be provided. All screen layouts shall be submitted for approval by the Port Authority's Project Manager.	Partial	Note: 3 clicks across entire system to meet all system requirements may not be practical and will likely have necessary exceptions that will be presented to the Port Authority for approval. Our commercial solution has gone through many iterations of usability testing across our entire user base over many years of development and we do not perform design of screen layouts as defined by this requirement for review of all screens. Our solution is a COTS-based solution.
C.5.J	The System shall automatically execute all site-specific configuration parameters required to start up and enter the operational mode of the application software upon system initialization.	Full	-
C.5.K	The System shall be capable of being shutdown in an orderly fashion and in a manner that causes no anomalies in other subsystem components or software applications and no loss of data. Other subsystem components shall not report multiple errors nor be unavailable for shutdown. Just prior to shutdown, the System shall automatically notify connected Workstations that system shutdown is imminent. Only authorized users, i.e. Application and System Administrators shall have the capability of shutting down the System.	Full	-
C.5.L	Change Management The application must be secured and all revision changes shall require prior Port Authority approval. All changes shall be tracked and implemented in accordance with the Authority's approved change management procedure.	Full	As a commercial product, the baseline will be periodically updated. Quarterly reviews will be held with the Port Authority to provide lists of available updates, and the Port Authority has the option of accepting the product update for operational deployment.
C.5.M	The System shall be capable of supporting, at a minimum, the following: ■ 1 airport location, supporting, at a minimum, 11 airline terminals ■ 400 concurrent Users on separate, independent Workstations. ■ 3200 Registered Users ■ Licenses to use the flight tracking software at 15 PANYNJ workstation locations, concurrently.	Full	-
C.6.A	For both phases of implementation, the System shall consist of readily available, proven hardware and software elements, which are fully consistent with the System's design and operation as specified. It shall have the throughput, capacity, and availability, as specified herein, to provide the required functionality. It shall meet the performance requirements identified herein and under the maximum loading when all Users, as specified in Section V. M. System Sizing, are connected and interacting with the System and all System devices are engaged and performing their specified functions, with no loss of data or user control. At a minimum, the System shall:	Full	10 second update can only be guaranteed on a suitably configured user workstation that is running no other applications. Since virtual machines will be used, the 50% requirement can only be proven through analysis.

Figure F-33. Compliance Matrix – Our proposed solution meets the Port Authority operational needs (continued)

Requirement Paragraph	Requirement Text	Compliance	Compliance Comments
	1. Update User Workstation displays within 10 seconds of User action/request if Workstation is connected to the Internet through a broadband Internet connection, except for reports or database queries. 2. Use a maximum of 50 % of internal random access memory and disk storage in the servers and Workstations. 3. Use a maximum of 50 % loading on individual processors under worst case loading when all devices are engaged and all System elements are in operation. 4. Provide the capability for the number of Users, specified in Section V. M. System Sizing, at different Workstations to access the same application concurrently without any degradation of system performance.		
C.6.B	The System shall be a redundant, fault tolerant architecture with an availability of 99.99%. The application software furnished and installed by the Contractor shall be designed and built so that the applications software always operates properly on an active server and meet the availability requirement of 99.99%.	Full	System is designed for redundancy and will achieve 99.99% availability requirement.
C.7	Users and Training	Full	-
C.7.A	The Authority currently has operational, supervisory and administrative staff that will use the application. Training shall be provided for up to 50 staff in all Port Authority facilities and up to 300 representatives of the various air carriers who will be using this system staff in accordance with the requirements of this section. The Contractor shall provide training for training of Users both who work at Port Authority facilities and training, using a separate methodology, for Users who do not physically work at Port Authority facilities.	Full	-
C.7.B	The Contractor shall provide operation and administrative training for the entire System to designated Authority personnel and representatives of the airline industry at several Authority facilities to be determined by the Port Authority's Project Manager, through the means of practical demonstrations, seminars and other related technical teaching procedures. Training shall also be provided to airline staff working for the air carriers in locations off Port Authority facilities. The training program shall be implemented with formal classroom training and/or other forms of presentation as recommended by the Contractor. The curriculum shall be designed so that each group of trainees shall be trained in the full repertoire of system commands that they may have to use in the course of performing their designated functions. Students shall be provided with complete sets of training materials during the training sessions, which they shall retain for use on the job at the completion of training. Training shall be conducted on-site at the designated Airport facilities, and off-site for air carrier representatives who do not work at Port Authority facilities, in accordance with the approved training plan and methodology. Separate training classes shall be provided for each phase of implementation. Upon completion of each training program, the Contractor shall prepare and submit to the Port Authority's Project Manager a training report that shall summarize the results of the training program, including a list of attendees and individual test results, course evaluation forms, and recommendations for follow-up training or modifications to the curriculum.	Full	-

Figure F-33. Compliance Matrix – Our proposed solution meets the Port Authority operational needs (continued)

Requirement Paragraph	Requirement Text	Compliance	Compliance Comments
C.8	Acceptance and Testing	Full	-
C.8.A	System Inspection & Tests	Full	As recognized by the Port Authority, availability of data feeds may impact schedule, and thus the operational readiness schedule is subject to amendment based on FAA approval process for access of NAS data.
C.8.B	14-day Operational Test – Upon notification from the Port Authority's Project Manager of approval of the System Inspection and Test Report and the Contractor's certification that the System is ready for operational testing, an Operational Test phase shall commence for each phase of the project. The Port Authority operating staff with the advice and assistance of the Contractor shall perform the Operational Test during a 14 consecutive day period. During this period, Port Authority staff and Users will operate the System using the latest version of all applicable manuals, printed guides and procedures. Therefore, the Contractor shall conduct two complete sets of 14-day Operational Tests of the System to coincide with each phase of the project implementation. If there is a major system or component failure during the 14 day Operational Test, the Contractor shall correct any malfunctions as they occur. After the Contractor corrects a malfunction, the 14-day test shall restart, at day one, and shall continue until the System and all associated control, electronics, and communications equipment have operated without interruption or malfunction for 14 days, and the results are satisfactory, with the written approval of the Port Authority's Project Manager.	Full	
C.8.C	Submittal Requirements for Testing	Full	-
C.9.A	General Submittal Requirements	Full	-
C.9.B	Submittal Schedule	Full	-
C.10	Maintenance	-	See details in requirements below.
C.10.A	Maintenance Requirements	Full	Regarding item 3, the operational availability of the system and services will be at least 99.99%. This does not apply to individual hardware and software elements.
C.10.B	Time to Respond In response to a call for maintenance by the Users, the Contractor shall contact the Contract Manager within fifteen (15) minutes of the initial notification by the Authority to the Contractor's designated telephone or Fax number, or email address for remedial maintenance, in order to document the need for service.	Full	-
C.10.C	Time to Repair	Partial	The 10 day response will apply only to defects that cause a system failure. See proposal.
C.10.D	Failure to Meet SLA	Partial	These obligations are accepted based only on the measure of achieving 99.99% system availability. See proposal.
C.10.E	Upgrades The Contractor shall notify the Port Authority's Project Manager whenever upgrades and/or enhancements to operating system, the software provided under the Contract or third party software become available and provide a proposal for the proposed enhancement and upgrade. The proposal shall describe the work to be performed, contain a detailed estimate of the labor involved by labor category, a lump sum price and a proposed schedule for the work. The Contractor shall also provide the Port Authority's Project Manager with an analysis of the potential effects of such	Full	-

Figure F-33. Compliance Matrix – Our proposed solution meets the Port Authority operational needs (continued)

Requirements Paragraph	Requirement Text	Compliance	Compliance Comments
	upgrades/enhancements on the System. This analysis shall include, at a minimum, the following: ■ Compatibility of the application software with the new operating system or third-party software ■ Potential increases or decreases in operating System performance ■ The availability of product support for the current (older) version of the operating system or third party software ■ The testing required ensuring that the upgrade will perform as expected ■ The cost of the software upgrade, including testing and any other tasks which may be associated with the upgrade The Port Authority's Project Manager will then determine whether to install the upgrade. If the Port Authority's Project Manager selects the upgrade, the Contractor shall perform the recommended testing, prepare the test report, and perform the upgrade on the System.		
C.10.F	Supplemental Work – The Port Authority's Project Manager will notify the Contractor whenever Supplemental Work is requested. In response to the request, the Contract Manager shall submit a proposal that describes the work to be performed, contain a detailed estimate of the labor involved by labor category, a lump sum price and a proposed schedule for the work. The Contractor shall also provide the Port Authority's Project Manager with an analysis of the potential effects of the requested supplemental work on the System.	Full	Will be done as requested by Port Authority.
C.10.G	Hours of Scheduled Maintenance Scheduled preventive maintenance of System components shall be conducted between the hours of midnight and 0500 EST.	Full	-
C.10.H	System Administration The Contractor shall perform all system and application administration functions in accordance with the requirement stated in Exhibit 4.	Full	-
C.10.I	Training The Contractor shall provide supplemental on-site refresher training twice a year, when requested by the Port Authority, using the training material already provided, for approximately 100 hours each 6 months. Refresher training shall also be provided to Users working in the airline industry in accordance with the approved training plan for off-site users. Payment for refresher training shall be separated from the overall maintenance costs (see Attachment D, Cost proposal Form);	Full	-
C.10.J	Disaster Recovery Plan The Contractor shall create, review and test the disaster recovery plan in accordance with the requirements stated in Exhibit 3. In the event a catastrophic event causes damage to the System or a portion of the System's components, the Contractor shall restore the System and its operation in accordance with the approved Disaster Recovery Plan.	Full	-

Figure F-33. Compliance Matrix – Our proposed solution meets the Port Authority operational needs (continued)

F.1.4.3 Sample Reports

A sample report is shown in Figure F-15. This report shows predicted gate utilization as a function of time. Another sample report is showing forecasted arrivals is shown in Figure F-13.

Other sample reports include:

- Departure delay prediction
- Flow rate program
- Gate utilization

Additional ad hoc reports are available by request of the user using the web-based interface.

Our approach to reporting requirements is described in Section F.1.1.4.5.

F.1.4.4 System Architecture

The system architecture is described in Section F.1.1.5.C.

F.1.4.5 Data Ownership

Raytheon proposes the following ownership rights of the data collected by and used for System Operation as follows: Ownership of output data resulting from processing of external data feeds not controlled by Raytheon or its subcontractors, such as external feeds that will be provided by the FAA, Volpe, or various airlines ("Third Party Providers"), shall be solely determined by the Third Party Providers. Notwithstanding the foregoing, Raytheon will take reasonable steps to negotiate with such Third Party Providers to provide such external data feeds and output data to PANYNJ for its use, and to negotiate on PANYNJ's behalf, a transfer of ownership of such output data to PANYNJ, subject to the retention of a limited license by Raytheon and its subcontractor, Metron Aviation, Inc. to permit internal use of such output data.

F.1.4.6 Training

Raytheon will provide the Port Authority of New York and New Jersey (PANYNJ) with an integrated training plan that specifically reflects system operations at JFK enabling JFK users to effectively operate system and realize operational benefits

F.1.4.6.1 Training Plan

The training plan will be developed by Raytheon Technical Services Company (RTSC), LLC in cooperation with the subcontractors and the PANYNJ. The information contained within the plan will become the baseline training document and is used as the reference guide during training course development.

We plan to use a composite approach to training that ensures all users receive necessary training critical to job performance. Drawing on the unique strengths of each of the team members ensures that all training for the SMS is thorough and thoroughly addresses all aspects of system operation. The Training Plan provides a complete description of all training courses, including logistics, and provides a detailed schedule for the training program.

F.1.4.6.2 Training Development Process

Raytheon training materials are prepared and administered to definitive standards, as defined in the Task and Skills Analysis. This ensures complete applicability of course contents and presentation for each subject. The methodology used to achieve the course preparation, delivery, and evaluation of our training packages implements the principles of Instructional Systems Development (ISD). The application of a systematic training development process, such as ISD, and the use of a job-centered training approach ensure that quality training products will be provided to JFK users.

Training materials produced according to these procedures are fully documented and validated packages of training materials that completely reflect the academic and technological requirements, and are consistent with the technical manuals relevant to the course subject. The procedures are specifically designed to facilitate cooperation in training development, while keeping the customer's needs in the forefront.

The training development process ensures that the training materials match the real needs and environment in which carried out, in an effective and efficient manner. All decisions regarding training strategy are based on analysis of training needs, available resources, and the learning characteristics of the students. Using the ISD process gives a clear indication of where the project is heading, required resources and the expected results before embarking on any new phase.

Multiple specialists are involved in a training development and conduct. Each specialist is continually informed of the training priorities and constraints. Utilizing ISD processes improves communication between course developers and users, between the program manager and the training manager, and between the different instructor teams. A standard format of presentation and a common terminology are prerequisites for successful training development and course delivery. While there are variations in the application of the ISD approach, the main steps are similar. This similarity simplifies the adaptation of our training material to local conditions at JFK.

While the primary objective of the Raytheon training development process is to ensure the preparation of the highest quality course material, it also ensures that the designated training manager is provided with the appropriate information relevant to managing training material preparation through course delivery. The training development process assists the training manager by:

- Ensuring prepared training material is effective and meets needs
- Justifying need for resources (e.g., labor) for training
- Ensuring that operational systems are available when needed and used effectively
- Identifying bottlenecks or issues and corresponding corrective actions
- Knowing when and to what degree, the course objectives are achieved
- Identifying and mitigating risk
- Establishing overall objectives for each course
- Developing training courses using existing materials tailoring to JFK
- Conducting subject matter expert and quality reviews
- Gathering user feedback on the effectiveness of the training
- Updating course materials reflect system enhancements

F.1.4.6.3 Training Concept

The training team will design, develop, and provide training courses to supply initial and ongoing training for all SMS users at JFK. Training for on-site users includes: operations training for system functions, coaching of users, employee orientation training (as required), and supplemental training thereafter upon request. The training for offsite users includes operations training for system functions and refresher training thereafter upon request.

This training will address the operation of JFK SMS and will be conducted at the scheduled times and designated locations, consistent with the approved Training Plan.

All training courses include theoretical education along with practical exercises. Based on the course teaching method, we use the lecture technique during classroom sessions and student exercises during practical sessions. We strive for an approximate ratio of 40% lecture time, to 60% practical exercises. Instructors may present course materials in the classroom via computer slide projection, white, stand-up easel or by equipment demonstration as appropriate.

Instructors will adjust the course material, presentation methods, and practical exercise emphasis based on the learning needs of the students. Student participation during class will be recognized and factored into the final report submitted regarding the student proficiency. A minimum score of 70% must be achieved on all written evaluations in order to obtain recommendation for user certification. This is based on U.S. Civil Service, FAA, DoD, ICAO and educational testing requirements and recommendations.

Classes will be conducted Monday through Friday with all holidays observed and coordinated with class schedules.

A detailed schedule for the delivery of all training will be developed as part of the Training Plan and included in the Integrated Management System (IMS), and conveyed during regularly scheduled program status meetings.

RTSC is responsible for developing the Training Plan and the provision of training for all elements of JFK SMS under contract with the Port Authority. These include:

- Operations Manual
- Application Administration Manual
- System Administration Manual
- Instructor Lesson Plans
- Visual aids:
  - Operator Training Course
  - Student Guides

F.1.4.7 SAS-70 Audit

Audit reports for the two data centers are provided in Appendix A.

F.1.4.8 Staff Experience

The extent to which personnel are dedicated to this program , the technical experience in implementing and managing similar services, and the summary of relevant experience of each individual are included in Section F.3.5.

F.1.4.9 Installation, Operations and Maintenance Experience

Experience in installing, operating and maintaining the service at other airports and airline operators is described in Section F.3.5.

Metron Aviation's Harmony for Airlines product is currently installed and operational at LGA, providing efficiency improvements to Delta Air Lines operations.

Metron Aviation is supporting the SMS developed under contract to NASA, and deployed at MEM, providing continuous situational awareness to FedEx air operations.

F.1.4.10 Experience of Senior Management Team in Managing Employees

Raytheon is a U.S.-based Fortune Top 10 Aerospace and Defense Company with 72,000 employees and $25B in 2010 annual sales. We are a CMMI Level 5 certified organization structured to provide the most relevant expertise to our customers through functional support organizations. Our Air Traffic Management (ATM) product area is responsible for the JFK SMS solution. All our program managers go through a rigorous Raytheon certified tiering processes to ensure all are fully trained to properly manage all aspects of a program, from startup, through execution, and shutdown. The senior leadership and program managers within the ATM product area have extensive expertise in ATM automation and surveillance systems and solutions. Engineering, Contracts, Finance, Supply Chain, IT, and others are all functional support organizations to the business. Our Technical Services Company (RTSC) has been supporting the FAA and international Air Navigation Service Providers (ANSPs) for over 30 years in ATM, providing deployment, customer service, maintenance and support to all our ATM programs. All leaders in their respective functional areas all have extensive experience in the ATM business. Our engineering organization has been developing ATM products for over 50 years, and the engineering base is colocated within the same physical building with the ATM business and program leaders. This ensures focused ATM business continuity to Raytheon and to our customers.

Raytheon, a premier defense contractor, has a human resource and talent acquisition group dedicated to hiring, staffing and retaining the best employees in the business. Within ATM, our leaders are in constant contact with HR for staffing of new programs, including internal and external hires and ensuring our best and brightest are being challenged and promoted. We ensure retention of our top talent through a variety of retention initiatives. Two of the key retention programs include performance sharing and achievement

awards. The performance sharing program provides an incentive for eligible employees to attain specific Raytheon Company goals by linking rewards to organizational success. The program offers eligible employees the opportunity to earn variable compensation, targeted as a percent of Eligible Earnings, if predetermined Plan Year performance goals are achieved. While performance sharing provides incentive based off annual performance, achievement awards are intended to immediately recognize employees and teams for exceptional contributions to Raytheon Company. Leaders nominate individuals and/or teams for these awards that are as large as $7,000 in value. These programs, as well as others, have led to a 5-year voluntary attrition rates less than 4.5% per year.

As far as hiring, Raytheon is committed to providing opportunities to diverse populations including women, minorities, and veterans. Raytheon's commitment to hiring diverse candidates was recently highlighted in a 2011 issue of Women Engineer Magazine. Readers of the magazine nominated Raytheon as the sixth best employer of women engineers when asked "for whom they would most like to work or that they believe would provide a positive working environment for women." Raytheon also has ongoing relationships with top Universities across the nation to recruit college students for internships and early career opportunities. Due to the focus on college hiring, in 2009 Raytheon was ranked by Business Week Magazine as being one of the top 25 Best Places to Launch a Career.

Our ATM business area not only invests in our core products and solutions to ensure that the best solutions are delivered to our customers, but also invests in future capabilities, such as the NextGen Tower and surface management decision support tools, to provided advanced technologies to meet mission requirements of our customers. Our IRAD investment is currently focused on NextGen automation, integrating SOA components using the FAA's System Wide Information Management (SWIM) middleware. Other investments include our low power X-band radar where we are creating the NextGen multipurpose radar used for accurate detection and tracking of aircraft, weather, and wake turbulence. We are also working on developing a Ground Based Sense and Avoid (GBSAA) capability that enables our Digital Airport Surveillance Radar (DASR) to track Unmanned Airborne Vehicles (UAVs) in three dimensions and provide "see and avoid" management of the aircraft from the automation systems such as STARS. Our early work with the FAA in the integration of ADS-B and Multi-Lateration (MLAT) capability with automation was successfully deployed within the STARS at the Philadelphia TRACON in early 2010.

At Raytheon, our contracts administrators and leaders are the contact points into our customers' contract and procurement community. It is Contract's Mission is to deliver balanced, equitable business deals that ensure our customer's success. Raytheon NCS Contracts is home to more than 6500 contracts with approximately 180 Contracts employees across the world. Contracts establishes effective customer relations based upon professionalism, ethics, and integrity to ensure the reputation of the company. They also represent the company in business matters for sales engagements, serve in an advisory capacity to company management for business matters, convey the views of the customer to company management and performing organizations and work with performing organizations to ensure prompt response to the needs and expectations of customers with focus on customer satisfaction.

Our Technical Services Company (RTSC) has been maintaining systems for the FAA and ANSPs in ATM for over 30 years. These include programs such as STARS, DASR, Integrated Terminal Weather System (ITWS), Long Range Radar (LRR), and our AutoTrac automation product deployed around the world. Metron Aviation has been maintaining the SMS at Memphis for FedEx since 2005 providing continuous operations for their business. Raytheon has many decades of experience in architecting and deploying high availability systems for public and private sectors. In particular, the Standard Terminal Automation Replacement System (STARS) delivered by Raytheon to the FAA for safety critical terminal airspace management have been delivering a measured system availability of more than four nines to its terminal controller end-users. Raytheon and its partners also have been providing multifaceted technical services to the customers, ranging from On-Call customer support through multiple levels of training for the end-users. Raytheon's maintenance plan for JFK SMS is the embodiment of all the skills and experience Raytheon and its partners have acquired over years by providing low risk and high quality support solutions to their customers. Our maintenance plan approach for JFK is discussed in detail in Section F.1.1.10.

In summary, Raytheon has been managing, developing and deploying ATM systems and solutions for over 50 years. Our business processes and strategies for staffing, technology investment, contract management and maintenance are well defined and have been implemented as part of daily business practices. We have clearly demonstrated through past performance on many large and small programs, both domestically and internationally, that our management expertise in these areas has been proven through the years. This management expertise and experience will be applied to the JFK SMS program.

F.1.4.11 Qualifying Experience

A list of contracts involving the development, installation, management, testing and operation of systems providing surface and airspace management capability are provided in Sections F.3.2 and E.

F.1.5 Employee Management Programs

Raytheon has a comprehensive approach and automated systems for the training of all of our personnel. We have programs that incentivize and motivate our employees as well as policies and procedures that govern all of the above and any disciplinary actions.

Raytheon's commitment to employee growth commences upon hiring. We have a new hire orientation which includes required training in Diversity, Security (including IT Security), Labor reporting guidelines, Six Sigma, Business Ethics, Import/Export, Hazard including Health and Safety, Performance Development and Alternative Dispute Resolution. These courses are all provided within the first 30 days of hire.

As individuals progress in their career, there are multiple leadership offerings to ensure readiness for increased responsibilities. Front Line Leadership is an initial program for employees entering into leadership roles. Leadership for Leaders is the next step for individuals who have leaders reporting to them. This training continues through the Executive Leadership Summit reserved for the top 250 employees at Raytheon. In addition, role specific leadership training is available such as Principles of Program Leadership which is a hands-on, case based program dealing with leading programs in Raytheon's environment.

Raytheon has set up very comprehensive programs to certify Program Leaders as well as any individual who is a Cost Account Manager. In addition to the many training programs and experience necessary to attain this certification, yearly refreshers are required to maintain proficiency in these roles. This training is also in conjunction with our overall engineering certification as a CMMI Level 5 organization.

Overall, training at Raytheon is managed by our comprehensive Learning Management System (LMS). Each employee, as part of their performance development is required to have an individual development plan which includes course and time necessary to maintain mastery of their particular position. This system not only gives all employees access to a wide array of courses but will also automatically adds mandatory courses required for all employees in their category.

Specifically, there are 21 courses related to Customer Service. All but one are web-based courses and simulations. For any employee who provides customer service, whether internally or externally, one or more of these courses included in their Individual Development Plan. These offerings include Call Center Customer Service, Internal Customer Service as well as field Customer Service and dealing with Customer Service Disputes.

In the security area, DoD Annual Security Refresher Training and IT Information Security Awareness Training are annual mandatory requirements. All employees assigned to secure areas receive annual Closed Area/OPSEC/Counterintelligence Training. Users of classified Information Systems (IS) receive IS Training. COMSEC and Crypto briefings are administered as dictated by job requirements. The following IT security training is available to all employees:

- Thwarting the Enemy – Providing Counterintelligence
- Anti-Terrorism Level I Training
- NATO Training

As mentioned earlier safety training is included in new hire orientation. Specific to ASHA Safety our LMS includes a 10-hour, instructor-led course for all employees but especially individuals whose job description require this training. There are 163 offerings for various safety training, both instructor-led and web-based, available to all employees. These include courses regarding handling of hazardous materials, fire safety, laser safety, and Machine Shop safety.

Raytheon Quality Engineering (QE) assists the organization to maintain excellence in all areas of the product/process life cycle both, internally and at Suppliers, from understanding customer requirements to service and repair after delivery. The Raytheon Quality Policy which Quality Engineers abide by includes quality excellence, customer satisfaction, and continual improvement using Raytheon Six Sigma principles. Professional standards are established to assure knowledge, skills, and training/experience for the Quality Engineer roles in Hardware, Software, and Supplier Quality, as well as Quality Management. In addition to discipline specific education, the organization provides training to ensure deployment of core quality skills to measure performance, isolate causes of variability, and identify and validate improvements. Established training includes: Quality Auditor Certification program, Raytheon Six Sigma Specialist Qualification, Root Cause and Corrective Action training, and Measurement by Metric. Employee Management level training requirements include Frontline Leadership, Earned Value Management, and Risk Management Process.

Raytheon has several incentive programs that are available and affect all employees. The Performance Sharing Plan gives all employees a bonus based on the business performance. Each year the specific business as well as all of Raytheon is measured on how well we have met our stretch goals and the amount of bonus is calculated on four factors affecting business performance. The Results Based Incentive (RBI) program is for more experienced and accomplished employees and similar to the Performance Sharing Plan, is also based on business performance. The RBI program bonuses are based on a higher percentage of the employee's salary. Raytheon also has an Achievement Award program whereby employees are recognized for performance over and above what would normally be expected and a cash award is presented.

Lastly, Raytheon has several policies and procedures regarding disciplinary action and related topics. Four specific policies and procedures cover the areas of Workplace Violence, Sexual Harassment, Alcohol and Drug Use as well as a policy regarding Alternative Dispute Resolution are included in Appendix B.

F.1.6 Technical Advances

Metron Aviation has a rich history in researching, developing and deploying advanced traffic flow management, surface management, and weather prediction technologies for the FAA, Airlines, and international service providers:

- As part of the Traffic Flow Management Modernization (TFMM) program for the FAA:
  - Ration by Schedule (RBS) algorithms
  - Collaborative Decision Making (CDM) substitution
- As part of the Departure Flow Manager (DFM) program for the FAA, web-based departure management automation
- As part of ongoing support of FedEx operations at Memphis International, Collaborative Departure Queue Management (CDQM)

Additionally, the following is a list of publications that describe research and approaches to surface management are incorporated either entirely, or in part, within the Harmony product:

- Algorithmic Traffic Abstraction and its Application to NextGen
- Simulating Weather Forecast Errors for Traffic Flow Management Applications
- Linking ATM to the surface: Departure Flow Management and Beyond

- Analysis of Increasing User Flow Management Responsibility Using Shared Delay Information
- Airline and Service Provider Collaborative Algorithms for Flight Router and Delay Decisions
- Sensitivity of Capacity Estimates given Convective Weather Constraints
- Translation of Ensemble Weather Forecasts into Probabilistic Air Traffic Capacity Impact
- Two Methods for Computing Directional Capacity given Convective Weather Constraints
- Integration of an Aggregate Flow Model with a Traffic Flow Simulator
- Ration-by-Distance with Equity Guarantees: A New Approach to Ground Delay Program Planning and Control
- Benefit Mechanisms of Enhanced Collaboration in Tactical Traffic Flow Management
- Weather Forecast Requirements to Facilitate Fix-Based Airport Ground Delay Programs

F.1.7 Qualifications and Experience

Qualifications and experience of maintenance and user support are provided in Section F.3.5.

F.2 Cost Proposal

As demonstrated in our Executive Summary (Section B) and Technical Proposal (Section F.1), Raytheon is providing a price-competitive offering while delivering a best value, low risk SMS solution.

Our approach to delivering and deploying Phase A and Phase B capabilities is to combine the two phases into one single delivery 2 weeks earlier than required, as specified in Section F.1.1.2.1. The Phase B delivery requirement is currently 1 August 2012. This would mean that our combined delivery will produce only one final system for "Operational Usage" to the Port Authority on 15 July 2012.

Raytheon provides a price-competitive offering while delivering a best value, low risk SMS solution

- We reduce schedule risk by providing a single integrated delivery to ensure early operational readiness
- Our Team brings experienced leadership and personnel with airport surface and ATM expertise to ensure program success
- Raytheon offers an SMS solution based on world leading TFM capabilities to deliver a best value solution

Based on our experience on the STDDS program, securing approval to use the external data feeds from the FAA is challenging and time-consuming, with very long lead times. Given the number of external data feeds required, we do not feel that a Phase A "Operational Usage" date of 15 February 2012 is achievable with only a 2.5-month schedule, assuming contract award is 1 December 2011. While these dependencies will potentially delay Operational Usage, we will work with the Port Authority to accelerate this as much as possible. Given this rationale, trying to fit a Phase A delivery into a schedule with a short turnaround to Phase B will only jeopardize both deliveries, as the system will require two testing and review periods leading to operational acceptance. Combining these events allows a schedule to absorb any potential impact due to unresolved external dependencies, and minimizes the overall testing and review periods. This also mitigates overall schedule risk and enables early delivery of the final capability.

Raytheon has made a slight modification to the Port Authority's Pricing Schedules to reflect this delivery approach. Specifically, Table 1 and Table 2 have been replaced with a single table, Table 2A, that sets forth the total Implementation Price and a Raytheon cash neutral payment schedule. This change was made to clearly identify the Implementation Price in a single table. Also, Table 3 is not utilized, as it provides pricing for System Operation during the period between the completion of Phase A and Phase B. System Operation will not be carried out until the completion of the total implementation. All tables and table rows that are not used or replaced are grayed out in this section.

COST PROPOSAL FORM

IMPLEMENTATION PERIODS
PHASE A AND PHASE B

TABLE

SERVICES PAYMENT SCHEDULE

Implementation costs [redacted] include the following

- [redacted]

- All Administrative Activities
- Labor to Conduct Acceptance Testing
- Labor and Materials for Training
- 1 Year Warranty [illegible] System and Servic[illegible]

[redacted]

- Labor to Conduct Acceptance Testing
- Labor and Materials for Training
- 1 Year Warranty for System and Services

TABLE 2A

IMPLEMENTATION SERVICES PAYMENT SCHEDULE				
Completion of Implementation Phase on or before July 15, 2012, payment for all SMS Implementation Services				
Document or Event	**Project Timeframe**	**Fractional Payment**	**Payment**	**Deliverables**
Project Plan and Schedule Submittal	7 Dec 2011	10.00%	$ 976,532.30	As described in SOW
Security Practices and Policies Submittal	14 Dec 2011	5.00%	$ 488,266.15	As described in SOW
Preliminary System Documentation Submittal	14 Dec 2011	5.00%	$ 488,266.15	As described in SOW
Preliminary Acceptance Test Plan Submittal	6 Jan 2012	10.00%	$ 976,532.30	As described in SOW
Preliminary System Diagrams Submittal	9 Jan 2012	5.00%	$ 488,266.15	As described in SOW
Preliminary System Hardware Documentation Submittal	9 Jan 2012	5.00%	$ 488,266.15	As described in SOW
Preliminary Database Documentation Submittal	14 Feb 2012	5.00%	$ 488,266.15	As described in SOW
Preliminary Disaster Recovery Plan Submittal	16 Feb 2012	5.00%	$ 488,266.15	As described in SOW
Preliminary Training Plan Submittal	21 Feb 2012	10.00%	$ 976,532.30	As described in SOW
Preliminary Manuals Submittal	21 Mar 2012	10.00%	$ 976,532.30	As described in SOW
System Test Pre-Acceptance Test Report Submittal	8 May 2012	5.00%	$ 488,266.15	As described in SOW
System Test Acceptance Test Report Submittal	15 Jun 2012	5.00%	$ 488,266.15	As described in SOW
Completion of User Training	23 Jun 2012	5.00%	$ 488,266.15	As described in SOW
As-Built Documentation Submittal	4 Jul 2012	5.00%	$ 488,266.15	As described in SOW
Successful Completion of 14 Day Operational Test	15 Jul 2012	10.00%	$ 976,532.30	As described in SOW
Total Cost to Implement SMS			$ 9,765,323.00	

Implementation Costs shall include but are not limited to the following:

- All Labor, Equipment and Miscellaneous Costs to Setup Primary and Backup Data Centers to Host Applications Software,
- Labor to Modify the Applications Software to Meet Contract Requirements
- Labor to Install Applications Software in Contractor's Hosted Environment
- Labor to Configure Applications Software for Operational Usage at JFK
- All Administrative Activities
- Labor to Conduct Acceptance Testing
- Labor and Materials for Training
- 1 Year Warranty for System and Services

OPERATIONAL USAGE

TABLE 3
MONTHLY FEE TO HOST, OPERATE, ADMINISTER AND MAINTAIN SYSTEM FOR INTERIM PERIOD

Monthly Operation Commencing from Base Date of Operational Usage (Est. January 15, 2012)* Through the Commencement of Phase B (Est. June 30, 2012 at 11:59 P.M.)		
Total Lump Sum Cost Per Month*	Estimated Number of Months	Total Estimated Cost for Period
$	X 6.5	=
*Monthly Charge shall be all inclusive and utilize fully loaded cost of staff to operate, administer and maintain the system in the JFK Operations Center within the calendar month; as well as fully loaded cost of labor, equipment and miscellaneous costs to host the Application in the Primary and Backup Data Centers.		

TABLE 4

Monthly Fee to Host, Operate, Administer and Maintain System For Operational Usage		
Monthly Operation Commencing from Completion of SMS Implementation (Est. July 16, 2012 at 12:00 A.M.) through Contract End Date		
Total Lump Sum Cost Per Month*	Estimated Number of Months	Total Estimated Cost for Period
$ 205,148.11	X 28.5**	= 5,848,231.14
*Monthly Charge shall be all inclusive and utilize fully loaded cost of staff to operate, administer and maintain the system in the JFK Operations Center within the calendar month; and also fully loaded cost of labor, equipment and miscellaneous costs to host the Application in the Primary and Backup Data Centers.		

** The estimated number of months is based on the period between July 16, 2012 and Contract End Date (November 30, 2014).

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TABLE 5

SUPPLEMENTAL WORK EFFECTIVE JULY 16, 2012 AT 12:00 A.M. THROUGH CONTRACT END DATE			
	A. Proposed Maximum Hourly Rate	B. Estimated number of hours for the first year of the base period	C. Total Estimated Cost (A x B = C)
Contract Manager (Information Technology)	$ [illegible]	150	$ [illegible]
Software Engineer (Analyst/Programmer)	$ [illegible]	300	$ [illegible]
Report Writer	$ [illegible]	300	$ [illegible]
Trainer	$ [illegible]	300	$ [illegible]
System Operator during Irregular Operations	$ [illegible]	450	$ [illegible]
TABLE ESTIMATED TOTAL			$ [illegible]

ESTIMATED TOTAL COSTS

TABLE 6

	ESTIMATED BASE CONTRACT TOTAL	
Table 1:	Total Cost to Implement Phase A	
Table 2:	Total Cost to Implement Phase B	
Table 2A	Total Cost to Implement SMS	$ [illegible]
Table 3:	Total Estimated Cost for First Operation Usage (Estimated to be 1/15/12 - 6/31/12 - 6.5 Months)	
Table 4:	Total Estimated Cost for Second Operational Usage (Estimated to be 7/16/12 to 11/30/14 - 28.5* months)	$ [illegible]
Table 5:	Estimated Cost for Supplemental Work	$ [illegible]
	TOTAL ESTIMATED CONTRACT COST	$ [illegible]

* The estimated number of months is based on the period between July 16, 2012 and November 30, 2014.

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ASSUMPTIONS

Proposers should identify any underlying cost-related assumptions in this section in the space below or on additional sheets if the space provided below is insufficient.

TABLE 7

Due to the uncertainty and volatility in the Consumer Price Index, Raytheon has forward-priced all operational performances and is providing Firm Fixed Price offers for these performances. These prices are presented under the OPTIONAL PERFORMANCES section herein.
Raytheon's offer is predicated on the cash neutral Milestone Payment Schedule presented in Table 2A herein.
Raytheon will work on behalf of PANYNJ to secure availability to external data system feeds from the external data feed providers. However, in the event that these feeds cannot be secured within thirty (30) days of our SQA Dry Run of the System Test due to no fault of Raytheon, Raytheon will not be held responsible for any resultant delay in schedule.
PANYNJ will be responsible for the provision to Raytheon of unlimited availability to the Port Authority LAN/WAN and the internet at the JFK Operations Center at no cost during the period of performance of this contract.
Raytheon will not provide the metering frequency option for the provision of direct communication with aircraft. Raytheon is providing decision support information to the current SMS operators to enhance their situational awareness and management efficiency, and they will be fully capable of providing this support after the training provided during the base period of the contract.
Raytheon will provide training to the customer in two 8-hour shifts a day, with a different set of students in each shift, a maximum of 10 students per class, and classes are back to back Monday - Friday. Raytheon has assumed that all training infrastructure (class room space, computers, internet connections, projectors capable of displaying information on instructor's computer, etc.) are provided by PANYNJ. It is assumed that all offsite training locations are within the New York City Metroplex area and follow the same assumption as the onsite courses.
All efforts for System Upgrades and Enhancements, Design, Development and Implementation of Custom Reports, Refresher Training and the Staffing to Support Irregular Operations are included under the Supplemental Work as stated in the Exhibit 8, Definitions. Any additional effort required on the part of the Contractor to support any of these items beyond the hours identified under Supplemental Work will be contracted for by the Port Authority at the same hourly rate set forth under Supplemental Work for that labor category.
Raytheon Pricing and Schedule are based on a combined Phase A and Phase B operational readiness delivery on 15 July 2012, 2 weeks earlier than required for current Phase B schedule.

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OPTIONAL PERFORMANCES

TABLE A-1

Monthly Fee to Host, Operate, Administer and Maintain System for Operational Usage during Optional 120 Day Extension		
Monthly Operation Commencing from Completion of Base Operational Period (Est. December 1, 2014 at 12:00 A.M.) through March 31, 2015 at 11:59 PM		
Total Lump Sum Cost Per Month*	**Estimate Number of Months**	**Total Estimate Cost for Period**
$ 159,299.25	X 4	= $ 637,197.00
*Monthly Charge shall be all inclusive and utilize fully loaded cost of staff to operate, administer and maintain the system in the JFK Operations Center within the calendar month; as well as fully loaded cost of labor, equipment and miscellaneous costs to host the Application in the Primary and Backup Data Centers.		

TABLE A-2

SUPPLEMENTAL WORK EFFECTIVE DECEMBER 1, 2014 AT 12.00 A.M. THROUGH MARCH 31, 2015 AT 11:59 PM			
	A. Proposed Maximum Hourly Rate	**B. Estimated number of hours for the first year of the base period**	**C. Total Estimated Cost (A x B = C)**
Contract Manager (Information Technology)	$259.36	150	$ 38,904.00
Software Engineer (Analyst/Programmer)	$ 218.34	300	$ 65,502.00
Report Writer	$218.34	300	$ 65,502.00
Trainer	$ 185.12	300	$ 55,536.00
System Operator during Irregular Operations	$ 169.03	450	$ 76,063.50
TABLE ESTIMATED TOTAL			$ 301,507.50

TABLE B-1

Monthly Fee to Host, Operate, Administer and Maintain System for Operational Usage during First 12 Month Extension		
Monthly Operation Commencing from Completion of Base Period Operation (Est. December 1, 2014 at 12:00 A.M.) through November 30, 2015 at 11:59 PM		
Total Lump Sum Cost Per Month*	**Estimate Number of Months**	**Total Estimate Cost for Period**
$ 175,661.42	X 12	=$ 2,107,937.04
*Monthly Charge shall be all inclusive and utilize fully loaded cost of staff to operate, administer and maintain the system in the JFK Operations Center within the calendar month; as well as fully loaded cost of labor, equipment and miscellaneous costs to host the Application in the Primary and Backup Data Centers.		

TABLE B-2

SUPPLEMENTAL WORK EFFECTIVE DECEMBER 1, 2014 AT 12.00 A.M. THROUGH NOVEMBER 30, 2015 AT 11:59 PM			
	A. Proposed Maximum Hourly Rate	**B. Estimated number of hours for the first year of the base period**	**C. Total Estimated Cost (A x B = C)**
Contract Manager (Information Technology)	$259.36	150	$ 38,904.00
Software Engineer (Analyst/Programmer)	$218.34	300	$ 65,502.00
Report Writer	$218.34	300	$ 65,502.00
Trainer	$201.35	300	$ 60,405.00
System Operator during Irregular Operations	$169.04	450	$ 76,068.00
TABLE ESTIMATED TOTAL			$ 306,381.00

TABLE B-3

Monthly Fee to Host, Operate, Administer and Maintain System for Operational Usage during Optional 120 Day Extension following First 12 Month Extension		
Monthly Operation Commencing from Completion of First 12 Month Extension (Est. December 1, 2015 at 12:00 A.M.) through March 31, 2016 at 11:59 PM		
Total Lump Sum Cost Per Month*	**Estimate Number of Months**	**Total Estimate Cost for Period**
$ 127,048.00	X 4	= $ 508,192.00
*Monthly Charge shall be all inclusive and utilize fully loaded cost of staff to operate, administer and maintain the system in the JFK Operations Center within the calendar month; as well as fully loaded cost of labor, equipment and miscellaneous costs to host the Application in the Primary and Backup Data Centers.		

TABLE B-4

SUPPLEMENTAL WORK EFFECTIVE DECEMBER 1, 2015 AT 12.00 A.M. THROUGH MARCH 31, 2016 AT 11:59 PM			
	A. Proposed Maximum Hourly Rate	**B. Estimated number of hours for the first year of the base period**	**C. Total Estimated Cost (A x B = C)**
Contract Manager (Information Technology)	$ 269.19	150	$ 40,378.50
Software Engineer (Analyst/Programmer)	$ 224.57	300	$ 67,371.00
Report Writer	$ 224.57	300	$ 67,371.00
Trainer	$ 201.35	300	$ 60,405.00
System Operator during Irregular Operations	$ 177.08	450	$ 79,686.00
TABLE ESTIMATED TOTAL			$ 315,211.50

TABLE C-1

Monthly Fee to Host, Operate, Administer and Maintain System for Operational Usage during Second 12 Month Extension		
Monthly Operation Commencing from Completion of First 12 Month Extension (Est. December 1, 2015 at 12:00 A.M.) through November 30, 2016 at 11:59 PM		
Total Lump Sum Cost Per Month*	**Estimate Number of Months**	**Total Estimate Cost for Period**
$ 170,907.50	X 12	= $ 2,059,890.00
*Monthly Charge shall be all inclusive and utilize fully loaded cost of staff to operate, administer and maintain the system in the JFK Operations Center within the calendar month; as well as fully loaded cost of labor, equipment and miscellaneous costs to host the Application in the Primary and Backup Data Centers.		

TABLE C-2

SUPPLEMENTAL WORK EFFECTIVE DECEMBER 1, 2015 AT 12.00 A.M. THROUGH NOVEMBER 30, 2016 AT 11:59 PM			
	A. Proposed Maximum Hourly Rate	**B. Estimated number of hours for the first year of the base period**	**C. Total Estimated Cost (A x B = C)**
Contract Manager (Information Technology)	$ 269.19	150	$ 40,378.50
Software Engineer (Analyst/Programmer)	$ 225.95	300	$ 67,785.00
Report Writer	$ 225.95	300	$ 67,785.00
Trainer	$ 207.62	300	$ 62,286.00
System Operator during Irregular Operations	$ 177.08	450	$ 79,686.00
TABLE ESTIMATED TOTAL			$ 317,920.50

TABLE C-3

Monthly Fee to Host, Operate, Administer and Maintain System for Operational Usage during Optional 120 Day Extension following Second 12 Month Extension		
Monthly Operation Commencing from Completion of Second 12 Month Extension (Est. December 1, 2016 at 12:00 A.M.) through March 31, 2017 at 11:59 PM		
Total Lump Sum Cost Per Month*	**Estimate Number of Months**	**Total Estimate Cost for Period**
$ 132,720.75	X4	=$ 530,883.00
*Monthly Charge shall be all inclusive and utilize fully loaded cost of staff to operate, administer and maintain the system in the JFK Operations Center within the calendar month; as well as fully loaded cost of labor, equipment and miscellaneous costs to host the Application in the Primary and Backup Data Centers.		

TABLE C-4

SUPPLEMENTAL WORK EFFECTIVE DECEMBER 1, 2016 AT 12.00 A.M. THROUGH MARCH 31, 2017 AT 11:59 PM			
	A. Proposed Maximum Hourly Rate	**B. Estimated number of hours for the first year of the base period**	**C. Total Estimated Cost (A x B = C)**
Contract Manager (Information Technology)	$279.39	150	$ 41,908.50
Software Engineer (Analyst/Programmer)	$233.10	300	$ 69,930.00
Report Writer	$233.10	300	$ 69,930.00
Trainer	$207.62	300	$ 62,286.00
System Operator during Irregular Operations	$185.13	450	$ 83,308.50
TABLE ESTIMATED TOTAL			$ 327,363.00

TABLE D-1

Monthly Fee to Host, Operate, Administer and Maintain System for Operational Usage during Third 12 Month Extension		
Monthly Operation Commencing from Completion of Second 12 Month Extension (Est. December 1, 2016 at 12:00 A.M.) through November 30, 2017 at 11:59 PM		
Total Lump Sum Cost Per Month*	**Estimate Number of Months**	**Total Estimate Cost for Period**
$ 180,631.83	X 12	=$ 2,167,581.96
*Monthly Charge shall be all inclusive and utilize fully loaded cost of staff to operate, administer and maintain the system in the JFK Operations Center within the calendar month; as well as fully loaded cost of labor, equipment and miscellaneous costs to host the Application in the Primary and Backup Data Centers.		

TABLE D-2

SUPPLEMENTAL WORK EFFECTIVE DECEMBER 1, 2016 AT 12.00 A.M. THROUGH NOVEMBER 30, 2017 AT 11:59 PM			
	A. Proposed Maximum Hourly Rate	**B. Estimated number of hours for the first year of the base period**	**C. Total Estimated Cost (A x B = C)**
Contract Manager (Information Technology)	$279.39	150	$ 41,908.50
Software Engineer (Analyst/Programmer)	$234.54	300	$ 79362.00
Report Writer	$ 234.54	300	$ 70,362.00
Trainer	$ 213.89	300	$ 64,167.00
System Operator during Irregular Operations	$ 185.13	450	$ 83,308.50
TABLE ESTIMATED TOTAL			$ 330,108.00

TABLE D-3

Monthly Fee to Host, Operate, Administer and Maintain System for Operational Usage during Optional 120 Day Extension following Third 12 Month Extension		
Monthly Operation Commencing from Completion of Third 12 Month Extension (Est. December 1, 2017 at 12:00 A.M.) through March 31, 2018 at 11:59 PM		
Total Lump Sum Cost Per Month*	**Estimate Number of Months**	**Total Estimate Cost for Period**
$ 134,463.00	X 4	= $ 537,852.00
*Monthly Charge shall be all inclusive and utilize fully loaded cost of staff to operate, administer and maintain the system in the JFK Operations Center within the calendar month; as well as fully loaded cost of labor, equipment and miscellaneous costs to host the Application in the Primary and Backup Data Centers.		

TABLE D-4

SUPPLEMENTAL WORK EFFECTIVE DECEMBER 1, 2017 AT 12.00 A.M. THROUGH MARCH 31, 2018 AT 11:59 PM			
	A. Proposed Maximum Hourly Rate	**B. Estimated number of hours for the first year of the base period**	**C. Total Estimated Cost (A x B = C)**
Contract Manager (Information Technology)	$289.95	150	$ 43,492.50
Software Engineer (Analyst/Programmer)	$241.96	300	$ 72,588.00
Report Writer	$241.96	300	$ 72,588.00
Trainer	$213.89	300	$ 64,167.00
System Operator during Irregular Operations	$185.13	450	$ 83,308.50
TABLE ESTIMATED TOTAL			$ 336,144.00

TABLE	SUMMARY OF ESTIMATED OPTIONAL PERFORMANCES	PRICE
A-1	Monthly Fee to Host, Operate, Administer and Maintain System for Operational Usage during Optional 120 Day Extension	$ 637,197.00
A-2	Supplemental Work effective December 1, 2014 at 12:00 AM through March 31, 2015 at 11:59 PM	$ 301,507.50
B-1	Monthly Fee to Host, Operate, Administer and Maintain System for Operational Usage during First 12 Month Extension	$ 2,107,937.04
B-2	Supplemental Work effective December 1, 2014 at 12:00 AM through November 30, 2015 at 11:59 PM	$ 306,381.00
B-3	Monthly Fee to Host, Operate, Administer and Maintain System for Operational Usage during Optional 120 Day Extension following First 12 Month Extension	$ 508,192.00
B-4	Supplemental Work effective December 1, 2015 at 12:00 AM through March 31, 2016 at 11:59 PM	$ 315,211.50
C-1	Monthly Fee to Host, Operate, Administer and Maintain System for Operational Usage during Second 12 Month Extension	$ 2,050,890.00
C-2	Supplemental Work effective December 1, 2015 at 12:00 AM through November 30, 2016 at 11:59 PM	$ 317,920.50
C-3	Monthly Fee to Host, Operate, Administer and Maintain System for Operational Usage during Optional 120 Day Extension following Second 12 Month Extension	$ 530,883.00
C-4	Supplemental Work effective December 1, 2016 at 12:00 AM through March 31, 2017 at 11:59 PM	$ 327,363.00
D-1	Monthly Fee to Host, Operate, Administer and Maintain System for Operational Usage during Third 12 Month Extension	$ 2,167,581.96
D-2	Supplemental Work effective December 1, 2016 at 12:00 AM through November 30, 2017 at 11:59 PM	$ 330,108.00
D-3	Monthly Fee to Host, Operate, Administer and Maintain System for Operational Usage during Optional 120 Day Extension following Third 12 Month Extension	$ 537,852.00
D-4	Supplemental Work effective December 1, 2017 at 12:00 AM through March 31, 2018 at 11:59 PM	$ 336,144.00

F.3 Management Proposal

The Raytheon Team has the ability, expertise, domain knowledge and demonstrated performance to effectively manage, deliver and support the Surface Management System at John F. Kennedy International Airport (JFK).

Raytheon has formed a proven and powerful team comprised of Raytheon Company, the prime contractor, and Metron Aviation, the supplier of our world class Surface Management System (SMS) technology, and highly skilled Air Traffic Control (ATC) support personnel to the FAA and airports around the USA.

This team provides the PANYNJ not only with the exceptional expertise, experience and resources available from the best of the large ATC Original Equipment Manufacturers (OEMs), but also with the openness, responsiveness and agility available from the most experienced SMS supplier.

Our 17 programs described in this Management Proposal are directly relevant to the SMS program at JFK

- $3B total contract value in reference programs
- Proven large scale global ATM system provider with hundreds of installations in the USA, Canada, Middle East, Europe and Asia
- Proven world leader in SMSs
- Cohesive team with demonstrated track record of successful collaboration
- Demonstrated ATM System Integrator – New and existing facilities: installation, integration, training and commissioning without impacting ongoing operations
- Proven commitment to Port Authority success

The team's qualifications to deliver the functional requirements are unmatched, from the team's successful collaboration in developing the industry's first advanced SMS over a decade ago to the depth of the existing technical capabilities in the groundbreaking Metron Harmony commercial product, to the numerous air traffic flow management innovations as well as the Subject Matter Expert (SME) knowledge of the unique efficiency and environmental challenges of the New York airspace.

Section F.3.2.1 provides a detailed description of our 17 relevant successfully executed contracts within the past 3 years. All programs have direct relevance to the JFK SMS program. The proven management processes used across our programs enable repeatable success.

Raytheon Company Role **Raytheon**

Raytheon is the prime contractor for the JFK SMS program and is teamed with Metron Aviation. As the prime contractor, Raytheon will provide the overall program leadership, systems engineering, site management, installation, integration, logistics and training, and testing.

Raytheon is a world leader in providing turnkey, fully integrated Communication, Navigation, Surveillance and Air Traffic Management (CNS/ATM) solutions throughout the world. With a 60-year legacy in ATC solutions, Raytheon designs, manufactures and services a full line of modern Air Traffic Management (ATM) systems and products for civil and military applications. Raytheon is a world leader in providing modern open architecture ATM systems, Global Positioning System (GPS) based navigation and landing systems, and modern solid state digital primary and secondary surveillance systems. In combination with Raytheon's role as a major ATM systems integrator, Raytheon's full range of products and services satisfies virtually any ATM requirement, from a small airport system to a gate-to-gate national ATM system. Raytheon systems are operationally controlling air traffic in over 50 countries on every continent, with operational systems in such large airports as Houston, Miami, Philadelphia, Boston, Hong Kong, Frankfurt and Amsterdam.

Raytheon and its teammates have extensive knowledge and practical experience with the required data feeds and processing of these various data sources on multiple U.S. ATC projects. Raytheon has a proven track record as both a supplier and systems integrator. Raytheon was awarded a contract for the FAA/Department of Defense (DoD) Standard Terminal Automation Replacement System (STARS) program to supply 331 automation systems, of which over 140 have already been deployed. Most STARS sites have continuing live operations during transition without any interruption in service.

No other company offers this breadth of equipment, systems integration, services, support and experience in ATM. Worldwide, over 600 of our systems are in operation with Air Navigation Service Providers (ANSPs) in 50 nations, as shown in Figure F-34.

As prime contractor and overall systems integrator, Raytheon has continued to assemble world class teams of internationally recognized partners and suppliers to work together on each project. Each of these companies has extensive experience in its own area and occupies a pre-eminent position in its field. Additionally, most have previously worked with Raytheon on major programs and have world class reputations in their respective specialties.

Metron Aviation Role

Metron Aviation is our teammate and major subcontractor to Raytheon for this SMS project. Metron Aviation is a leading provider of advanced ATM products and services for the global aviation industry, including: Air Traffic Flow Management (ATFM), concept engineering, advanced research, software development, surface operations management, airspace design and environmental analysis. Metron Aviation fuses advanced science and mathematics with unparalleled ATM expertise to provide groundbreaking Collaborative Decision Making (CDM) solutions for the world's leading Air Navigation Service Providers (ANSP), airports, airlines and other stakeholders. Some of the Metron Aviation products include:

- ***Surface Management System (SMS)*** – Raytheon and Metron Aviation first collaborated on advanced airport surface systems in 2001. The SMS, developed under NASA's Advanced Air

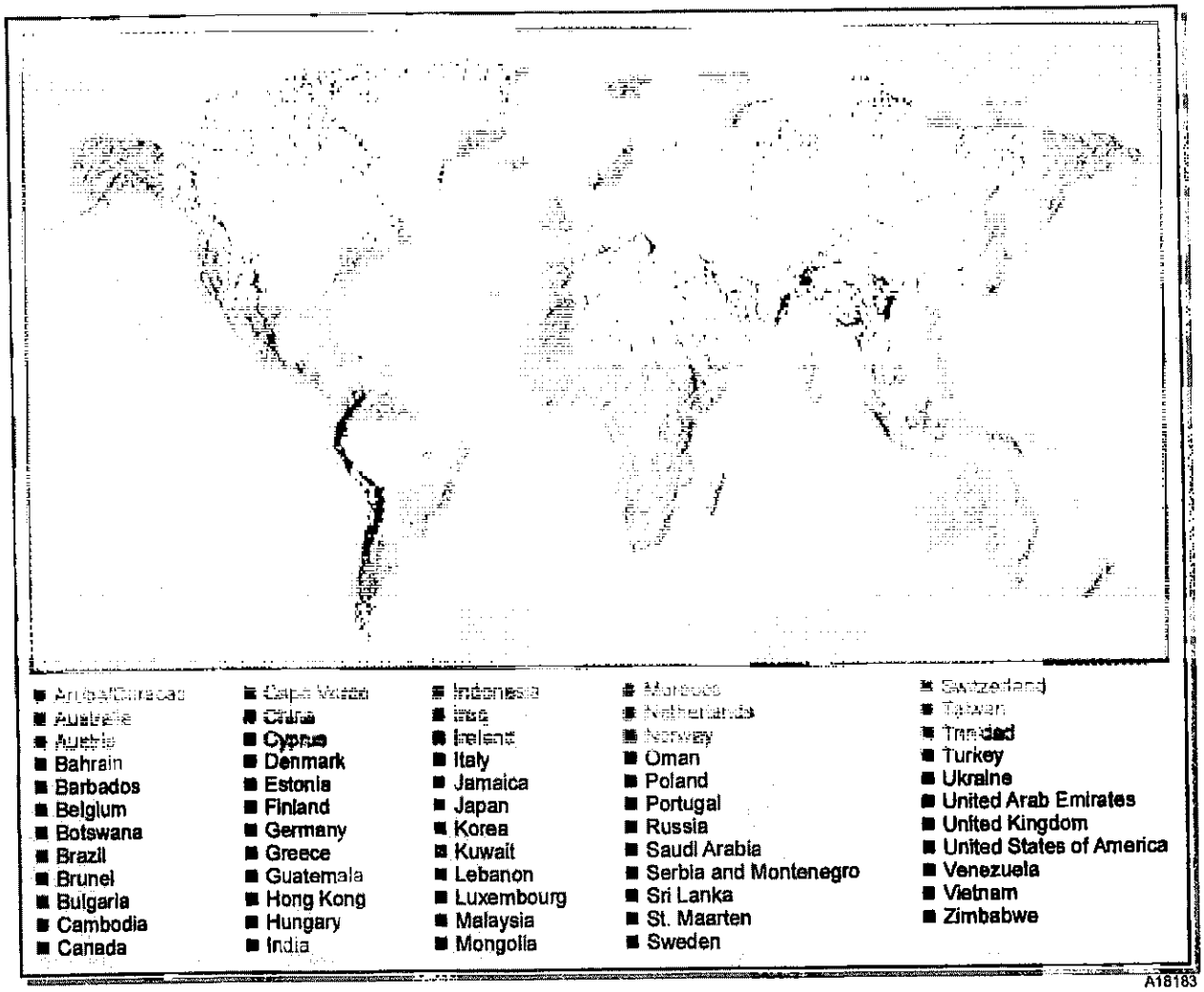


Figure F-34. Past Relevant Experience – Raytheon ATM equipment is fielded worldwide

Transportation Technologies (AATT) project, began as a prototype in 2001 at Louisville International Airport, transitioned to live operations in 2004 at Memphis International Airport, incorporated numerous technical advancements and operates today as the surface management backbone for FedEx, the world's largest air cargo carrier, at its global hub in Memphis. SMS provides predictive decision support capabilities to improve airport surface movement efficiency and flexibility with more complete and precise information about departure demand, arrival demand, predicted pushback times and runway utilization. An independent third party study concluded that the SMS system decreased taxi times by 2.8 minutes per flight for $8.3M in savings per year, increased departure capacity by 7.8% per year and reduced excessive taxi times (>40 minutes) by over 50%. Building upon a decade of daily operational use, customer feedback and technology investment, Metron successfully developed the next generation SMS, Metron Harmony.

- ***Metron Harmony at LaGuardia*** – Metron Aviation deployed the groundbreaking Metron Harmony at LaGuardia, which integrates a real-time and predictive view of national air traffic conditions with airport surface operations to dramatically improve on-time performance, reduce tarmac delays, lower operating costs and provide better service to passengers. While other commercial SMSs lack visibility into airport, regional and nationwide traffic demand and are thus unable to optimize departure and arrival operations affected by these conditions, Metron Harmony integrates nationwide and New York airspace constraints with real-time airport operational data to enable users to see real demand on the airport as well as overhead stream capacity, enabling improvements in predictability, which facilitates more effective tactical and pretactical decision making for airport surface operations.

- ***Departure Flow Management (DFM)*** – Metron Aviation developed the Departure Flow Management (DFM) system for the FAA, which increases departure flow efficiency by streamlining the coordination of departures over shared and congested resources (fixes, FIR boundaries, destination airports, jet routes, etc.) through automation, decision support, and web-based communication capabilities between the Towers and ACC. The DFM system provides functionality to assist rerouting, and flow management and monitoring capabilities that allow both the Tower and ACC facilities to track controlled departure time compliance and the state of the overhead flow over time. The DFM system provides flexible and reactive tools and procedures to account for uncertainty on the surface and in the en route airspace. The DFM system improves the coordination between the release of flights by the local tower and the efficient management of downstream airspace constraints. This improved coordination results in a smoother, more orderly flow of traffic, which in turn equates to a reduction of vectoring and directed speed changes. Operations at Los Angeles Center (ZLA) indicated the DFM system produces substantial fuel savings, emission reductions, related delay reductions, and reduced workload for controllers and flight crews. Further, the smoothing of traffic flows leads to significant increases in the throughput of constrained airspace elements.

- ***CDM-Based Enhanced Substitution Module (ESM)*** – Metron Aviation delivered the industry's first, and only commercially available, CDM-based slot substitution capability, Enhanced Substitution Module (ESM) which is today a core capability of 16 airline customers, and helps such carriers as Delta, JetBlue, Virgin America and American optimize daily flight operations at JFK. ESM opens a new dimension for operators allowing the open exchange of arrival slots with other operators in situations where all participating airlines benefit. ESM exchanges can be initiated directly by one carrier and accommodated automatically by other carriers, without explicit action on their parts. ESM is the first interplayer resource exchange in the National Airspace System (NAS), and represented the first step to a more efficient market-based system of resource management.

- ***Flight Schedule Monitor (FSM)*** – Metron Aviation pioneered the field of Air Traffic Flow Management (ATFM) and developed Flight Schedule Monitor (FSM) for the FAA, which was the world's first advanced ATFM platform. Developed in 1998 and deployed for NAS-wide operations in 2000, FSM remains the cornerstone of system-wide situational awareness and traffic flow control in the National Airspace System (NAS) today. Developed by Metron Aviation in 1998, FSM provides users with up-to-date, real-time information on the future behavior of all flights operating to or from the 800+ largest airports in the country, as well as any flights planned to pass through key

regions of the NAS. FSM is used regularly at over 90 FAA facilities, seven NAV CANADA facilities and by over 40 airlines, and is an integral part of daily operations management for NAS managers and users. Over the past decade, FSM has saved over 68 million minutes of delays, reduced 573,000 metric tons of Carbon Dioxide (CO_2), reduced fuel consumption by over 49 million gallons and lowered operating costs for NAS stakeholders by over $6.3B.

- ***Metron Harmony in South Africa*** – Building upon the success of ATFM, over a decade daily operational use of FSM, customer feedback and technology investment, Metron Aviation developed Metron Harmony, as an Integrated Air Traffic Flow Management (I-ATFM) solution for ANSPs that provides a framework for exchanging data among users who share the need for a common view of air traffic flow operations. Metron Harmony fully supports current and emerging CDM concepts to improve efficiency and predictability by aligning air traffic demand with available capacity through specific airport-based and airspace-based flow programs.

  Deployed by South Africa's ATNS to support long-term air travel and tourism growth, Metron Harmony also enabled South Africa to deal with influx of over 350,000 visitors for the 2010 FIFA Soccer World Cup and doubling of flight operations into Johannesburg and other key airports. Metron Harmony gave ATNS advanced tools for strategic planning, as well as pretactical and tactical management of traffic flows to maximize both airport and airspace capacities. Metron Aviation not only provided a proven commercial software solution, but a turnkey capacity management solution comprised of subject matter experts and on-site traffic flow managers to operate the system.

- ***Metron Harmony in Australia*** – Airservices Australia selected Metron Harmony to provide the foundation for ATFM and regional coordination to enhance the capacity, efficiency and safety of the Australian airspace. The contract covers a 15-year period, with all options exercised, and provides the framework for future collaboration. Metron Harmony will transition to nationwide operations in Fall 2011 and is currently deployed at Airservices Australia's Network Operations Center in Canberra, airport towers, area control centers and airline operations centers.

- ***Time-Based Flow Management*** – Extending its heritage of ATFM and airport SMSs, Metron Aviation is entrusted with the core NextGen programs that will build the future flow management systems to optimize the efficiency of airports and airspace. Metron Aviation provides subject matter expertise for the FAA's Time Based Flow Management (TBFM) program, which will provide advanced automation and a series of enhancements to the existing Traffic Management Advisor (TMA), providing more sophisticated scheduling, a greater span of control, more flexibility and integration with other FAA automation systems. Based on the principle of Time Based Metering (TBM), TBFM generates efficient scheduling and spacing plans for en route and predeparture aircraft and distributes flight-specific directives to execute the plans. This results in more efficient and predictable traffic management reducing delays, emissions and fuel burn. The Integrated Departure/Arrival Capability (IDAC) developed by Metron Aviation is being deployed as part of the TBFM program to increase departure throughput and capacity by integrating airport surface departure releases with the downstream airspace elements.

- ***Tower Flight Data Manager*** – Metron Aviation is providing Tower Flight Data Manager (TFDM), a terminal automation platform that will establish data exchange and processing architecture for future tower operations. TFDM will include a taxi route generator and a suite of tools for sequencing and scheduling, route assignment, departure route viability and airport configuration. The suite of tools will drive an integrated tower-user display suite consisting of surface surveillance, extended electronic flight strip or Flight Data Management (FDM), airport information and airport systems status. TFDM will provide the automation environment necessary to support future flexible terminal and airport operations for NextGen towers.

  The integrated information exchange and processing environment established by TFDM will provide an additional automation-assisted suite for user support tools. Collectively they represent the Arrival/Departure Management Tool (A/DMT). A/DMT will integrate information from a variety of systems and decision support tools to create a comprehensive database characterizing arrival and departure

demand, relevant airport operating parameters and surface/airspace constraints that may affect capacity, efficiency and safety.

- ***New York Airspace Expertise and Experience*** – Metron Aviation maintains a deep understanding of New York airspace configurations, redesign initiatives, capacity constraints and optimization characteristics, and the potential impact of airspace constraints on airport surface operations. Metron Aviation has performed on multiple New York Metro airspace analysis, design, configuration and policy programs for the FAA, accumulating deep understanding of the region's particular airspace capacity, constraints and optimization characteristics. Metron Aviation SME staff includes numerous former FAA staff with New York traffic management experience from New York Center (ZNY), New York TRACON (N90), tower, airline dispatch, pilot, weather and air traffic flow management domains. The Metron Aviation team has worked in collaboration with the FAA for more than 15 years on a range of environmental programs and performed numerous environmental reviews for the FAA in support of regional airspace redesign including New York, New Jersey, Philadelphia Metropolitan Airspace Redesign (NY/NJ/PHL), providing unequaled expertise to support the Port Authority's environmental initiatives, goals and compliance. Metron Aviation solutions are proven to reduce the operational delay sources at JFK, which represent an opportunity pool of approximately $2.6B annual impact of delays on the New York regional economy.
- ***SE-2020 NextGen Operational Concept Alignment and Integration*** – The SE-2020 program is the FAA's cornerstone program for NextGen systems engineering that will transform and modernize the nation's airspace into NextGen. As prime contractor on the SE-2020 program (awarded June 2010), Metron Aviation is entrusted with developing the operational concepts of the FAA's strategic program for implementing the Next Generation Air Transportation System (NextGen). The 10-year contract awarded to Metron Aviation has a value of U.S. $1.15B, making it the largest single award to a small business in FAA history. Metron Aviation has been officially notified that it has been selected as the FAA's 2011 Small Business of the Year.

F.3.1 Detailed Project Schedules

The Integrated Master Schedule (IMS) provides and documents the Team's executable plan for deploying the SMS at JFK. The IMS integrates the activities of all team members and includes all aspects of the program: pre-contract award demonstration, Phase A development, Phase B development, warranty and maintenance.

Our approach to delivering and deploying Phase A and B capabilities is to combine the two phases into one single delivery. This will allow our delivery to be provided 2 weeks ahead of the Port Authority requested date of 1 August 2012. Our combined delivery will produce a final delivered system for "Operational Usage" to the Port Authority on 15 July 2012.

Based on our current experience on the STDDS program, securing approval to use the external data feeds from the FAA is challenging and time-consuming, with very long lead times. Given the number of external data feeds required, we do not feel that a Phase A "Operational Usage" date of 15 February 2012 is achievable with only a 2.5-month schedule, assuming contract award is 1 December 2011. As the Port Authority has pointed out, these dependencies could potentially delay Operational Usage. We will work with the Port Authority to accelerate this coordination as much as possible. Given this assumption, trying to fit a Phase A delivery into a schedule with a short turnaround to Phase B will only jeopardize both deliveries, as the system will require two testing and review periods leading to operational acceptance. Combining these events allows a schedule to absorb any potential impact due to unresolved external dependencies, and minimizes the overall testing and review periods. This also mitigates overall schedule risk and enables early delivery of the final capability.

Figure F-35 is the team's high level overview of the schedule produced with "OnePager Pro." "OnePager Pro" is a useful tool for creating high level views directly from Microsoft Project. The proposed detailed Integrated Master Schedule (IMS) is shown in Figure F-36 and the full Microsoft Project file is included on the CD. The Program Manager (PM) will be assisted by a dedicated project scheduler

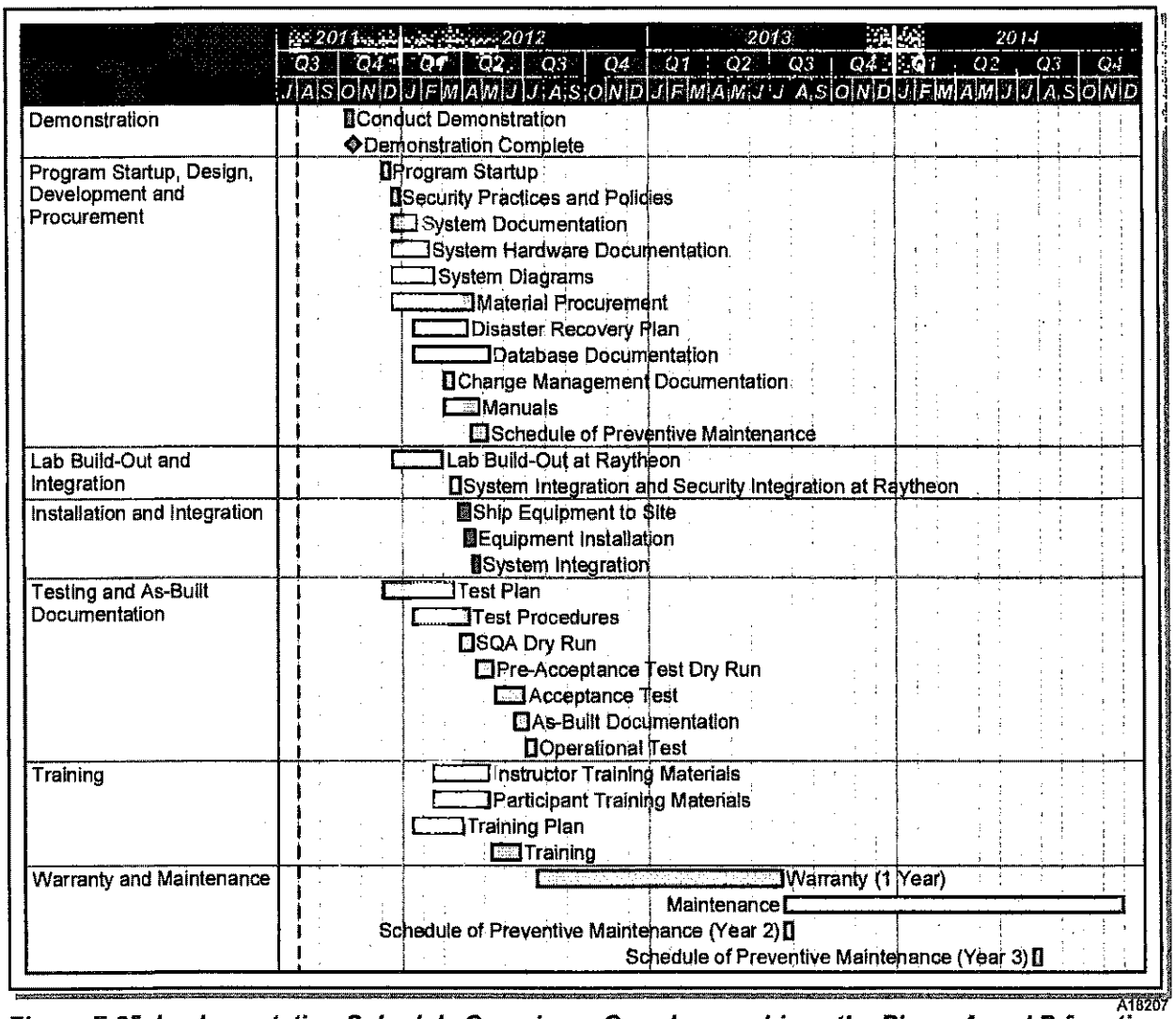


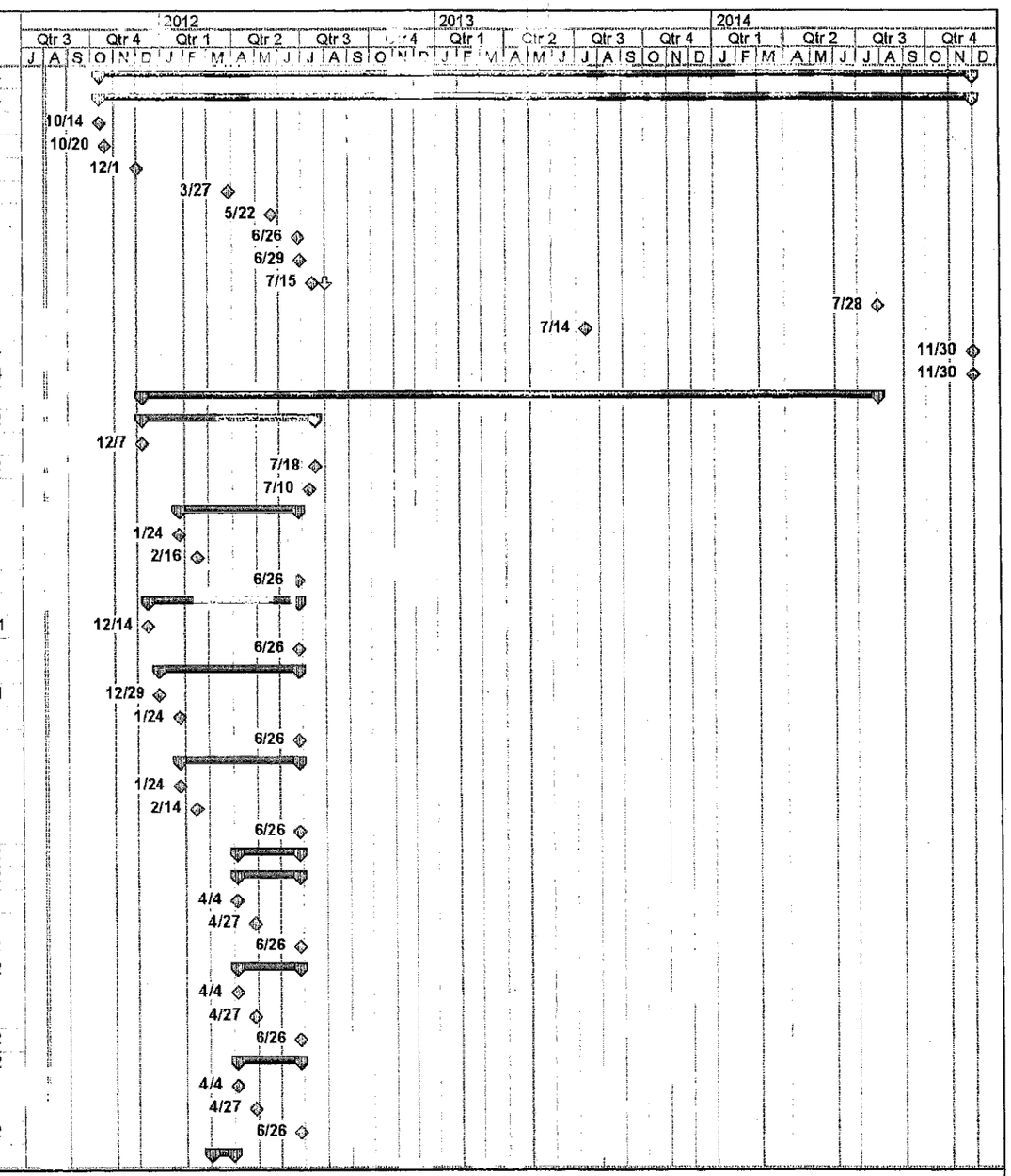
Figure F-35. Implementation Schedule Overview – Our plan combines the Phase A and B functions into a single delivery on 15 July 2012

to use and maintain the IMS over the life of the program. Changes and updates to the IMS will be shared with the customer per the submittal schedule and whenever necessary to ensure program success. The critical path has been highlighted in red for easy reference on the IMS.

The Team's proposed IMS includes all activities required to fully realize the SMS at JFK and has been grouped under the following program phases:

- ***Pre-Award System Evaluation Demonstration*** – Delivery of demonstration on proposed date of 14 October 2011 with 1 week leave behind capability for Port Authority evaluation.
- ***Program Startup*** – Generate the project plan/schedule and conduct program setup
- ***Design, Development and Documentation*** – Delivery of documentation, such as system diagrams, system documentation, system hardware documentation, manuals and disaster recovery plan (for a complete listing of the submittal schedule, see Section F.1.1.9.2, Figure F-31)
- ***Material Procurement*** – Procurement and receipt of material
- ***Lab at Raytheon Build-Out*** – Build-out of lab at Raytheon, including system and security integration

ID	Task Name	Duration	Start	Finish
1	**Surface Management System (SMS) at JFK International Airport**	**816 days**	**Fri 10/14/11**	**Sun 11/30/14**
2	**Program Milestones**	**816 days**	**Fri 10/14/11**	**Sun 11/30/14**
3	Demonstration Start	0 days	Fri 10/14/11	Fri 10/14/11
4	Demonstration Complete	0 days	Thu 10/20/11	Thu 10/20/11
5	Contract Award	0 days	Thu 12/1/11	Thu 12/1/11
6	Installation and Integration Complete	0 days	Tue 3/27/12	Tue 3/27/12
7	Pre-acceptance Testing Complete	0 days	Tue 5/22/12	Tue 5/22/12
8	Training Complete	0 days	Tue 6/26/12	Tue 6/26/12
9	Acceptance Testing Complete	0 days	Fri 6/29/12	Fri 6/29/12
10	Operational Test Complete	0 days	Sun 7/15/12	Sun 7/15/12
11	Submittal and Documentation Deliverables Complete	0 days	Mon 7/28/14	Mon 7/28/14
12	Warranty Complete	0 days	Sun 7/14/13	Sun 7/14/13
13	Maintenance Complete	0 days	Sun 11/30/14	Sun 11/30/14
14	Program Complete	0 days	Sun 11/30/14	Sun 11/30/14
15	**Submittal and Documentation Deliverables**	**688 days**	**Wed 12/7/11**	**Mon 7/28/14**
16	**Project Plan and Status**	**160 days**	**Wed 12/7/11**	**Wed 7/18/12**
17	Project Plan and Schedule	0 days	Wed 12/7/11	Wed 12/7/11
18	Progress Schedule Reporting	0 days	Wed 7/18/12	Wed 7/18/12
19	Status Meeting Agenda and Report	0 days	Tue 7/10/12	Tue 7/10/12
20	**System Diagrams**	**109.5 days**	**Tue 1/24/12**	**Tue 6/26/12**
21	Preliminary System Diagrams	0 days	Tue 1/24/12	Tue 1/24/12
22	Final System Diagrams	0 days	Thu 2/16/12	Thu 2/16/12
23	As-built System Diagrams	0 days	Tue 6/26/12	Tue 6/26/12
24	**Security Practices and Policies**	**138.5 days**	**Wed 12/14/11**	**Tue 6/26/12**
25	Security Practices and Policies	0 days	Wed 12/14/11	Wed 12/14/11
26	As-Built Security Practices and Policies	0 days	Tue 6/26/12	Tue 6/26/12
27	**System Documentation**	**127.5 days**	**Thu 12/29/11**	**Tue 6/26/12**
28	Preliminary System Documentation	0 days	Thu 12/29/11	Thu 12/29/11
29	Final System Documentation	0 days	Tue 1/24/12	Tue 1/24/12
30	As-built System Documentation	0 days	Tue 6/26/12	Tue 6/26/12
31	**System Hardware Documentation**	**109.5 days**	**Tue 1/24/12**	**Tue 6/26/12**
32	Preliminary System Hardware Documentation	0 days	Tue 1/24/12	Tue 1/24/12
33	Final System Hardware Documentation	0 days	Tue 2/14/12	Tue 2/14/12
34	As-built System Hardware Documentation	0 days	Tue 6/26/12	Tue 6/26/12
35	**Manuals**	**58.5 days**	**Wed 4/4/12**	**Tue 6/26/12**
36	**Operations Manuals**	**58.5 days**	**Wed 4/4/12**	**Tue 6/26/12**
37	Preliminary Operations Manuals	0 days	Wed 4/4/12	Wed 4/4/12
38	Final Operations Manuals	0 days	Fri 4/27/12	Fri 4/27/12
39	As-Built Operations Manuals	0 days	Tue 6/26/12	Tue 6/26/12
40	**Application Administration Manual**	**58.5 days**	**Wed 4/4/12**	**Tue 6/26/12**
41	Preliminary Application Administration Manual	0 days	Wed 4/4/12	Wed 4/4/12
42	Final Application Administration Manual	0 days	Fri 4/27/12	Fri 4/27/12
43	As-Built Application Administration Manual	0 days	Tue 6/26/12	Tue 6/26/12
44	**System Administrators Manual**	**58.5 days**	**Wed 4/4/12**	**Tue 6/26/12**
45	Preliminary System Administrators Manual	0 days	Wed 4/4/12	Wed 4/4/12
46	Final System Administrators Manual	0 days	Fri 4/27/12	Fri 4/27/12
47	As-Built System Administrators Manual	0 days	Tue 6/26/12	Tue 6/26/12
48	**Disaster Recovery Plan**	**20 days**	**Fri 3/2/12**	**Fri 3/30/12**

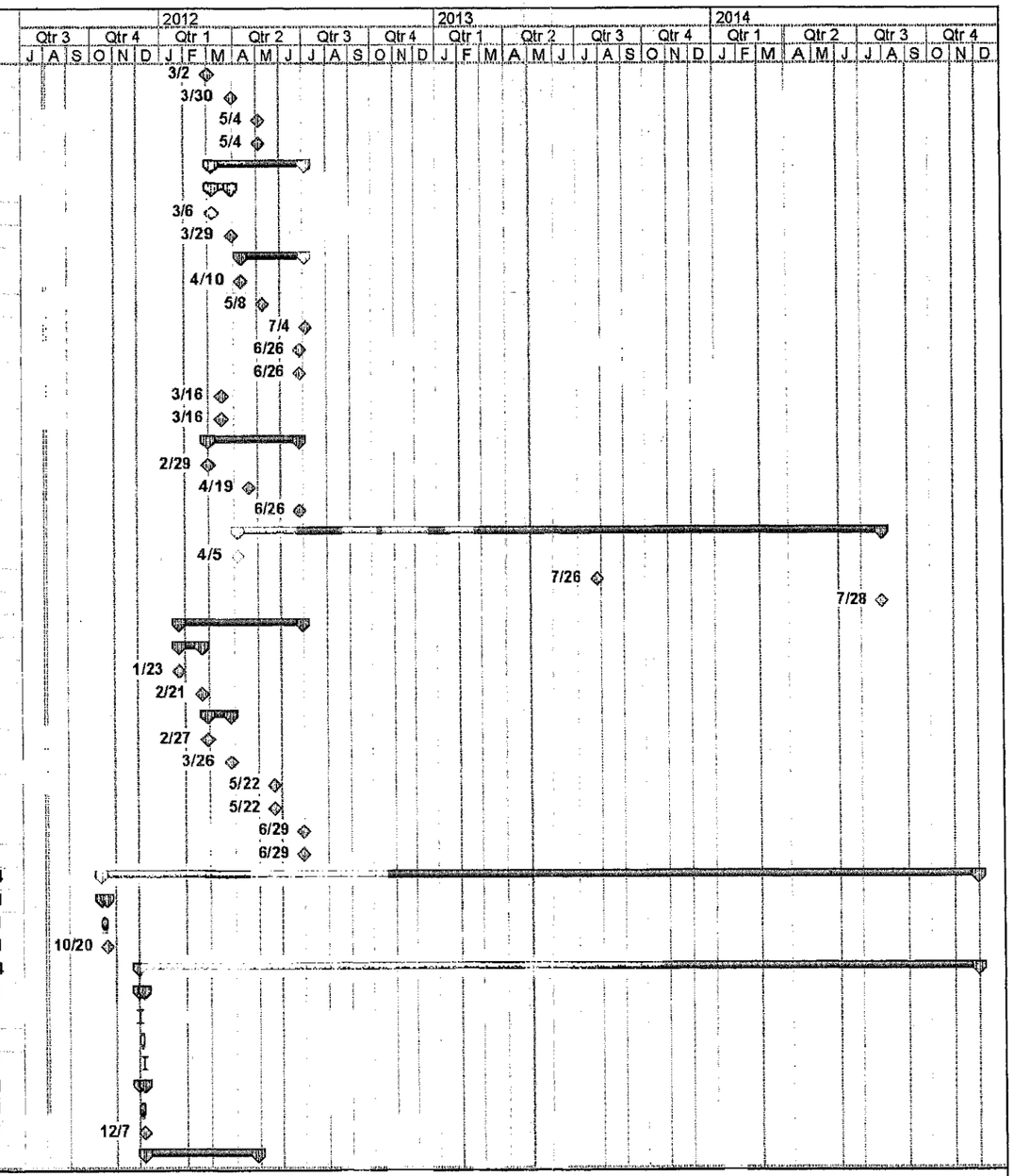


Task | Milestone | Summary | Deadline | Critical Task

Figure F-36. Integrated Master Schedule (IMS) – Our solution provides a credible, low risk schedule

Use or disclosure of data contained on this sheet is subject to the restriction on the title page of this proposal.

ID	Task Name	Duration	Start	Finish
49	Preliminary Disaster Recovery Plan	0 days	Fri 3/2/12	Fri 3/2/12
50	Final Disaster Recovery Plan	0 days	Fri 3/30/12	Fri 3/30/12
51	**Audit Report**	**0 days**	**Fri 5/4/12**	**Fri 5/4/12**
52	Audit Report (SAS 70)	0 days	Fri 5/4/12	Fri 5/4/12
53	**Training**	**86 days**	**Tue 3/6/12**	**Wed 7/4/12**
54	**Training Plan**	**17 days**	**Tue 3/6/12**	**Thu 3/29/12**
55	Preliminary Training Plan	0 days	Tue 3/6/12	Tue 3/6/12
56	Final Training Plan	0 days	Thu 3/29/12	Thu 3/29/12
57	**Training Materials**	**61 days**	**Tue 4/10/12**	**Wed 7/4/12**
58	Preliminary Training Materials	0 days	Tue 4/10/12	Tue 4/10/12
59	Final Training Materials	0 days	Tue 5/8/12	Tue 5/8/12
60	As-Trained Training Materials	0 days	Wed 7/4/12	Wed 7/4/12
61	**Training Report**	**0 days**	**Tue 6/26/12**	**Tue 6/26/12**
62	Training Report	0 days	Tue 6/26/12	Tue 6/26/12
63	**Change Management**	**0 days**	**Fri 3/16/12**	**Fri 3/16/12**
64	Change Management Form and Procedures	0 days	Fri 3/16/12	Fri 3/16/12
65	**Database Documentation**	**83.5 days**	**Wed 2/29/12**	**Tue 6/26/12**
66	Preliminary Database Documentation	0 days	Wed 2/29/12	Wed 2/29/12
67	Final Database Documentation	0 days	Thu 4/19/12	Thu 4/19/12
68	As-Built Database Documentation	0 days	Tue 6/26/12	Tue 6/26/12
69	**Schedule of Preventive Maintenance**	**602 days**	**Thu 4/5/12**	**Mon 7/28/14**
70	Schedule of Preventive Maintenance Phase A/B	0 days	Thu 4/5/12	Thu 4/5/12
71	Schedule of Preventive Maintenance Year 2	0 days	Fri 7/26/13	Fri 7/26/13
72	Schedule of Preventive Maintenance Year 3	0 days	Mon 7/28/14	Mon 7/28/14
73	**Testing**	**113.5 days**	**Mon 1/23/12**	**Fri 6/29/12**
74	**Acceptance Test Plan**	**21 days**	**Mon 1/23/12**	**Tue 2/21/12**
75	Preliminary Acceptance Test Plan	0 days	Mon 1/23/12	Mon 1/23/12
76	Final Acceptance Test Plan	0 days	Tue 2/21/12	Tue 2/21/12
77	**Acceptance Test Procedures**	**20 days**	**Mon 2/27/12**	**Mon 3/26/12**
78	Preliminary Acceptance Test Procedures	0 days	Mon 2/27/12	Mon 2/27/12
79	Final Acceptance Test Procedures	0 days	Mon 3/26/12	Mon 3/26/12
80	**Pre-acceptance Test Report**	**0 days**	**Tue 5/22/12**	**Tue 5/22/12**
81	Pre-acceptance Test Report	0 days	Tue 5/22/12	Tue 5/22/12
82	**Acceptance Test Report**	**0 days**	**Fri 6/29/12**	**Fri 6/29/12**
83	Acceptance Test Report	0 days	Fri 6/29/12	Fri 6/29/12
84	**SMS at JFK Program**	**816 days**	**Fri 10/14/11**	**Sun 11/30/14**
85	**Pre-Award - System Evaluation Demonstration**	**5 days**	**Fri 10/14/11**	**Thu 10/20/11**
86	Conduct Demonstration	5 days	Fri 10/14/11	Thu 10/20/11
87	Demonstration Complete	0 days	Thu 10/20/11	Thu 10/20/11
88	**SMS at JFK Phase A/B**	**782 days**	**Thu 12/1/11**	**Sun 11/30/14**
89	**Program Startup**	**5 days**	**Thu 12/1/11**	**Wed 12/7/11**
90	Generate Sales Order	1 day	Thu 12/1/11	Thu 12/1/11
91	Create SAP Account Data	3 days	Fri 12/2/11	Tue 12/6/11
92	Issue Preliminary NWAs	1 day	Wed 12/7/11	Wed 12/7/11
93	**Project Plan/Schedule**	**5 days**	**Thu 12/1/11**	**Wed 12/7/11**
94	Generate Project Plan/Schedule	5 days	Thu 12/1/11	Wed 12/7/11
95	Submit Project Plan/Schedule	0 days	Wed 12/7/11	Wed 12/7/11
96	**Design, Development and Documentation**	**102 days**	**Thu 12/8/11**	**Fri 4/27/12**



Task Milestone Summary Deadline Critical Task

Figure F-36. Integrated Master Schedule (IMS) – Our solution provides a credible, low risk schedule (continued)

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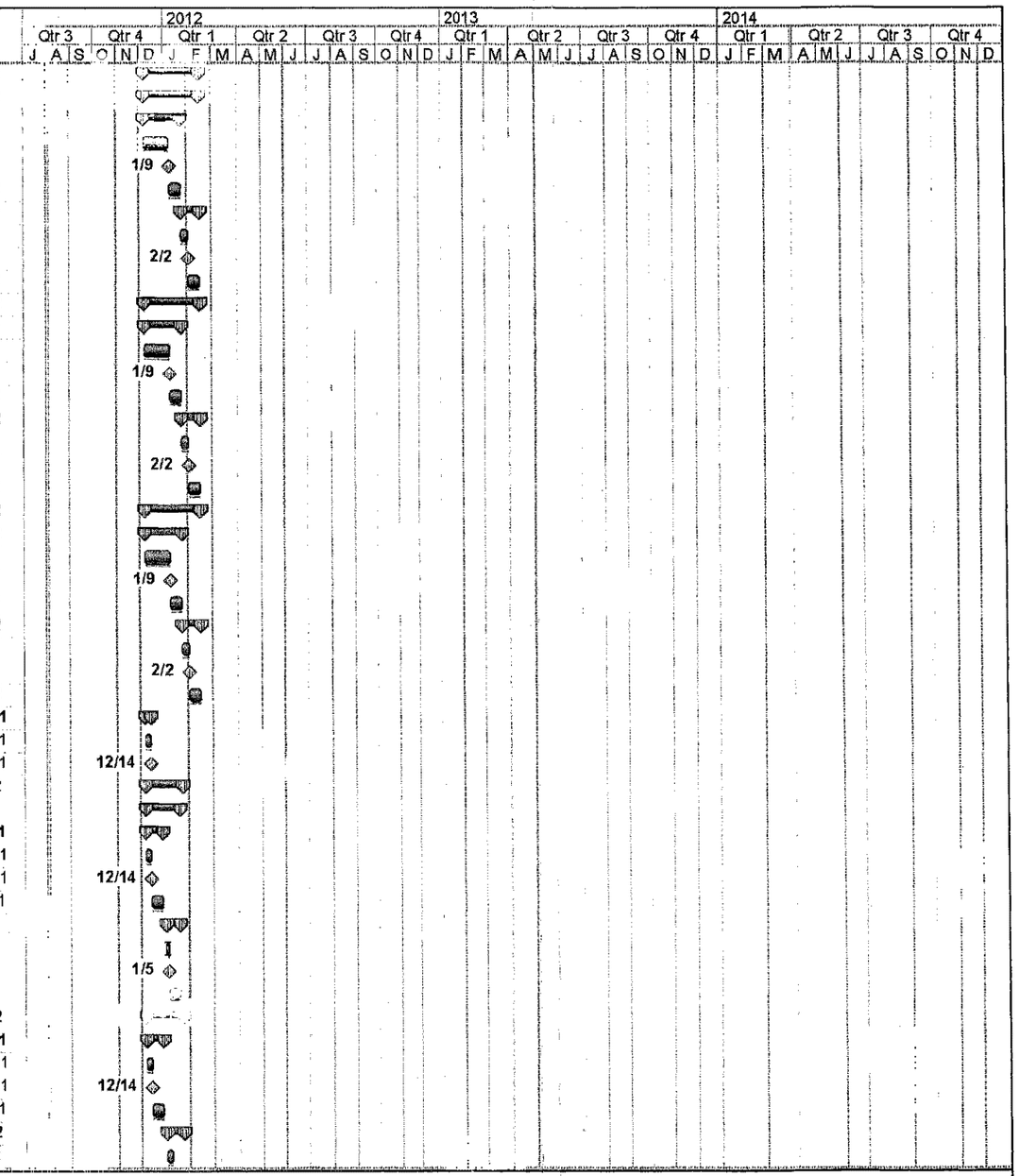
ID	Task Name	Duration	Start	Finish
97	**System Diagrams**	**51 days**	**Thu 12/8/11**	**Thu 2/16/12**
98	**System Block Diagram**	**51 days**	**Thu 12/8/11**	**Thu 2/16/12**
99	**Preliminary System Block Diagram**	**34 days**	**Thu 12/8/11**	**Tue 1/24/12**
100	Generate Prelim System Block Diagram	16 days	Thu 12/8/11	Mon 1/9/12
101	Submit Prelim System Block Diagram	0 days	Mon 1/9/12	Mon 1/9/12
102	Review Prelim System Block Diagram and Comment	10 days	Tue 1/10/12	Tue 1/24/12
103	**Final System Block Diagram**	**17 days**	**Wed 1/25/12**	**Thu 2/16/12**
104	Generate Final System Block Diagram	7 days	Wed 1/25/12	Thu 2/2/12
105	Submit Final System Block Diagram	0 days	Thu 2/2/12	Thu 2/2/12
106	Review and Approve Final System Block Diagram	10 days	Fri 2/3/12	Thu 2/16/12
107	**Connectivity Diagram**	**51 days**	**Thu 12/8/11**	**Thu 2/16/12**
108	**Preliminary Connectivity Diagram**	**34 days**	**Thu 12/8/11**	**Tue 1/24/12**
109	Generate Prelim Connectivity Diagram	16 days	Thu 12/8/11	Mon 1/9/12
110	Submit Prelim Connectivity Diagram	0 days	Mon 1/9/12	Mon 1/9/12
111	Review Prelim Connectivity Diagram and Comment	10 days	Tue 1/10/12	Tue 1/24/12
112	**Final Connectivity Diagram**	**17 days**	**Wed 1/25/12**	**Thu 2/16/12**
113	Generate Final Connectivity Diagram	7 days	Wed 1/25/12	Thu 2/2/12
114	Submit Final Connectivity Diagram	0 days	Thu 2/2/12	Thu 2/2/12
115	Review and Approve Final Connectivity Diagram	10 days	Fri 2/3/12	Thu 2/16/12
116	**Schematic Diagrams**	**51 days**	**Thu 12/8/11**	**Thu 2/16/12**
117	**Preliminary Schematic Diagrams**	**34 days**	**Thu 12/8/11**	**Tue 1/24/12**
118	Generate Prelim Schematic Diagrams	16 days	Thu 12/8/11	Mon 1/9/12
119	Submit Prelim Schematic Diagrams	0 days	Mon 1/9/12	Mon 1/9/12
120	Review Prelim Schematic Diagrams and Comment	10 days	Tue 1/10/12	Tue 1/24/12
121	**Final Schematic Diagrams**	**17 days**	**Wed 1/25/12**	**Thu 2/16/12**
122	Generate Final Schematic Diagrams	7 days	Wed 1/25/12	Thu 2/2/12
123	Submit Final Schematic Diagrams	0 days	Thu 2/2/12	Thu 2/2/12
124	Review and Approve Final Schematic Diagrams	10 days	Fri 2/3/12	Thu 2/16/12
125	**Security Practices and Policies**	**5 days**	**Thu 12/8/11**	**Wed 12/14/11**
126	Generate Security Practices and Policies	5 days	Thu 12/8/11	Wed 12/14/11
127	Submit Security Practices and Policies	0 days	Wed 12/14/11	Wed 12/14/11
128	**System Documentation**	**34 days**	**Thu 12/8/11**	**Tue 1/24/12**
129	**Executive Summary**	**32 days**	**Thu 12/8/11**	**Fri 1/20/12**
130	**Preliminary Executive Summary**	**16 days**	**Thu 12/8/11**	**Thu 12/29/11**
131	Generate Prelim Executive Summary	5 days	Thu 12/8/11	Wed 12/14/11
132	Submit Prelim Executive Summary	0 days	Wed 12/14/11	Wed 12/14/11
133	Review Prelim Executive Summary and Comment	10 days	Thu 12/15/11	Thu 12/29/11
134	**Final Executive Summary**	**14 days**	**Tue 1/3/12**	**Fri 1/20/12**
135	Generate Final Executive Summary	3 days	Tue 1/3/12	Thu 1/5/12
136	Submit Final Executive Summary	0 days	Thu 1/5/12	Thu 1/5/12
137	Review and Approve Final Executive Summary	10 days	Fri 1/6/12	Fri 1/20/12
138	**Design Overview**	**34 days**	**Thu 12/8/11**	**Tue 1/24/12**
139	**Preliminary Design Overview**	**16 days**	**Thu 12/8/11**	**Thu 12/29/11**
140	Generate Prelim Design Overview	5 days	Thu 12/8/11	Wed 12/14/11
141	Submit Prelim Design Overview	0 days	Wed 12/14/11	Wed 12/14/11
142	Review Prelim Design Overview and Comment	10 days	Thu 12/15/11	Thu 12/29/11
143	**Final Design Overview**	**16 days**	**Tue 1/3/12**	**Tue 1/24/12**
144	Generate Final Design Overview	5 days	Tue 1/3/12	Mon 1/9/12



Task Milestone Summary Deadline Critical Task

Figure F-36. Integrated Master Schedule (IMS) – Our solution provides a credible, low risk schedule (continued)

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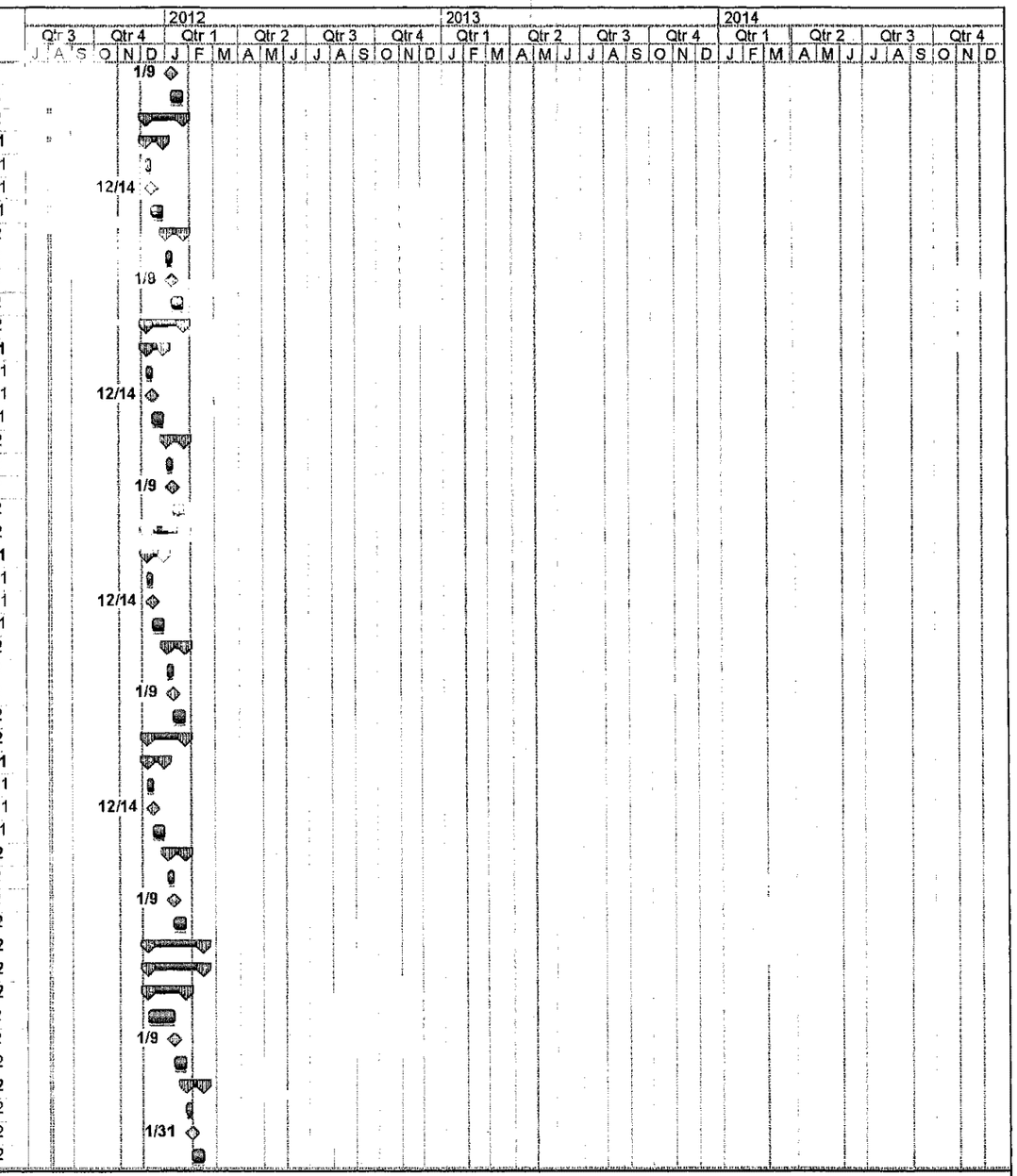
ID	Task Name	Duration	Start	Finish
145	Submit Final Design Overview	0 days	Mon 1/9/12	Mon 1/9/12
146	Review and Approve Final Design Overview	10 days	Tue 1/10/12	Tue 1/24/12
147	**Functional Description**	**34 days**	**Thu 12/8/11**	**Tue 1/24/12**
148	**Preliminary Functional Description**	**16 days**	**Thu 12/8/11**	**Thu 12/29/11**
149	Generate Prelim Functional Description	5 days	Thu 12/8/11	Wed 12/14/11
150	Submit Prelim Functional Description	0 days	Wed 12/14/11	Wed 12/14/11
151	Review Prelim Functional Description and Comment	10 days	Thu 12/15/11	Thu 12/29/11
152	**Final Functional Description**	**16 days**	**Tue 1/3/12**	**Tue 1/24/12**
153	Generate Final Functional Description	5 days	Tue 1/3/12	Mon 1/9/12
154	Submit Final Functional Description	0 days	Mon 1/9/12	Mon 1/9/12
155	Review and Approve Final Functional Description	10 days	Tue 1/10/12	Tue 1/24/12
156	**System Architecture**	**34 days**	**Thu 12/8/11**	**Tue 1/24/12**
157	**Preliminary System Architecture**	**16 days**	**Thu 12/8/11**	**Thu 12/29/11**
158	Generate Prelim System Architecture	5 days	Thu 12/8/11	Wed 12/14/11
159	Submit Prelim System Architecture	0 days	Wed 12/14/11	Wed 12/14/11
160	Review Prelim System Architecture and Comment	10 days	Thu 12/15/11	Thu 12/29/11
161	**Final System Architecture**	**16 days**	**Tue 1/3/12**	**Tue 1/24/12**
162	Generate Final System Architecture	5 days	Tue 1/3/12	Mon 1/9/12
163	Submit Final System Architecture	0 days	Mon 1/9/12	Mon 1/9/12
164	Review and Approve Final System Architecture	10 days	Tue 1/10/12	Tue 1/24/12
165	**Failure Handling/Recovery**	**34 days**	**Thu 12/8/11**	**Tue 1/24/12**
166	**Preliminary Failure Handling/Recovery**	**16 days**	**Thu 12/8/11**	**Thu 12/29/11**
167	Generate Prelim Failure Handling/Recovery	5 days	Thu 12/8/11	Wed 12/14/11
168	Submit Prelim Failure Handling/Recovery	0 days	Wed 12/14/11	Wed 12/14/11
169	Review Prelim Failure Handling/Recovery and Comment	10 days	Thu 12/15/11	Thu 12/29/11
170	**Final Failure Handling/Recovery**	**16 days**	**Tue 1/3/12**	**Tue 1/24/12**
171	Generate Final Failure Handling/Recovery	5 days	Tue 1/3/12	Mon 1/9/12
172	Submit Final Failure Handling/Recovery	0 days	Mon 1/9/12	Mon 1/9/12
173	Review and Approve Final Failure Handling/Recovery	10 days	Tue 1/10/12	Tue 1/24/12
174	**Narratives/Operating Features**	**34 days**	**Thu 12/8/11**	**Tue 1/24/12**
175	**Preliminary Narratives/Operating Features**	**16 days**	**Thu 12/8/11**	**Thu 12/29/11**
176	Generate Prelim Narratives/Operating Features	5 days	Thu 12/8/11	Wed 12/14/11
177	Submit Prelim Narratives/Operating Features	0 days	Wed 12/14/11	Wed 12/14/11
178	Review Prelim Narratives/Operating Features and Comment	10 days	Thu 12/15/11	Thu 12/29/11
179	**Final Narratives/Operating Features**	**16 days**	**Tue 1/3/12**	**Tue 1/24/12**
180	Generate Final Narratives/Operating Features	5 days	Tue 1/3/12	Mon 1/9/12
181	Submit Final Narratives/Operating Features	0 days	Mon 1/9/12	Mon 1/9/12
182	Review and Approve Final Narratives/Operating Features	10 days	Tue 1/10/12	Tue 1/24/12
183	**System Hardware Documentation**	**49 days**	**Thu 12/8/11**	**Tue 2/14/12**
184	**Hardware Specifications**	**49 days**	**Thu 12/8/11**	**Tue 2/14/12**
185	**Preliminary Hardware Specifications**	**34 days**	**Thu 12/8/11**	**Tue 1/24/12**
186	Generate Prelim Hardware Specifications	16 days	Thu 12/8/11	Mon 1/9/12
187	Submit Prelim Hardware Specifications	0 days	Mon 1/9/12	Mon 1/9/12
188	Review Prelim Hardware Specifications and Comment	10 days	Tue 1/10/12	Tue 1/24/12
189	**Final Hardware Specifications**	**15 days**	**Wed 1/25/12**	**Tue 2/14/12**
190	Generate Final Hardware Specifications	5 days	Wed 1/25/12	Tue 1/31/12
191	Submit Final Hardware Specifications	0 days	Tue 1/31/12	Tue 1/31/12
192	Review and Approve Final Hardware Specifications	10 days	Wed 2/1/12	Tue 2/14/12

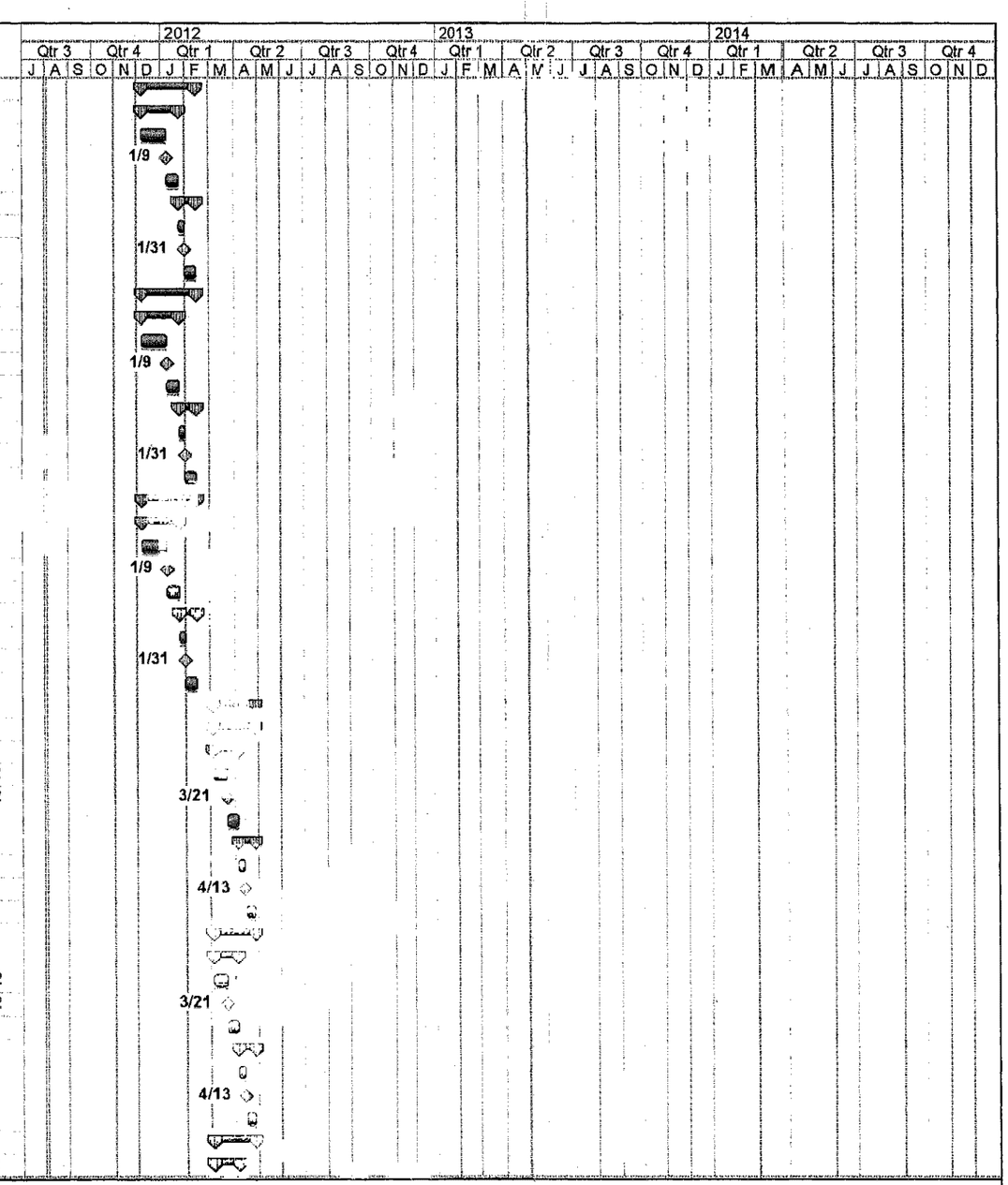


Task Milestone Summary Deadline Critical Task

Figure F-36. Integrated Master Schedule (IMS) – Our solution provides a credible, low risk schedule (continued)

Use or disclosure of data contained on this sheet is subject to the restriction on the title page of this proposal.

ID	Task Name	Duration	Start	Finish
193	**Component Drawings**	**49 days**	**Thu 12/8/11**	**Tue 2/14/12**
194	**Preliminary Component Drawings**	**34 days**	**Thu 12/8/11**	**Tue 1/24/12**
195	Generate Prelim Component Drawings	16 days	Thu 12/8/11	Mon 1/9/12
196	Submit Prelim Component Drawings	0 days	Mon 1/9/12	Mon 1/9/12
197	Review Prelim Component Drawings and Comment	10 days	Tue 1/10/12	Tue 1/24/12
198	**Final Component Drawings**	**15 days**	**Wed 1/25/12**	**Tue 2/14/12**
199	Generate Final Component Drawings	5 days	Wed 1/25/12	Tue 1/31/12
200	Submit Final Component Drawings	0 days	Tue 1/31/12	Tue 1/31/12
201	Review and Approve Final Component Drawings	10 days	Wed 2/1/12	Tue 2/14/12
202	**Computer Hardware Requirements**	**49 days**	**Thu 12/8/11**	**Tue 2/14/12**
203	**Preliminary Computer Hardware Requirements**	**34 days**	**Thu 12/8/11**	**Tue 1/24/12**
204	Generate Prelim Computer Hardware Requirements	16 days	Thu 12/8/11	Mon 1/9/12
205	Submit Prelim Computer Hardware Requirements	0 days	Mon 1/9/12	Mon 1/9/12
206	Review Prelim Computer Hardware Requirements and Comment	10 days	Tue 1/10/12	Tue 1/24/12
207	**Final Computer Hardware Requirements**	**15 days**	**Wed 1/25/12**	**Tue 2/14/12**
208	Generate Final Computer Hardware Requirements	5 days	Wed 1/25/12	Tue 1/31/12
209	Submit Final Computer Hardware Requirements	0 days	Tue 1/31/12	Tue 1/31/12
210	Review and Approve Final Computer Hardware Requirements	10 days	Wed 2/1/12	Tue 2/14/12
211	**COTS Products**	**49 days**	**Thu 12/8/11**	**Tue 2/14/12**
212	**Preliminary COTS Products**	**34 days**	**Thu 12/8/11**	**Tue 1/24/12**
213	Generate Prelim COTS Products	16 days	Thu 12/8/11	Mon 1/9/12
214	Submit Prelim COTS Products	0 days	Mon 1/9/12	Mon 1/9/12
215	Review Prelim COTS Products and Comment	10 days	Tue 1/10/12	Tue 1/24/12
216	**Final COTS Products**	**15 days**	**Wed 1/25/12**	**Tue 2/14/12**
217	Generate Final COTS Products	5 days	Wed 1/25/12	Tue 1/31/12
218	Submit Final COTS Products	0 days	Tue 1/31/12	Tue 1/31/12
219	Review and Approve Final COTS Products	10 days	Wed 2/1/12	Tue 2/14/12
220	**Manuals**	**40 days**	**Mon 3/5/12**	**Fri 4/27/12**
221	**Operations Manuals**	**40 days**	**Mon 3/5/12**	**Fri 4/27/12**
222	**Preliminary Operations Manuals**	**23 days**	**Mon 3/5/12**	**Wed 4/4/12**
223	Generate Prelim Operations Manuals	13 days	Mon 3/5/12	Wed 3/21/12
224	Submit Prelim Operations Manuals	0 days	Wed 3/21/12	Wed 3/21/12
225	Review Prelim Operations Manuals and Comment	10 days	Thu 3/22/12	Wed 4/4/12
226	**Final Operations Manuals**	**17 days**	**Thu 4/5/12**	**Fri 4/27/12**
227	Generate Final Operations Manuals	7 days	Thu 4/5/12	Fri 4/13/12
228	Submit Final Operations Manuals	0 days	Fri 4/13/12	Fri 4/13/12
229	Review and Approve Final Operations Manuals	10 days	Mon 4/16/12	Fri 4/27/12
230	**Application Administration Manual**	**40 days**	**Mon 3/5/12**	**Fri 4/27/12**
231	**Preliminary Application Administration Manual**	**23 days**	**Mon 3/5/12**	**Wed 4/4/12**
232	Generate Prelim Application Administration Manual	13 days	Mon 3/5/12	Wed 3/21/12
233	Submit Prelim Application Administration Manual	0 days	Wed 3/21/12	Wed 3/21/12
234	Review Prelim Application Administration Manual and Comment	10 days	Thu 3/22/12	Wed 4/4/12
235	**Final Application Administration Manual**	**17 days**	**Thu 4/5/12**	**Fri 4/27/12**
236	Generate Final Application Administration Manual	7 days	Thu 4/5/12	Fri 4/13/12
237	Submit Final Application Administration Manual	0 days	Fri 4/13/12	Fri 4/13/12
238	Review and Approve Final Application Administration Manual	10 days	Mon 4/16/12	Fri 4/27/12
239	**System Administrators Manual**	**40 days**	**Mon 3/5/12**	**Fri 4/27/12**
240	**Preliminary System Administrators Manual**	**23 days**	**Mon 3/5/12**	**Wed 4/4/12**



Task Milestone Summary Deadline Critical Task

Figure F-36. Integrated Master Schedule (IMS) – Our solution provides a credible, low risk schedule (continued)

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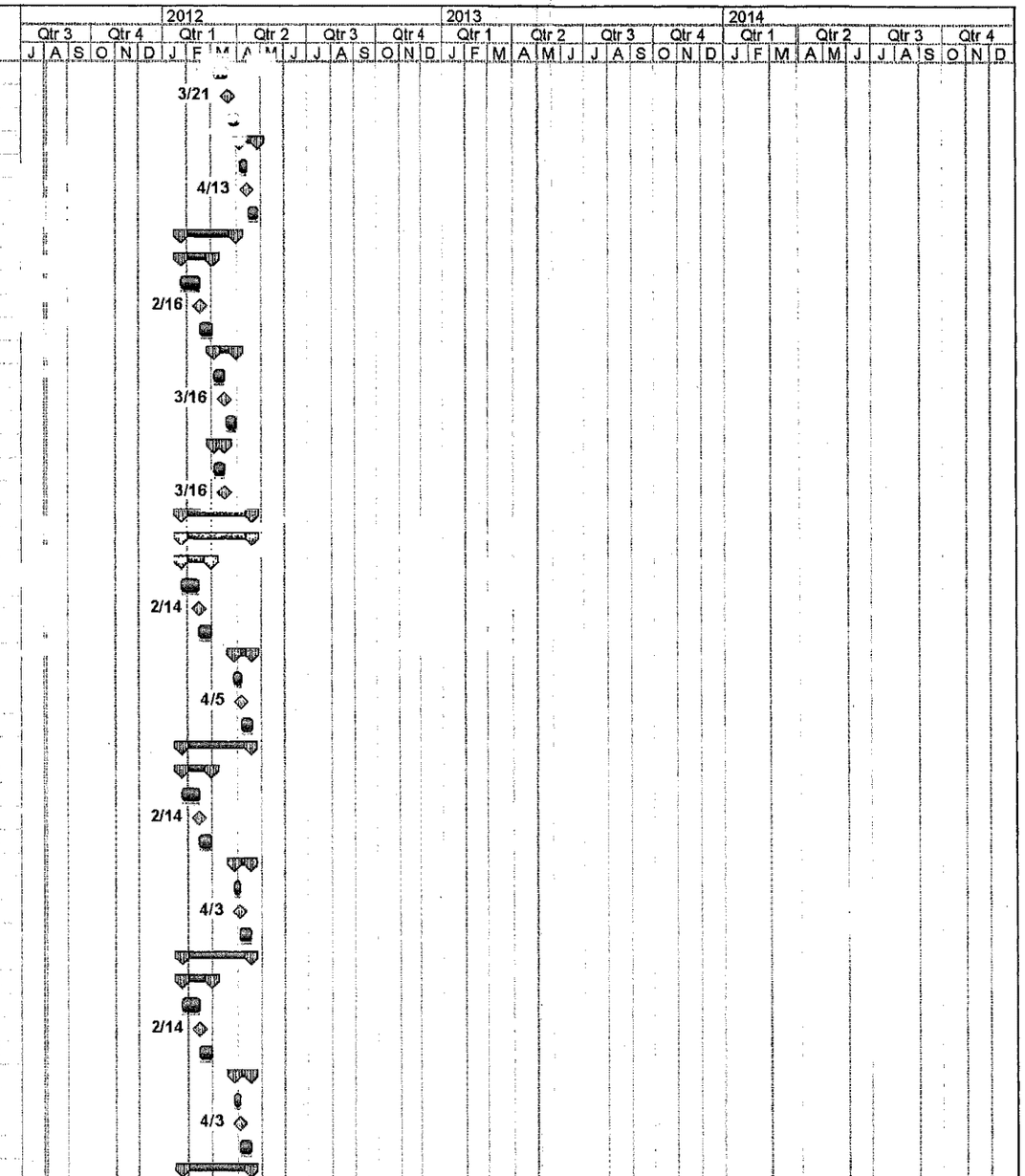
ID	Task Name	Duration	Start	Finish
241	Generate Prelim System Administrators Manual	13 days	Mon 3/5/12	Wed 3/21/12
242	Submit Prelim System Administrators Manual	0 days	Wed 3/21/12	Wed 3/21/12
243	Review Prelim System Administrators Manual and Comment	10 days	Thu 3/22/12	Wed 4/4/12
244	**Final System Administrators Manual**	**17 days**	**Thu 4/5/12**	**Fri 4/27/12**
245	Generate Final System Administrators Manual	7 days	Thu 4/5/12	Fri 4/13/12
246	Submit Final System Administrators Manual	0 days	Fri 4/13/12	Fri 4/13/12
247	Review and Approve Final System Administrators Manual	10 days	Mon 4/16/12	Fri 4/27/12
248	**Disaster Recovery Plan**	**48 days**	**Wed 1/25/12**	**Fri 3/30/12**
249	**Preliminary Disaster Recovery Plan**	**28 days**	**Wed 1/25/12**	**Fri 3/2/12**
250	Generate Prelim Disaster Recovery Plan	17 days	Wed 1/25/12	Thu 2/16/12
251	Submit Prelim Disaster Recovery Plan	0 days	Thu 2/16/12	Thu 2/16/12
252	Review Prelim Disaster Recovery Plan and Comment	10 days	Fri 2/17/12	Fri 3/2/12
253	**Final Disaster Recovery Plan**	**20 days**	**Mon 3/5/12**	**Fri 3/30/12**
254	Generate Final Disaster Recovery Plan	10 days	Mon 3/5/12	Fri 3/16/12
255	Submit Final Disaster Recovery Plan	0 days	Fri 3/16/12	Fri 3/16/12
256	Review and Approve Final Disaster Recovery Plan	10 days	Mon 3/19/12	Fri 3/30/12
257	**Change Management Documentation**	**10 days**	**Mon 3/5/12**	**Fri 3/16/12**
258	Generate Change Management Documentation	10 days	Mon 3/5/12	Fri 3/16/12
259	Submit Change Management Documentation	0 days	Fri 3/16/12	Fri 3/16/12
260	**Database Documentation**	**62 days**	**Wed 1/25/12**	**Thu 4/19/12**
261	**Database Schema**	**62 days**	**Wed 1/25/12**	**Thu 4/19/12**
262	**Preliminary Database Schema**	**26 days**	**Wed 1/25/12**	**Wed 2/29/12**
263	Generate Prelim Database Schema	15 days	Wed 1/25/12	Tue 2/14/12
264	Submit Prelim Database Schema	0 days	Tue 2/14/12	Tue 2/14/12
265	Review Prelim Database Schema and Comment	10 days	Wed 2/15/12	Wed 2/29/12
266	**Final Database Schema**	**17 days**	**Wed 3/28/12**	**Thu 4/19/12**
267	Generate Final Database Schema	7 days	Wed 3/28/12	Thu 4/5/12
268	Submit Final Database Schema	0 days	Thu 4/5/12	Thu 4/5/12
269	Review and Approve Final Database Schema	10 days	Fri 4/6/12	Thu 4/19/12
270	**Data Dictionary**	**60 days**	**Wed 1/25/12**	**Tue 4/17/12**
271	**Preliminary Data Dictionary**	**26 days**	**Wed 1/25/12**	**Wed 2/29/12**
272	Generate Prelim Data Dictionary	15 days	Wed 1/25/12	Tue 2/14/12
273	Submit Prelim Data Dictionary	0 days	Tue 2/14/12	Tue 2/14/12
274	Review Prelim Data Dictionary and Comment	10 days	Wed 2/15/12	Wed 2/29/12
275	**Final Data Dictionary**	**15 days**	**Wed 3/28/12**	**Tue 4/17/12**
276	Generate Final Data Dictionary	5 days	Wed 3/28/12	Tue 4/3/12
277	Submit Final Data Dictionary	0 days	Tue 4/3/12	Tue 4/3/12
278	Review and Approve Final Data Dictionary	10 days	Wed 4/4/12	Tue 4/17/12
279	**Data Storage Analysis**	**60 days**	**Wed 1/25/12**	**Tue 4/17/12**
280	**Preliminary Data Storage Analysis**	**26 days**	**Wed 1/25/12**	**Wed 2/29/12**
281	Generate Prelim Data Storage Analysis	15 days	Wed 1/25/12	Tue 2/14/12
282	Submit Prelim Data Storage Analysis	0 days	Tue 2/14/12	Tue 2/14/12
283	Review Prelim Data Storage Analysis and Comment	10 days	Wed 2/15/12	Wed 2/29/12
284	**Final Data Storage Analysis**	**15 days**	**Wed 3/28/12**	**Tue 4/17/12**
285	Generate Final Data Storage Analysis	5 days	Wed 3/28/12	Tue 4/3/12
286	Submit Final Data Storage Analysis	0 days	Tue 4/3/12	Tue 4/3/12
287	Review and Approve Final Data Storage Analysis	10 days	Wed 4/4/12	Tue 4/17/12
288	**Data Flow Diagram**	**60 days**	**Wed 1/25/12**	**Tue 4/17/12**



Task Milestone Summary Deadline Critical Task

Figure F-36. Integrated Master Schedule (IMS) – Our solution provides a credible, low risk schedule (continued)

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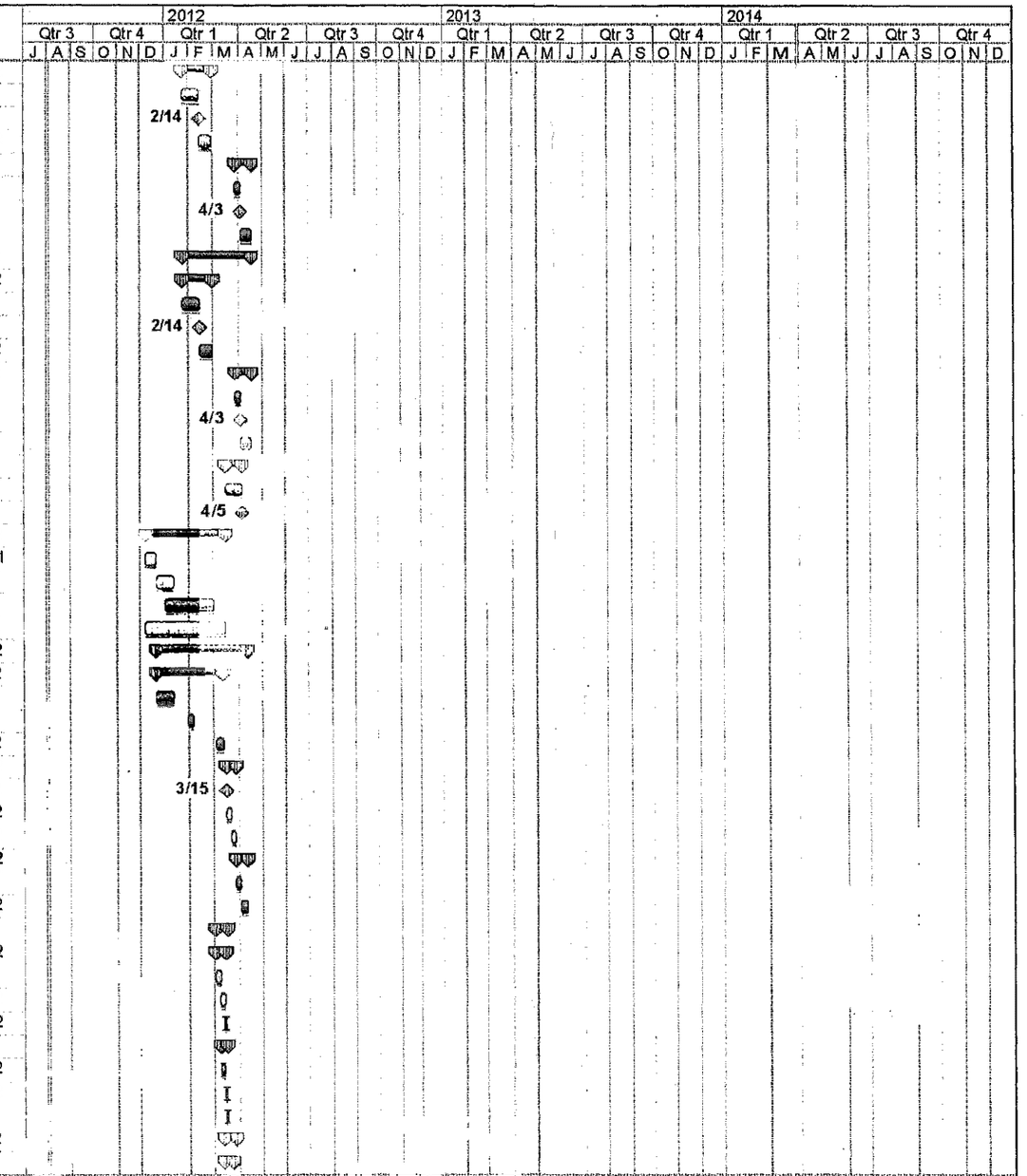
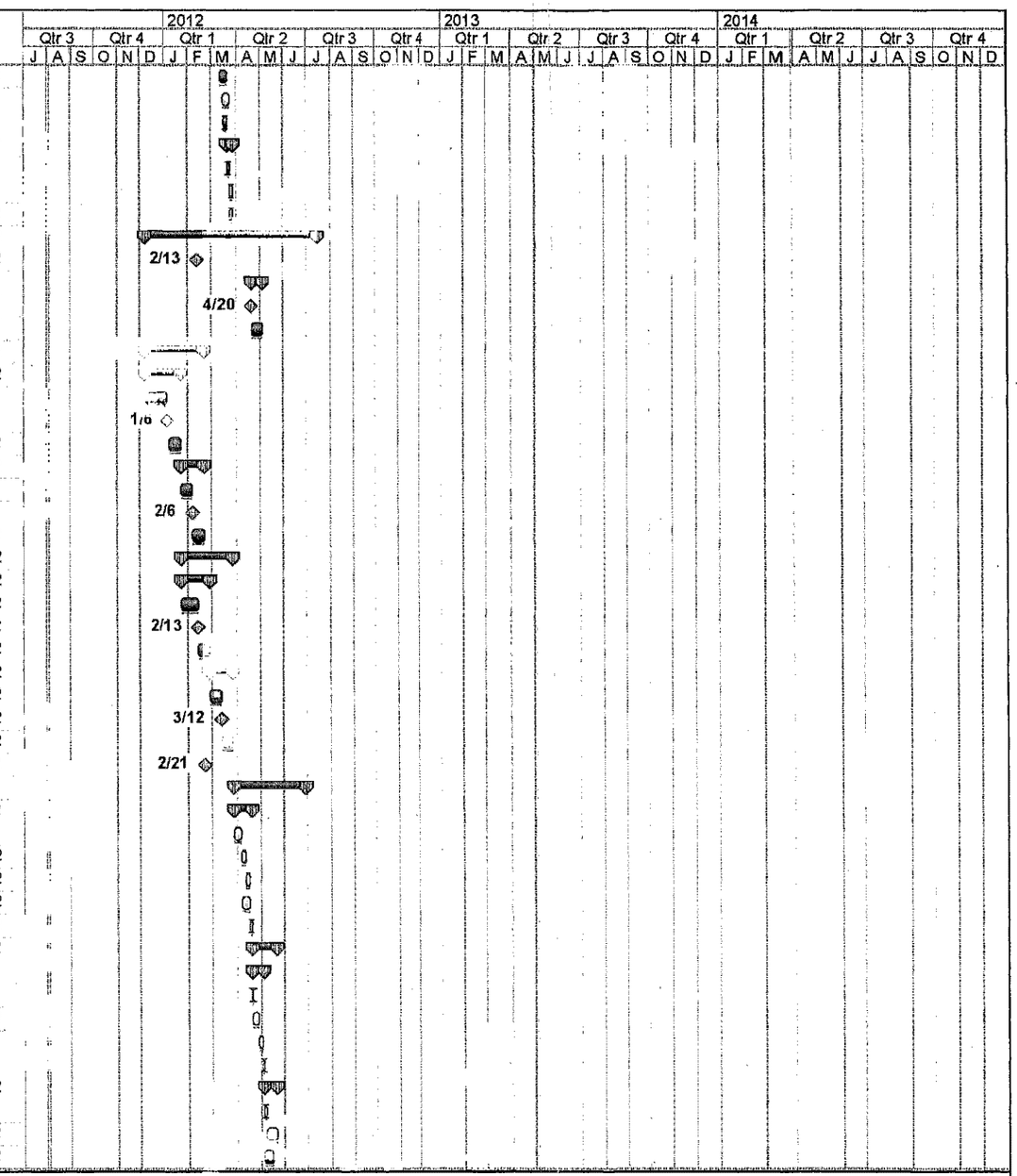
ID	Task Name	Duration	Start	Finish
289	**Preliminary Data Flow Diagram**	**26 days**	**Wed 1/25/12**	**Wed 2/29/12**
290	Generate Prelim Data Flow Diagram	15 days	Wed 1/25/12	Tue 2/14/12
291	Submit Prelim Data Flow Diagram	0 days	Tue 2/14/12	Tue 2/14/12
292	Review Prelim Data Flow Diagram and Comment	10 days	Wed 2/15/12	Wed 2/29/12
293	**Final Data Flow Diagram**	**15 days**	**Wed 3/28/12**	**Tue 4/17/12**
294	Generate Final Data Flow Diagram	5 days	Wed 3/28/12	Tue 4/3/12
295	Submit Final Data Flow Diagram	0 days	Tue 4/3/12	Tue 4/3/12
296	Review and Approve Final Data Flow Diagram	10 days	Wed 4/4/12	Tue 4/17/12
297	**Entity-Relationship Diagram**	**60 days**	**Wed 1/25/12**	**Tue 4/17/12**
298	**Preliminary Entity-Relationship Diagram**	**26 days**	**Wed 1/25/12**	**Wed 2/29/12**
299	Generate Prelim Entity-Relationship Diagram	15 days	Wed 1/25/12	Tue 2/14/12
300	Submit Prelim Entity-Relationship Diagram	0 days	Tue 2/14/12	Tue 2/14/12
301	Review Prelim Entity-Relationship Diagram and Comment	10 days	Wed 2/15/12	Wed 2/29/12
302	**Final Entity-Relationship Diagram**	**15 days**	**Wed 3/28/12**	**Tue 4/17/12**
303	Generate Final Entity-Relationship Diagram	5 days	Wed 3/28/12	Tue 4/3/12
304	Submit Final Entity-Relationship Diagram	0 days	Tue 4/3/12	Tue 4/3/12
305	Review and Approve Final Entity-Relationship Diagram	10 days	Wed 4/4/12	Tue 4/17/12
306	**Schedule of Preventive Maintenance**	**15 days**	**Fri 3/16/12**	**Thu 4/5/12**
307	Generate Schedule of Preventive Maintenance	15 days	Fri 3/16/12	Thu 4/5/12
308	Submit Schedule of Preventive Maintenance	0 days	Thu 4/5/12	Thu 4/5/12
309	**Material Procurement**	**71 days**	**Thu 12/8/11**	**Thu 3/15/12**
310	Review and Release BOM	10 days	Thu 12/8/11	Wed 12/21/11
311	Procure Material	10 days	Thu 12/22/11	Fri 1/13/12
312	Material Lead Time	60 edays	Mon 1/2/12	Fri 3/2/12
313	Metron Lead Time	71 days	Thu 12/8/11	Thu 3/15/12
314	**Lab Build-out**	**80 days**	**Thu 12/22/11**	**Wed 4/11/12**
315	**Lab Build-out at Raytheon**	**58 days**	**Thu 12/22/11**	**Mon 3/12/12**
316	Build-out Lab	10 days	Thu 12/22/11	Fri 1/13/12
317	Install and Checkout Initial Material	5 days	Tue 1/31/12	Mon 2/6/12
318	Install and Checkout Final Material	6 days	Mon 3/5/12	Mon 3/12/12
319	**System Integration and Security Integration at Raytheon**	**8 days**	**Thu 3/15/12**	**Tue 3/27/12**
320	Final Metron Software Version Available	0 days	Thu 3/15/12	Thu 3/15/12
321	Integrate System	5 days	Fri 3/16/12	Wed 3/21/12
322	Implement Initial Security	5 days	Thu 3/22/12	Tue 3/27/12
323	**Breakdown and Ship Lab Equipment**	**11 days**	**Wed 3/28/12**	**Wed 4/11/12**
324	Breakdown Lab	5 days	Wed 3/28/12	Mon 4/2/12
325	Pack and Ship Lab Equipment	7 days	Tue 4/3/12	Wed 4/11/12
326	**Ship Equipment to Site**	**10 days**	**Sat 3/3/12**	**Fri 3/16/12**
327	**Kit and Pack**	**8 days**	**Sat 3/3/12**	**Wed 3/14/12**
328	Kit and Pack Data Center 1	5 days	Sat 3/3/12	Thu 3/8/12
329	Kit and Pack Data Center 2	5 days	Thu 3/8/12	Tue 3/13/12
330	Kit and Pack JFK	2 days	Tue 3/13/12	Wed 3/14/12
331	**Ship to Site**	**6 days**	**Fri 3/9/12**	**Fri 3/16/12**
332	Ship to Data Center 1	2 days	Fri 3/9/12	Mon 3/12/12
333	Ship to Data Center 2	2 days	Wed 3/14/12	Thu 3/15/12
334	Ship to JFK	2 days	Thu 3/15/12	Fri 3/16/12
335	**Installation and Integration**	**11 days**	**Tue 3/13/12**	**Tue 3/27/12**
336	**Equipment Installation**	**9 days**	**Tue 3/13/12**	**Fri 3/23/12**



Task Milestone Summary Deadline Critical Task

Figure F-36. Integrated Master Schedule (IMS) – Our solution provides a credible, low risk schedule (continued)

ID	Task Name	Duration	Start	Finish
337	Install Data Center 1	7 days	Tue 3/13/12	Tue 3/20/12
338	Install Data Center 2	7 days	Fri 3/16/12	Fri 3/23/12
339	Install JFK	3 days	Sat 3/17/12	Tue 3/20/12
340	**System Integration**	**5 days**	**Wed 3/21/12**	**Tue 3/27/12**
341	Integrate Data Center 1	3 days	Wed 3/21/12	Fri 3/23/12
342	Integrate Data Center 2	3 days	Sat 3/24/12	Tue 3/27/12
343	Integrate JFK	3 days	Sat 3/24/12	Tue 3/27/12
344	**Testing**	**157 days**	**Thu 12/8/11**	**Sun 7/15/12**
345	External Feeds Available	0 days	Mon 2/13/12	Mon 2/13/12
346	**Audit Report**	**10 days**	**Fri 4/20/12**	**Fri 5/4/12**
347	Submit Audit Report (SAS-70 Level 2 certification)	0 days	Fri 4/20/12	Fri 4/20/12
348	Review and Approve Audit Report (SAS-70 Level 2 certification)	10 days	Fri 4/20/12	Fri 5/4/12
349	**Test Plan**	**54 days**	**Thu 12/8/11**	**Tue 2/21/12**
350	**Preliminary Acceptance Test Plan**	**33 days**	**Thu 12/8/11**	**Mon 1/23/12**
351	Generate Prelim Acceptance Test Plan	15 days	Thu 12/8/11	Fri 1/6/12
352	Submit Prelim Acceptance Test Plan	0 days	Fri 1/6/12	Fri 1/6/12
353	Review Prelim Acceptance Test Plan and Comment	10 days	Mon 1/9/12	Mon 1/23/12
354	**Final Acceptance Test Plan**	**21 days**	**Tue 1/24/12**	**Tue 2/21/12**
355	Generate Final Acceptance Test Plan	10 days	Tue 1/24/12	Mon 2/6/12
356	Submit Final Acceptance Test Plan	0 days	Mon 2/6/12	Mon 2/6/12
357	Review and Approve Final Acceptance Test Plan	10 days	Tue 2/7/12	Tue 2/21/12
358	**Test Procedures**	**45 days**	**Tue 1/24/12**	**Mon 3/26/12**
359	**Preliminary Acceptance Test Procedures**	**25 days**	**Tue 1/24/12**	**Mon 2/27/12**
360	Generate Prelim Acceptance Test Procedures	15 days	Tue 1/24/12	Mon 2/13/12
361	Submit Prelim Acceptance Test Procedures	0 days	Mon 2/13/12	Mon 2/13/12
362	Review Prelim Acceptance Test Procedures and Comment	10 days	Tue 2/14/12	Mon 2/27/12
363	**Final Acceptance Test Procedures**	**20 days**	**Tue 2/28/12**	**Mon 3/26/12**
364	Generate Final Acceptance Test Procedures	10 days	Tue 2/28/12	Mon 3/12/12
365	Submit Final Acceptance Test Procedures	0 days	Mon 3/12/12	Mon 3/12/12
366	Review and Approve Final Acceptance Test Procedures	10 days	Tue 3/13/12	Mon 3/26/12
367	Notify Port Authority Ready to Schedule System Acceptance Test	0 days	Tue 2/21/12	Tue 2/21/12
368	**System Test**	**67.5 days**	**Wed 3/28/12**	**Fri 6/29/12**
369	**SQA Dry Run**	**17 days**	**Wed 3/28/12**	**Thu 4/19/12**
370	Execute Functional Test SQA Dry Run	8 days	Wed 3/28/12	Thu 4/5/12
371	Execute Stress & Performance Test SQA Dry Run	5 days	Fri 4/6/12	Wed 4/11/12
372	Execute Failover Test SQA Dry Run	4 days	Thu 4/12/12	Mon 4/16/12
373	Conduct STR Resolution	8 days	Sat 4/7/12	Mon 4/16/12
374	Execute Regression Test	3 days	Tue 4/17/12	Thu 4/19/12
375	**Pre-Acceptance Test Dry Run**	**22.5 days**	**Fri 4/20/12**	**Tue 5/22/12**
376	**Pre-Acceptance Test Dry Run Conduct**	**11 days**	**Fri 4/20/12**	**Sat 5/5/12**
377	Conduct Pre-Acceptance Test Readiness Review	0.5 days	Fri 4/20/12	Fri 4/20/12
378	Execute Pre-Acceptance Functional Test Dry Run	7 days	Fri 4/20/12	Sat 4/28/12
379	Execute Pre-Acceptance Stress & Performance Test Dry Run	4 days	Sat 4/28/12	Thu 5/3/12
380	Execute Pre-Acceptance Failover Test Dry Run	2 days	Thu 5/3/12	Sat 5/5/12
381	**Pre-Acceptance Dry Run Test Report**	**11.5 days**	**Sat 5/5/12**	**Tue 5/22/12**
382	Generate Pre-Acceptance Test Dry Run Report	2 days	Sat 5/5/12	Tue 5/8/12
383	Review and Approval Pre-Acceptance Test Dry Run Report	10 days	Tue 5/8/12	Tue 5/22/12
384	Conduct Security Hardening	10 days	Sat 5/5/12	Thu 5/17/12



Task Milestone Summary Deadline Critical Task

Figure F-36. Integrated Master Schedule (IMS) – Our solution provides a credible, low risk schedule (continued)

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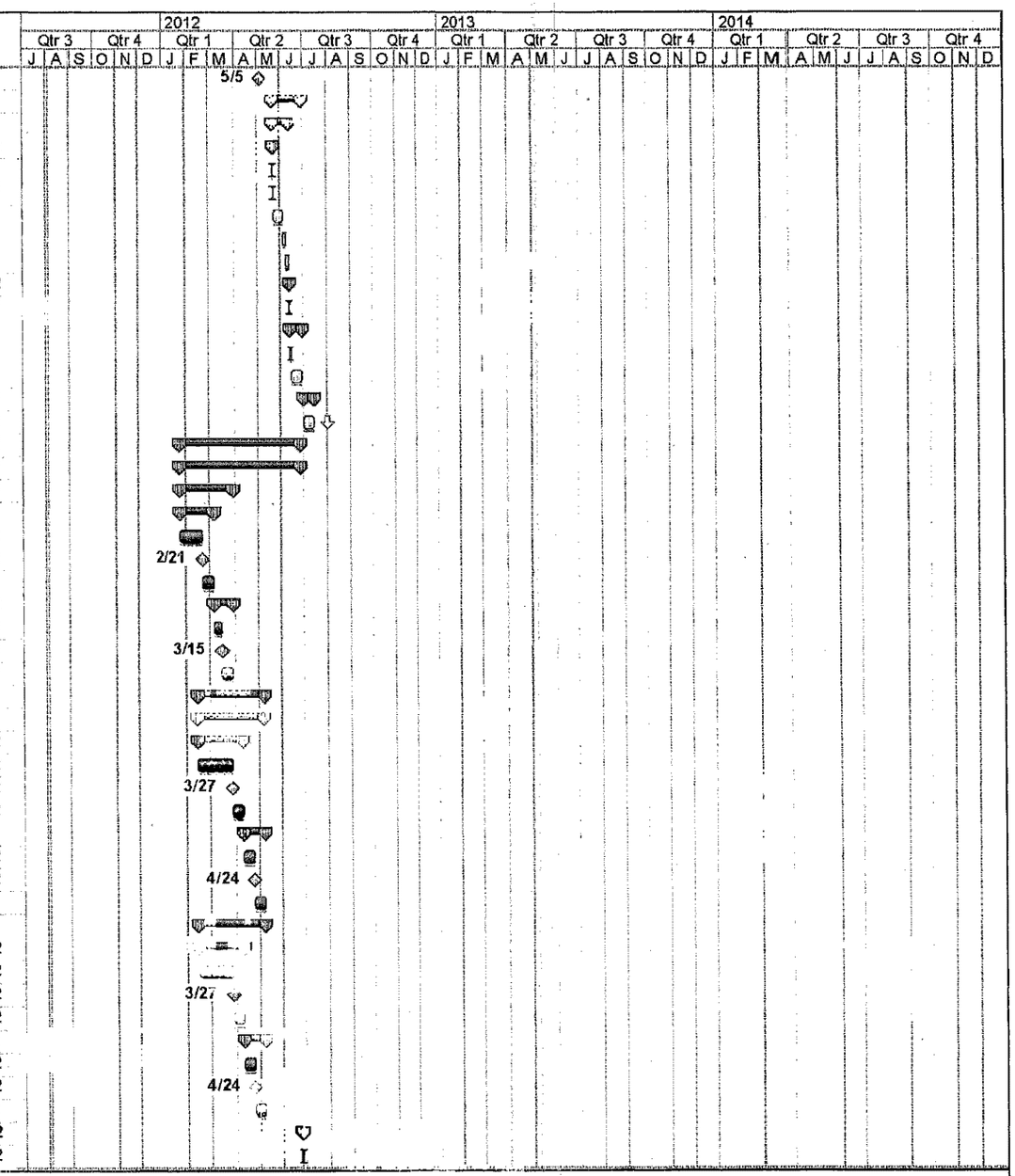
ID	Task Name	Duration	Start	Finish
385	Notify Port Authority Schedule Reminder for System Acceptance Test	0 days	Sat 5/5/12	Sat 5/5/12
386	**Acceptance Test**	**28 days**	**Tue 5/22/12**	**Fri 6/29/12**
387	**Acceptance Test Conduct**	**15 days**	**Tue 5/22/12**	**Tue 6/12/12**
388	**Acceptance Test Inbrief**	**1 day**	**Tue 5/22/12**	**Wed 5/23/12**
389	Conduct Acceptance Test Inbrief	0.5 days	Tue 5/22/12	Tue 5/22/12
390	Conduct Acceptance Test Readiness Review	0.5 days	Wed 5/23/12	Wed 5/23/12
391	Execute Acceptance Functional Test	7 days	Wed 5/23/12	Mon 6/4/12
392	Execute Acceptance Stress & Performance Test	4 days	Mon 6/4/12	Fri 6/8/12
393	Execute Acceptance Failover Test	2 days	Fri 6/8/12	Tue 6/12/12
394	**Acceptance Test Outbrief**	**1 day**	**Tue 6/12/12**	**Wed 6/13/12**
395	Acceptance Test Outbrief	1 day	Tue 6/12/12	Wed 6/13/12
396	**Acceptance Test Report**	**12 days**	**Wed 6/13/12**	**Fri 6/29/12**
397	Acceptance Test Report Generation	2 days	Wed 6/13/12	Fri 6/15/12
398	Review and Approve Acceptance Test Report	10 days	Fri 6/15/12	Fri 6/29/12
399	**Operational Test**	**10 days**	**Sun 7/1/12**	**Sun 7/15/12**
400	Conduct 14 day Operational Test	14 days	Sun 7/1/12	Sun 7/15/12
401	**Training**	**110 days**	**Wed 1/25/12**	**Tue 6/26/12**
402	**Training Documentation**	**110 days**	**Wed 1/25/12**	**Tue 6/26/12**
403	**Training Plan**	**47 days**	**Wed 1/25/12**	**Thu 3/29/12**
404	**Preliminary Training Plan**	**30 days**	**Wed 1/25/12**	**Tue 3/6/12**
405	Generate Prelim Training Plan	20 days	Wed 1/25/12	Tue 2/21/12
406	Submit Prelim Training Plan	0 days	Tue 2/21/12	Tue 2/21/12
407	Review Prelim Training Plan and Comment	10 days	Wed 2/22/12	Tue 3/6/12
408	**Final Training Plan**	**17 days**	**Wed 3/7/12**	**Thu 3/29/12**
409	Generate Final Training Plan	7 days	Wed 3/7/12	Thu 3/15/12
410	Submit Final Training Plan	0 days	Thu 3/15/12	Thu 3/15/12
411	Review and Approve Final Training Plan	10 days	Fri 3/16/12	Thu 3/29/12
412	**Training Materials**	**60 days**	**Wed 2/15/12**	**Tue 5/8/12**
413	**Instructor Training Materials**	**60 days**	**Wed 2/15/12**	**Tue 5/8/12**
414	**Preliminary Instructor Training Materials**	**40 days**	**Wed 2/15/12**	**Tue 4/10/12**
415	Generate Prelim Instructor Training Materials	30 days	Wed 2/15/12	Tue 3/27/12
416	Submit Prelim Instructor Training Materials	0 days	Tue 3/27/12	Tue 3/27/12
417	Review Prelim Instructor Training Materials and Comment	10 days	Wed 3/28/12	Tue 4/10/12
418	**Final Instructor Training Materials**	**20 days**	**Wed 4/11/12**	**Tue 5/8/12**
419	Generate Final Instructor Training Materials	10 days	Wed 4/11/12	Tue 4/24/12
420	Submit Final Instructor Training Materials	0 days	Tue 4/24/12	Tue 4/24/12
421	Review and Approve Final Instructor Training Materials	10 days	Wed 4/25/12	Tue 5/8/12
422	**Participant Training Materials**	**60 days**	**Wed 2/15/12**	**Tue 5/8/12**
423	**Preliminary Participant Training Materials**	**40 days**	**Wed 2/15/12**	**Tue 4/10/12**
424	Generate Preliminary Participant Training Materials	30 days	Wed 2/15/12	Tue 3/27/12
425	Submit Preliminary Participant Training Materials	0 days	Tue 3/27/12	Tue 3/27/12
426	Review Preliminary Participant Training Materials and Comment	10 days	Wed 3/28/12	Tue 4/10/12
427	**Final Participant Training Materials**	**20 days**	**Wed 4/11/12**	**Tue 5/8/12**
428	Generate Final Participant Training Materials	10 days	Wed 4/11/12	Tue 4/24/12
429	Submit Final Participant Training Materials	0 days	Tue 4/24/12	Tue 4/24/12
430	Review and Approve Final Participant Training Materials	10 days	Wed 4/25/12	Tue 5/8/12
431	**Post Training Report**	**2 days**	**Mon 6/25/12**	**Tue 6/26/12**
432	Generate Training Report	2 days	Mon 6/25/12	Tue 6/26/12

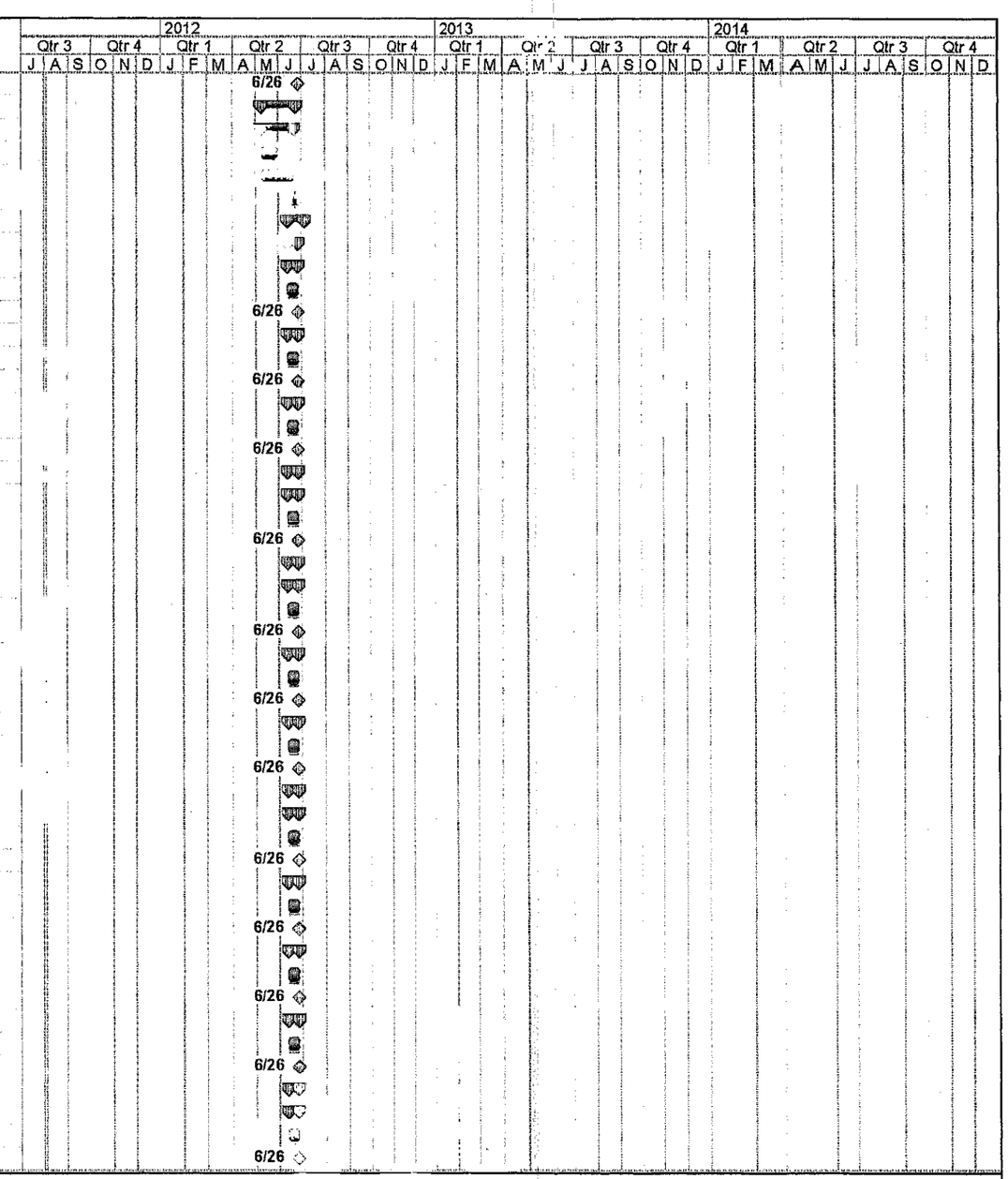


Task Milestone Summary Deadline Critical Task

Figure F-36. Integrated Master Schedule (IMS) – Our solution provides a credible, low risk schedule (continued)

Use or disclosure of data contained on this sheet is subject to the restriction on the title page of this proposal.

ID	Task Name	Duration	Start	Finish
433	Submit Training Report	0 days	Tue 6/26/12	Tue 6/26/12
434	**Training**	**33 days**	**Wed 5/9/12**	**Sat 6/23/12**
435	**Classroom Training**	**31 days**	**Wed 5/9/12**	**Wed 6/20/12**
436	Conduct Training - PANYNJ Users (5 16 hour classes)	15 days	Wed 5/9/12	Wed 5/30/12
437	Conduct Training - Non PANYNJ Users (30 8 hour classes)	30 days	Wed 5/9/12	Wed 6/20/12
438	Conduct Coaching/Training	3 edays	Wed 6/20/12	Sat 6/23/12
439	**As-Built Documentation**	**16.5 days**	**Tue 6/12/12**	**Wed 7/4/12**
440	**System Diagrams**	**10 days**	**Tue 6/12/12**	**Tue 6/26/12**
441	**As-Built System Block Diagram**	**10 days**	**Tue 6/12/12**	**Tue 6/26/12**
442	Generate As-Built System Block Diagram	10 days	Tue 6/12/12	Tue 6/26/12
443	Submit As-Built System Block Diagram	0 days	Tue 6/26/12	Tue 6/26/12
444	**As-Built Connectivity Diagram**	**10 days**	**Tue 6/12/12**	**Tue 6/26/12**
445	Generate As-Built Connectivity Diagram	10 days	Tue 6/12/12	Tue 6/26/12
446	Submit As-Built Connectivity Diagram	0 days	Tue 6/26/12	Tue 6/26/12
447	**As-Built Schematic Diagrams**	**10 days**	**Tue 6/12/12**	**Tue 6/26/12**
448	Generate As-Built Schematic Diagrams	10 days	Tue 6/12/12	Tue 6/26/12
449	Submit As-Built Schematic Diagrams	0 days	Tue 6/26/12	Tue 6/26/12
450	**Security Practices and Policies**	**10 days**	**Tue 6/12/12**	**Tue 6/26/12**
451	**As-Built Security Practices and Policies**	**10 days**	**Tue 6/12/12**	**Tue 6/26/12**
452	Generate As-Built Security Practices and Policies	10 days	Tue 6/12/12	Tue 6/26/12
453	Submit As-Built Security Practices and Policies	0 days	Tue 6/26/12	Tue 6/26/12
454	**System Documentation**	**10 days**	**Tue 6/12/12**	**Tue 6/26/12**
455	**As-Built System Architecture**	**10 days**	**Tue 6/12/12**	**Tue 6/26/12**
456	Generate As-Built System Architecture	10 days	Tue 6/12/12	Tue 6/26/12
457	Submit As-Built System Architecture	0 days	Tue 6/26/12	Tue 6/26/12
458	**As-Built Failure Handling/Recovery**	**10 days**	**Tue 6/12/12**	**Tue 6/26/12**
459	Generate As-Built Failure Handling/Recovery	10 days	Tue 6/12/12	Tue 6/26/12
460	Submit As-Built Failure Handling/Recovery	0 days	Tue 6/26/12	Tue 6/26/12
461	**As-Built Narratives/Operating Features**	**10 days**	**Tue 6/12/12**	**Tue 6/26/12**
462	Generate As-Built Narratives/Operating Features	10 days	Tue 6/12/12	Tue 6/26/12
463	Submit As-Built Narratives/Operating Features	0 days	Tue 6/26/12	Tue 6/26/12
464	**System Hardware Documentation**	**10 days**	**Tue 6/12/12**	**Tue 6/26/12**
465	**As-Built Hardware Specifications**	**10 days**	**Tue 6/12/12**	**Tue 6/26/12**
466	Generate As-Built Hardware Specifications	10 days	Tue 6/12/12	Tue 6/26/12
467	Submit As-Built Hardware Specifications	0 days	Tue 6/26/12	Tue 6/26/12
468	**As-Built Component Drawings**	**10 days**	**Tue 6/12/12**	**Tue 6/26/12**
469	Generate As-Built Component Drawings	10 days	Tue 6/12/12	Tue 6/26/12
470	Submit As-Built Component Drawings	0 days	Tue 6/26/12	Tue 6/26/12
471	**As-Built Computer Hardware Requirements**	**10 days**	**Tue 6/12/12**	**Tue 6/26/12**
472	Generate As-Built Computer Hardware Requirements	10 days	Tue 6/12/12	Tue 6/26/12
473	Submit As-Built Computer Hardware Requirements	0 days	Tue 6/26/12	Tue 6/26/12
474	**As-Built COTS Products**	**10 days**	**Tue 6/12/12**	**Tue 6/26/12**
475	Generate As-Built COTS Products	10 days	Tue 6/12/12	Tue 6/26/12
476	Submit As-Built COTS Products	0 days	Tue 6/26/12	Tue 6/26/12
477	**Manuals**	**10 days**	**Tue 6/12/12**	**Tue 6/26/12**
478	**Operations Manuals**	**10 days**	**Tue 6/12/12**	**Tue 6/26/12**
479	Generate As-Built Operations Manuals	10 days	Tue 6/12/12	Tue 6/26/12
480	Submit As-Built Operations Manuals	0 days	Tue 6/26/12	Tue 6/26/12

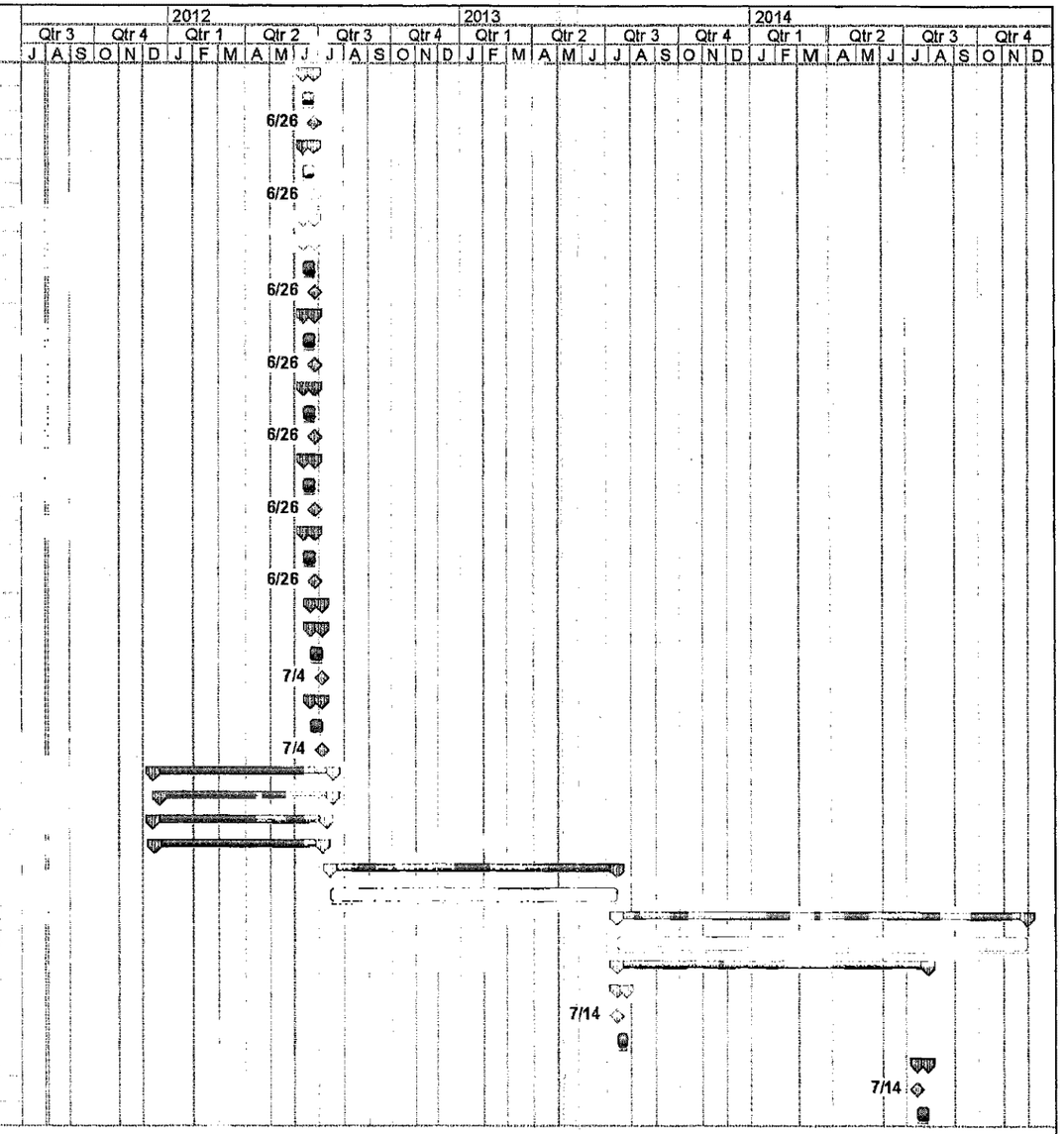


Task Milestone Summary Deadline Critical Task

Figure F-36. Integrated Master Schedule (IMS) – Our solution provides a credible, low risk schedule (continued)

Use or disclosure of data contained on this sheet is subject to the restriction on the title page of this proposal.

ID	Task Name	Duration	Start	Finish
481	**Application Administration Manual**	**10 days**	**Tue 6/12/12**	**Tue 6/26/12**
482	Generate As-Built Application Administration Manual	10 days	Tue 6/12/12	Tue 6/26/12
483	Submit As-Built Application Administration Manual	0 days	Tue 6/26/12	Tue 6/26/12
484	**System Administrators Manual**	**10 days**	**Tue 6/12/12**	**Tue 6/26/12**
485	Generate As-Built System Administrators Manual	10 days	Tue 6/12/12	Tue 6/26/12
486	Submit As-Built System Administrators Manual	0 days	Tue 6/26/12	Tue 6/26/12
487	**Database Documentation**	**10 days**	**Tue 6/12/12**	**Tue 6/26/12**
488	**As-Built Database Schema**	**10 days**	**Tue 6/12/12**	**Tue 6/26/12**
489	Generate As-Built Database Schema	10 days	Tue 6/12/12	Tue 6/26/12
490	Submit As-Built Database Schema	0 days	Tue 6/26/12	Tue 6/26/12
491	**As-Built Data Dictionary**	**10 days**	**Tue 6/12/12**	**Tue 6/26/12**
492	Generate As-Built Data Dictionary	10 days	Tue 6/12/12	Tue 6/26/12
493	Submit As-Built Data Dictionary	0 days	Tue 6/26/12	Tue 6/26/12
494	**As-Built Data Storage Analysis**	**10 days**	**Tue 6/12/12**	**Tue 6/26/12**
495	Generate As-Built Data Storage Analysis	10 days	Tue 6/12/12	Tue 6/26/12
496	Submit As-Built Data Storage Analysis	0 days	Tue 6/26/12	Tue 6/26/12
497	**As-Built Data Flow Diagram**	**10 days**	**Tue 6/12/12**	**Tue 6/26/12**
498	Generate As-Built Data Flow Diagram	10 days	Tue 6/12/12	Tue 6/26/12
499	Submit As-Built Data Flow Diagram	0 days	Tue 6/26/12	Tue 6/26/12
500	**As-Built Entity-Relationship Diagram**	**10 days**	**Tue 6/12/12**	**Tue 6/26/12**
501	Generate As-Built Entity-Relationship Diagram	10 days	Tue 6/12/12	Tue 6/26/12
502	Submit As-Built Entity-Relationship Diagram	0 days	Tue 6/26/12	Tue 6/26/12
503	**Training Materials**	**10 days**	**Thu 6/21/12**	**Wed 7/4/12**
504	**As-Built Instructor Training Materials**	**10 days**	**Thu 6/21/12**	**Wed 7/4/12**
505	Generate As-Built Instructor Training Materials	10 days	Thu 6/21/12	Wed 7/4/12
506	Submit As-Built Instructor Training Materials	0 days	Wed 7/4/12	Wed 7/4/12
507	**As-Built Participant Training Materials**	**10 days**	**Thu 6/21/12**	**Wed 7/4/12**
508	Generate As-Built Participant Training Materials	10 days	Thu 6/21/12	Wed 7/4/12
509	Submit As-Built Participant Training Materials	0 days	Wed 7/4/12	Wed 7/4/12
510	**Program Reporting**	**156 days**	**Tue 12/13/11**	**Wed 7/18/12**
511	**Progress Schedule (Project Schedule/PERT) Updates**	**150 days**	**Wed 12/21/11**	**Wed 7/18/12**
528	**Status Meeting Agenda and Report**	**150 days**	**Tue 12/13/11**	**Tue 7/10/12**
559	**Status Meetings**	**145 days**	**Thu 12/15/11**	**Thu 7/5/12**
590	**Warranty**	**260 days**	**Sun 7/15/12**	**Sun 7/14/13**
591	Warranty (1 year)	300 days	Sun 7/15/12	Sun 7/14/13
592	**Maintenance**	**360 days**	**Sun 7/14/13**	**Sun 11/30/14**
593	Maintenance	433 days	Sun 7/14/13	Sun 11/30/14
594	**Schedule of Preventive Maintenance**	**271 days**	**Sun 7/14/13**	**Mon 7/28/14**
595	**Schedule of Preventive Maintenance Year 2**	**10 days**	**Sun 7/14/13**	**Fri 7/26/13**
596	Generate and Submit Schedule of Preventive Maintenance Year 2	0 days	Sun 7/14/13	Sun 7/14/13
597	Review Schedule of Preventive Maintenance Year 2	10 days	Mon 7/15/13	Fri 7/26/13
598	**Schedule of Preventive Maintenance Year 3**	**10 days**	**Mon 7/14/14**	**Mon 7/28/14**
599	Generate and Submit Schedule of Preventive Maintenance Year 3	0 days	Mon 7/14/14	Mon 7/14/14
600	Review Schedule of Preventive Maintenance Year 3	10 days	Tue 7/15/14	Mon 7/28/14



Task | Milestone | Summary | Deadline | Critical Task

Figure F-36. Integrated Master Schedule (IMS) – Our solution provides a credible, low risk schedule (continued)

Use or disclosure of data contained on this sheet is subject to the restriction on the title page of this proposal.

- ***Ship to Site, Installation and Integration*** – Shipping of the material, and the installation and integration of the material
- ***Testing:***
  - Generation of test plan and test procedures
  - Submission of audit report
  - Execution of SQA dry run, pre-acceptance dry run, acceptance test and operational test
  - Generation of pre-acceptance and acceptance test reports
- ***Training*** – Generation of training plan, training materials and post-training reports
- ***As-Built Documentation*** – Documents updated after the acceptance test is complete
- ***Program Status and Reporting*** – Includes the every other week schedule and PERT chart updates, weekly agenda and weekly meetings
- ***Warranty*** – The warranty begins the day after the operational test is complete
- ***Maintenance*** – Maintenance begins after the warranty is complete

The critical path runs from the final Metron Aviation software delivery through the integration at the Raytheon lab. It then continues through the SQA dry run, the pre-acceptance dry run, the acceptance test, the operational test, the warranty period and the maintenance period.

F.3.2 Relevant Experience

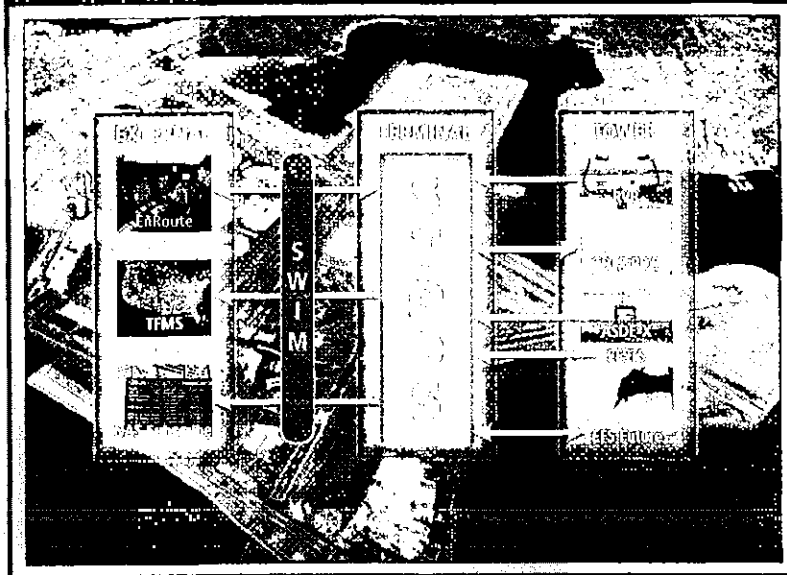
Our relevant experience programs demonstrate the team's significant and directly relevant experience applicable to the JFK SMS program. The experience gained on these and other similar programs give our team the following unique combination of skills and experience that will guarantee a low risk successful program:

- Proven large scale ATC system design, integration of multiple diverse systems and deployment
- Proven global supplier of SMSs
- Successful transition capability on operational airports, with no interruption of service
- Highly experienced SMS staff with significant JFK operational background to support the JFK SMS mission
- Best practice program management processes with rigor and discipline

F.3.2.1 Relevant Past Performance Programs

F.3.2.1.1 SWIM Terminal Data Distribution System (STDDS)

SWIM Terminal Data Distribution System (STDDS)



- Prototype tower solution that publishes tower data using SWIM core services
- Installed for demonstrations at Bradley International Airport, CT
- Fully functioning data distribution services integrate with key legacy tower systems using SWIM technology
- Raytheon is leveraging prototype system to provide a deliverable, deployable system

A. Company/Division Information:	
1. Offeror Name	**Raytheon**
2. CAGE Code	7Y193
3. DUNS Number	193049236
B. Contract Specifics:	
1. Program Name	SWIM Terminal Data Distribution System (STDDS)
2. Contracting Agency/Customer	U.S. DOT/RITA/Volpe National Transportation Systems Center
3. Contract Number	DTRT57-08-D-30013, Task Order CA 9501
4. Contract Type	Cost Plus Fixed Fee (CPFF)
5. Period of Performance	27 January 2009 to 26 January 2013
6. Final Contract Value	$9.549M; $6.401M spent to date

C. Description of Contract Work Scope Performed as Prime or Subcontractor:

The Terminal Data Distribution System is being developed for The Volpe National Transportation Systems Center, a research arm of the U.S. Department of Transportation, under a contract awarded in early 2009.

TDDS will adhere to the evolving FAA System Wide Information Management (SWIM) standards to net-enable a number of legacy systems, improving capacity, efficiency and security for all National Air Space (NAS) users. In Segment 1, STDDS implements network-centric capability for the NAS systems within the terminal and tower domains to replace today's environment of point-to-point interfaces with unique communication links and special purpose protocols. STDDS will replace these point-to-point interfaces with SWIM-compliant service-oriented interfaces using an Internet Protocol Wide Area network, facilitating cost effective future NAS expansion.

The STDDS program is comprised of three program phases, each of which iteratively build upon the previous phase. These phases are the proof of concept system, the prototype system and the final system. The Raytheon team has completed development activities for the prototype system and is preparing for an operational prototype demonstration at Bradley International

SWIM Terminal Data Distribution System (STDDS)
Airport. The system includes fully functioning data distribution services that integrate key legacy tower systems into the NextGen architecture using the SWIM core services. The Raytheon team is now leveraging the prototype system to complete the final system phase to provide a deliverable and deployable product. The Raytheon Team's SE discipline, along with the hardware and software disciplines, are all certified at CMMI level 5 and follow ISO 9001:2001 Quality Plans and practices. The STDDS program phasing consists of multiple prototypes being performed in concert with system and software requirements activities. Such an approach has resulted in continuously conducting trade studies and analysis to determine the most cost effective, safe and secure implementation of new technologies into the Terminal Environment. Studies typically involve multiple design approaches, which are assessed in design trade off to achieve the most cost effective solutions. The results of these studies can now be incorporated into the evolving STDDS implementation. As a result of the STDDS program, Raytheon's broad base of ATC related engineering capabilities have been further increased with the knowledge and experience gained from being a SWIM Implementing Program (SIP). Our participation in SWIM as an active SIP has given us a deeper insight into both the philosophy and mechanics of SWIM and has further strengthened our understanding of Network Enabled Operations (NEO) and SWIM's evolution into NextGen. As a result of work on STDDS, Raytheon has an established project management and technical relationship with the Volpe Center and is ready to immediately begin work on the STDDS Task Order CA 1509.
D. Define the system configuration(s) and deployed operating locations for this contract's equipment. A prototype system was deployed for demonstration at Bradley International Airport, CT.

E. Primary Customer Points of Contact:	
1. Program Manager:	
a. Name	Laura Mellen
b. Office	U.S. DOT/RITA/Volpe National Transportation Systems Center
c. Address	55 Broadway Cambridge, MA 02142-1001 USA
d. Contract Type	CPFF
e. Telephone	617.494.2038
f. Email Address	laura.mellen@dot.gov
2. Contracting Officer:	
a. Name	Robert Robinson
b. Office	U.S. DOT/RITA/Volpe National Transportation Systems Center
c. Address	55 Broadway Cambridge, MA 02142-1001 USA
d. Contract Type	CPFF
e. Telephone	617.494.3433
f. Email Address	robert.robinson@dot.gov

F.3.2.1.2 Air Traffic Control Optimum Training Solution (ATCOTS)

Air Traffic Control Optimum Training Solution (ATCOTS)	
	■ Delivers qualification, proficiency and specialized training to current and future FAA Air Traffic Control (ATC) specialists, and supports training modernization to assist FAA in meeting challenge posed by anticipated volume of requirements of ATC Specialists and increasing demand for air travel ■ Provides trained instructors to deliver training at FAA Academy in Oklahoma City, OK ■ Responsible for 316 training locations ■ Development and maintenance of training curriculum
A. Company/Division Information:	
1. Offeror Name	**Raytheon**
2. CAGE Code	2Y992
3. DUNS Number	112820840
B. Contract Specifics:	
1. Program Name	Air Traffic Control Optimum Training Solution (ATCOTS)
2. Contracting Agency/Customer	Federal Aviation Administration (FAA) Air Traffic Technical Training and Development Directorate
3. Contract Number	DTFAWA-08-C-00117
4. Contract Type	CPIF/CPAF, Requirements, FFP
5. Period of Performance	September 2008 to September 2013 (base period); September 2013 to September 2016 (Option 1); September 2016 to September 2018 (Option 2)
6. Final Contract Value	$437M (base period); $253.4M (Option 1); $169M (Option 2)

C. Description of Contract Work Scope Performed as Prime or Subcontractor:

ATCOTS delivers qualification, proficiency and specialized training to current and future FAA Air Traffic Control (ATC) specialists and supports training modernization to assist the FAA in meeting the challenge posed by the anticipated volume of retirements of ATC Specialists and the increasing demand for air travel.

Raytheon provides trained instructors to deliver training at the FAA Academy in Oklahoma City, OK, at FAA ATC facilities nationwide, and in classrooms and simulation laboratories. The FAA employs more than 15,000 air traffic controllers and will train approximately 17,000 new air traffic controllers during the next 10 years. Raytheon is responsible for 316 training locations, and at any given time we are at approximately 200 sites. For ATCOTS, 100% of trainees require certification(s) including Certified Professional Controller, ATC Specialist, Control Tower Operator, Radar Approach Control, ATC Facility Manager, On the Job Trainer (OJT), Terminal BRITE Radar Qualification, Certified Traffic Management, and many others.

Raytheon supports development and maintenance of the training curriculum; analyzes and evaluates curriculum; develops new courses; reviews, refines, and updates courseware; delivers initial course conduct and evaluation; provides Computer Based Instruction (CBI) design support; develops and incorporates multimedia assets; and develops and validates scenarios for simulators.

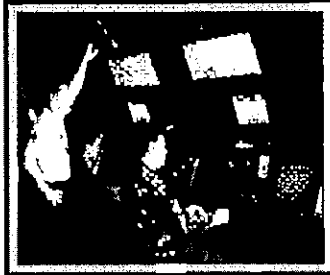
We assist the FAA in its efforts to bring ATC training into the 21st century; provide the expertise and support needed to transition to an integrated and optimized training environment; and

Airport Surface Detection Equipment (ASDE-X)
align learning transformation with Next Generation (NextGen) requirements that replace today's ground-based radar with tomorrow's satellite-based radar. The influx of younger controllers and the NextGen ATC system transition is driving training method and media change. The training methods for prior generations used some technology, but the predominant method was Instructor-Led Training (ILT). To reach different age group training audiences, we use the ADDIE+M methodology to determine the most appropriate training delivery media, and apply a blended learning approach that combines ILT for high-touch topics and eLearning for those areas that lend themselves to independent study. Raytheon reduces training process costs through ATC curriculum modernization, blended training, and use of integrated learning management systems. We maintain training records and provide course evaluation assistance. Raytheon provides program management and control, quality management, change management, and configuration management. Based on the most recent customer evaluation, the FAA has provided Raytheon with an overall rating of "Very Good" with a resultant award fee of $2.4M.
D. Define the system configuration(s) and deployed operating locations for this contract's equipment. Training is conducted at over 300 sites.

E. Primary Customer Points of Contact:	
1. Program Manager:	
a. Name	Chrishaun Jones
b. Office	Federal Aviation Administration (FAA)
c. Address	950 L'Enfant Plaza, SW, 4th Floor Washington, DC 20024 USA
d. Contract Type	CPIF/CPAF, Requirements, FFP
e. Telephone	202.385.6690
f. Email Address	chrishaun.jones@faa.gov
2. Contracting Officer:	
a. Name	William Middleswart
b. Office	Federal Aviation Administration (FAA)
c. Address	800 Independence Avenue, SW Washington, DC 20591 USA
d. Contract Type	CPIF/CPAF, Requirements, FFP
e. Telephone	202.385.6442
f. Email Address	william.middleswart@faa.gov

F.3.2.1.3 Standard Terminal Automation Replacement System (STARS)/Terminal Automation Modernization Replacement (TAMR)

Standard Terminal Automation Replacement System (STARS)/ Terminal Automation Modernization Replacement (TAMR)



- Large scale automation system installed at over 160 sites in U.S., and overseas in Germany, Spain, Korea and Japan
- Integrated multilateration (MLAT) and ADS-B capability
- COTS integration
- CONUS/OCONUS installations
- Comprehensive training program
- Joint U.S. FAA/DoD program

A. Company/Division Information:	
1. Offeror Name	**Raytheon**
2. CAGE Code	7Y193
3. DUNS Number	193049236
B. Contract Specifics:	
1. Program Name	Standard Terminal Automation Replacement System (STARS)/Terminal Automation Modernization Replacement (TAMR)
2. Contracting Agency/Customer	FAA, joint program with DoD
3. Contract Number	DTFA01-96-D-03008
4. Contract Type	CPFF, FFP, CR, T&M, IDIQ
5. Period of Performance	September 1996 to September 2012
6. Final Contract Value	$1.5B

C. Description of Contract Work Scope Performed as Prime or Subcontractor:

The joint FAA/DoD STARS program provides an ATC system that replaces multiple existing systems in both the FAA (TRACON) and DoD (RAPCON) environments, with a single integrated system providing both internal and external data security. STARS is being implemented at 331 FAA and DoD sites. The STARS architecture provides ultra-high availability by integrating two hardware- and software-independent, fully redundant, automated systems running in parallel, which provides an instantaneous back-up service to controllers. Raytheon: (a) performs hardware, software and systems engineering; (b) develops new system configurations from COTS hardware; and (c) designs site-unique configurations, deploys them to the field, and integrates them with existing and new radar and flight data sources. The deployment effort includes: (a) deployment planning and scheduling; (b) large scale COTS/CAS material procurement and control; (c) site surveys and site designs; (d) site-specific software adaptation; (e) preassembly and staging of systems prior to site delivery; and (f) site installation, integration and acceptance testing. Raytheon also provides mission support services, including O&M training, preoperational site maintenance support, second level engineering support and depot support.

D. Define the system configuration(s) and deployed operating locations for this contract's equipment.

STARS, the original program name, remains the name of Raytheon's terminal automation system, but TAMR is now the FAA's program name. During TAMR 1 and 2, 51 FAA TRACONs and 63 (of 93 by 2015) were delivered, including 70% of the nation's 50 busiest (Miami, Charlotte, Philadelphia, Houston, etc.). Under TAMR 3, Segment 1, 11 more sites will receive STARS, including the busiest in the world (southern and northern California, New York, Atlanta, etc.), bringing the total operational STARS sites to155 by 2015. Under TAMR 3, Segment 2, up to

Standard Terminal Automation Replacement System (STARS)/ Terminal Automation Modernization Replacement (TAMR)	
96 smaller TRACONs will potentially be replaced by STARS (total of 251 by 2015). Many of the tasks performed by Raytheon on the STARS program over the last 15 years directly correlate to the scope of work required to be executed byt he MFK SMS prime integrating contractor, including extensive experience deploying and integrating ATC systems to new and existing surveillance sensors, as well as mission support services.	
E. Primary Customer Points of Contact:	
1. Program Manager:	
a. Name	Jeff Yarnell
b. Office	Federal Aviation Administration (FAA)
c. Address	F0B10B, Room 5W31BS 600 Independence Avenue, SW Washington, DC 20591 USA
d. Contract Type	FFP, CPFF, CR, T&M
e. Telephone	202.385.8778
f. Email Address	Jeff.Yarnell@faa.gov
2. Contracting Officer:	
a. Name	Peter DeWald
b. Office	FAA National Headquarters
c. Address	600 Independence Avenue, SW Washington, DC 20591 USA
d. Contract Type	FFP, CPFF, CR, T&M
e. Telephone	202.385.8737
f. Email Address	peter.dewald@faa.gov

F.3.2.1.4 OSL Gardermoen Upgrade Project

OSL Gardermoen Upgrade Project

- Original Integrated Controller Workstation (ICW) project awarded to Raytheon by Norway National Airport Authority (OSL) in late 1990s
- OSL specified an automated integrated tower system at their new international "green field" airport
- Based on Raytheon's proven AutoTrac system, with 2 added capabilities:
  - Electronic flight strip system on a single integrated position display
  - Another position display (Situation Data Display (SDD)) with shared display area with the Surface Management and Ground Control System (SMGCS)
- ICW was integrated into Raytheon's AutoTrac system installed at Royken Area Control Center, located 85 km away from OSL
- These 2 sites share radar and flight data information
- Major mid-life refresh for ICW conducted in 2010:
  - New hardware and operating system installed
  - Software enhancements added to provide:
    - Network Timing Protocol (NTP)
    - Non-Transgression Zone (NTZ)
    - Short Term Conflict Alert (STCA)
    - Migration of SMGCS to new hardware and operating system

A. Company/Division Information:	
1. Offeror Name	**Raytheon**
2. CAGE Code	7Y193
3. DUNS Number	193049236
B. Contract Specifics:	
1. Program Name	OSL Gardermoen Upgrade Project
2. Contracting Agency/Customer	Avinor
3. Contract Number	2006 02732 – 015, Purchase Order 15
4. Contract Type	Time and Materials (T&M)
5. Period of Performance	November 2009 through August 2010
6. Final Contract Value	$2.06M (USD) for this purchase order (total program >$12M)

C. Description of Contract Work Scope Performed as Prime or Subcontractor:

The original Gardermoen ICW Project was based on Raytheon's proven performance on the AutoTrac system installed by Raytheon for Avinor at the Royken Area Control Center. Raytheon was selected by the Norway National Airport Authority (OSL), to provide an automated Tower system for the new Gardermoen National Airport. This new "green field" airport was built in the late 1990s on a site approximately 30 miles Northeast of Oslo. This new international airport replaced the old airport that was in downtown Oslo. OSL is a civil agency developer and manager of the Gardermoen International Airport. After a successful fielding and a number of years of operational use OSL contacted Raytheon to conduct a mid-life refresh for the original system. The original ICW project was based on the proven AutoTrac System, with two added capabilities:

- An electronic flight strip system on a single integrated position display
- The other position display (the Situation Data Display (SDD)) shared display area with the Surface Management and Ground Control System (SMGCS)

This system, known as the Gardermoen Integrated Controller Workstation (ICW) was integrated into the AutoTrac system in Royken over 85 kilometers away to share radar and flight data information. The ICW controls the arrivals and departure airspace for the Gardermoen Airport as well as the surface management of the aircraft on the Gardermoen airport proper.

Based on the successful operational upgrade of the Royken ATCC, the next Purchase Order on the MSC was to do the same upgrade and operational cutover for the Gardermoen Tower ICW system. The hardware and operating system was upgraded for the Gardermoen with the same level of success. The Gardermoen Tower's software was also enhanced with NTP, NTZ, STCA, along with the migrating the Surface Management and Ground Control System to the new hardware and operating system. Avinor has requested Raytheon to provide an additional five years of support under a new MSC to start next year, at the expiration of this MSC.

The OSL Gardermoen Upgrade Project provided a mid life refresh and additional new capabilities. The OSL Project provided for: new hardware and a new operating system; new features were added including: NTP, NTZ, STCA, and migration of the Surface Management and Ground Control System to the new hardware and operating system.

D. Define the system configuration(s) and deployed operating locations for this contract's equipment.

The OSL Gardermoen Upgrade Project provided a mid-life refresh and additional new capabilities for Norway's new automated tower at the new international airport in Gardermoen, Norway, 30 miles north of Oslo.

E. Primary Customer Points of Contact:	
1. Program Manager:	
a. Name	Roy Dommersnes
b. Office	OSL Software Support Facility
c. Address	Gardermoen Airport Gardermoen, Norway
d. Contract Type	T&M
e. Telephone	+47 6 481 2876
f. Email Address	roy.dommersnes@osl.no
2. Contracting Officer:	
a. Name	Gunhild Synnestvedt
b. Office	Avinor Headquarters
c. Address	Air Navigation Services Avinor AS Oslo, Norway
d. Contract Type	T&M
e. Telephone	+47 9 050 1908
f. Email Address	gunhild.h.synnestvedt@avinor.no

F.3.2.1.5 Digital Airport Surveillance Radar (DASR)

Digital Airport Surveillance Radar (DASR)

- Raytheon turnkey solution for ASRs
- 124 total worldwide sites include the U.S., Middle East (Baghdad and Kirkuk, Iraq), Europe (Germany, Spain and the United Kingdom (UK)) and Asia (Korea, Japan and Marshall Islands)
- 35 additional sites currently being installed in parallel
- Facilities engineering, site construction and construction management
- Operational transition planning and support
- Joint U.S. DoD/FAA program
- Program is on schedule and within budget
- Positive Customer Performance Assessment Report (CPAR) ratings received from customer

A. Company/Division Information:	
1. Offeror Name	**Raytheon**
2. CAGE Code	7Y193
3. DUNS Number	193049236
B. Contract Specifics:	
1. Program Name	Digital Airport Surveillance Radar (DASR)
2. Contracting Agency/Customer	U.S. Air Force Electronic Systems Center (ESC)
3. Contract Number	F19628-96-D-0038 and FA8730-08-D-0001
4. Contract Type	FFP, Cost Plus Fixed Fee (CPFF), labor hour, Cost Reimbursement (CR), Indefinite Delivery/Indefinite Quantity (IDIQ) contract with delivery orders
5. Period of Performance	August 1996 to September 2016
6. Final Contract Value	$1,000M+

C. Description of Contract Work Scope Performed as Prime or Subcontractor:

The ASR-11 DASR is Raytheon's widely fielded and proven ASR system. The DASR system was jointly developed by the U.S. DoD and FAA as the fully modernized, all digital replacement surveillance radar for use in the U.S. NAS and at U.S. DoD sites around the world. DASR has been successfully installed at 124 sites worldwide, and has been certified for use by the U.S. FAA and DoD, and verified against applicable ICAO and Eurocontrol surveillance standards. The DASR system provides terminal area radar services using an improved digital radar that offers air traffic controllers enhanced performance and improved reliability, resulting in increased situational awareness, greater safety and efficient airspace management.

Raytheon is the prime contractor for the DASR program. DASR is a joint DoD (Army, Air Force and Navy) and FAA program deploying the next generation, solid state terminal, ATC radar, which provides PSR coverage to 60 miles and MSSR coverage to 120 miles. It provides the air traffic controller with improved aircraft detection in clutter and a National Weather Service (NWS) calibrated six-level weather display, and improves reliability with automatic fault detection and reduced support costs.

The DASR program includes capability and expertise to deliver complete, turnkey airport surveillance system packages. These total package solutions employ a "cradle-to-grave" concept that includes the site survey/selection and site design, site preparation and civil works, system installation and checkout, system test and certification support, comprehensive operator and maintenance training and full long-term contractor logistical support packages. This turnkey approach has been

Digital Airport Surveillance Radar (DASR)	
successfully employed at a variety of sites, including those conducted in austere and difficult environments, such as Iraq. With our regular civil works partners and subcontractors, we are currently delivering quality civil engineering work for sites around the world We have worked with our DoD and FAA customers to improve system deployment cycle times and reduce deployment costs, building a library of lessons learned that are directly applicable to the JFK SMS program.	
D. Define the system configuration(s) and deployed operating locations for this contract's equipment. Several of the tasks under the DASR contract are directly applicable to the JFK SMS Program, such as site surveys/radar/equipment siting, construction management, radar tower erection, dispersed equipment installation and integration, and operation transition planning.	
E. Primary Customer Points of Contact:	
1. Program Manager:	
a. Name	Major John Holt
b. Office	U.S. Air Force Electronic Systems Center (ESC)
c. Address	3 Eglin Street Hanscom Air Force Base, MA 01731-2103 USA
d. Contract Type	FFP, Time and Materials (T&M), CPFF, CR
e. Telephone	781.377.6114
f. Email Address	john.holt@hanscom.af.mil
2. Contracting Officer:	
a. Name	Thomas F. Leeds
b. Office	U.S. Air Force Electronic Systems Center (ESC)
c. Address	3 Eglin Street Hanscom Air Force Base, MA 01731-2103 USA
d. Contract Type	FFP, T&M, CPFF, CR
e. Telephone	781.377.5612
f. Email Address	tom.leeds@hanscom.af.mil

F.3.2.1.6 Kirkuk Regional Air Base (KRAB) DASR/AutoTrac II and ATC Communications System

Kirkuk Regional Air Base (KRAB) DASR/AutoTrac II and ATC Communications System

- Turnkey ATM automation system
- PSR/MSSR radar facility installation and integration
- Multiple site simultaneous construction
- VHF/UHF radios and VCCS installation and integration
- ATC systems integration with existing facilities
- Automation/radar integration
- Flight certification system commissioning
- Logistics and export/import solutions
- ATC technical support and familiarization training
- Installed in a difficult, adverse environment
- USAF customer (Hanscom Air Force Base)

A. Company/Division Information:	
1. Offeror Name	**Raytheon**
2. CAGE Code	7Y193
3. DUNS Number	193049236
B. Contract Specifics:	
1. Program Name	Kirkuk Regional Air Base (KRAB) DASR/AutoTrac II and ATC Communications System
2. Contracting Agency/Customer	USAF 853d Electronic Systems Center (ESC/PK) FMS Group
3. Contract Number	FA8730-08-C-0004
4. Contract Type	Pseudo FMS – FFP, CPFF, CR
5. Period of Performance	3 March 2008 to 30 September 2010
6. Final Contract Value	$24M

C. Description of Contract Work Scope Performed as Prime or Subcontractor:

Raytheon was prime contractor to the USAF 853d ESC FMS Group to deliver a turnkey air-space management system to the USAF at KRAB, Iraq, for transition to the Iraqi Air Force following program completion. Program scope included: (a) all civil works, site improvements and site construction at multiple airfield locations; (b) door-to-door transportation of all system components and construction materials; (c) installation and test of ASR-11 DASR; (d) seven-position AutoTrac II automation system for radar and VFR tower operations and control; (e) fully integrated, remotely tunable VHF/UHF radio communications system with VCCSs; (f) fully self-contained, transportable, Combined En route Radar Approach Control (CERAP) facility consisting of an ATC-OPS and ATC-EE shelter; (g) CONUS risk reduction integration of AutoTrac II and voice communications equipment; (h) site acceptance testing, system validation and initial commissioning flight certification; (i) training for DASR and AutoTrac II controllers and maintainers (separate Air Force Satellite (AFSAT) contract), and (j) multiyear on-site CLS. The above program scope included ATCT equipment procurement, production, installation and sustainment. The CLS portion of effort is ongoing through follow-on Contract Line Item Numbers (CLINs) to contract FA8730-09-C-0004, which was awarded to provide an AutoTrac II simulator system in Kirkuk and an ATCT simulator in Tikrit, Iraq. These simulator systems have been installed and completed, and CLS now encompasses all systems (both Kirkuk and Tikrit).

D. Define the system configuration(s) and deployed operating locations for this contract's equipment.

Acting as the prime integrating contractor, Raytheon managed civil works and site construction efforts at multiple airfields, and installed a new ATM system that required the integration of new and existing data feeds. The system also integrated the VCCS digital touch entry device and the ground-to-air VHF/UHF radio communications system, including 16 transceivers with integrated filter/combiner and remote controllability. These efforts provide valuable lessons learned for the integration of the various external interfaces on the JFK SMS program.

E. Primary Customer Points of Contact:	
1. Program Manager:	
a. Name	Khalid Musameh
b. Office	USAF 853d Electronic Systems Center (ESC/PK) FMS Group
c. Address	75 Vandenberg Drive, Bldg. 1630 Hanscom Air Force Base, MA 01731-2103 USA
d. Contract Type	Pseudo FMS – FFP, CPFF, CR
e. Telephone	781.377.2053
f. Email Address	Khalid.Musameh@hanscom.af.mil
2. Contracting Officer:	
a. Name	Jill F. Asimakopoulos
b. Office	USAF 853d Electronic Systems Center (ESC/PK) FMS Group
c. Address	75 Vandenberg Drive, Bldg. 1630 Hanscom Air Force Base, MA 01731-2103 USA
d. Contract Type	Pseudo FMS – FFP, CPFF, CR
e. Telephone	781.377.5195
f. Email Address	Jill.Asimakopoulos@hanscom.af.mil

F.3.2.1.7 Surface Management System (SMS)

Surface Management System (SMS)	
■ Partnered with Raytheon on original SMS research and development ■ Developed and supported SMS for Louisville airport ■ Installation and integration for FedEx Memphis	■ Operating commercially for over 7 years ■ Improves situational awareness ■ Increases departure capacity and reduces taxi time

A. Company/Division Information:	
1. Offeror Name	METRON
2. CAGE Code	3F6S4
3. DUNS Number	11-846-3475
B. Contract Specifics:	
1. Program Name	a. Raytheon CTO -5 b. Raytheon Phase 1B c. FedEx SMS Support d. Metron Surface FedEx
2. Contracting Agency/Customer	a. NASA b. FAA c. FedEx d. Metron Surface FedEx
3. Contract Number	a. NAS2-00015 b. DTFAWA-05-C-00011 c. 06-0109 d. C120
4. Contract Type	a. CPAF b. CPFF c. T&M d. Fixed Price (FP)
5. Period of Performance	a. 5 February 2001 to 30 September 2004 b. 1 December 2004 to 30 September 2005 c. 25 August 2005 to 25 January 2010 d. 1 January 2010 to 31 December 2014
6. Final Contract Value	a. $6,611,706 b. $390,000 c. $164,781 d. $658,332 Total of $7,824,819

C. Description of Contract Work Scope Performed as Prime or Subcontractor:

In 2002, FedEx partnered with NASA to provide its ramp tower facility as a testbed for Metron Aviation's SMS, in an effort to reduce delays and optimize its operations in Memphis. The system integrated aircraft track and flight data from the airport's ASDI data feed and airport surface surveillance from ASDE-X (A-SMGCS), as well as RMAS gate management system data and ACARS messages from FedEx. For the first time, FedEx GOC users were given an "out-the-window" view and direct insight into MEM operations.

Based on the performance of the SMS, FedEx worked with Metron Aviation to deploy and enhance the system to provide a broader scope, which included the incorporation of new data feeds, such as Traffic Management Advisor (TMA) for sequencing arrivals. Metron Aviation's surface system provided FedEx with real-time and forward-looking information that improved surface resource allocation, allowing strategic decisions to be made for arriving aircraft as much as 30 minutes prior to touchdown.

As a long time and first client for Metron Aviation's Surface Optimization product, FedEx has been instrumental in the development of concepts into product solutions regarding surface operations. FedEx will deploy Metron Aviation's Harmony for Airlines product at more sites in the U.S. and has indicated the intention to follow this with an international deployment overseas, giving the Global Operations Center visibility into the operation anywhere in the world, allowing improved decision-making.

D. Define the system configuration(s) and deployed operating locations for this contract's equipment.

Since the deployment of the system at the FedEx Ramp Tower in 2004, the system has grown to support the Memphis Airport Authority and many additional FedEx users, including the Hub Control Room, Aircraft Service Attendant, Global Operations Center, Gate Desk, Line Maintenance, Crew Bus Dispatch, Flight Coordination and Corporate Aviation.

E. Primary Customer Points of Contact:	
1. Program Manager:	
a. Name	a. Paul E. Cassel (Vice President, Flight Operations) b. Steven J. Rogowski c. Art Parra d. Dan Allen
b. Office	a. Fed Express Corp b. Raytheon Company c. Flight Operations Administration Federal Express Corporation d. FedEx Express
c. Address	a. 3131 Democrat Road Memphis, TN 38118 USA b. 1001 Boston Post Road East Marlborough, MA 01752-3789 USA c. 3131 Democrat Road, Bldg. C Memphis, TN 38118 USA d. 3131 Democrat Road Memphis, TN 38118 USA
d. Contract Type	a. FP b. CPFF c. T&M d. FP

Surface Management System (SMS)	
e. Telephone	a. NA b. 508.490.1343 c. 901.224.5116 d. 901.224.5114
f. Email Address	a. NA b. steven_j_rogowski@raytheon.com c. ArParra@fedex.com d. daniel.allen@fedex.com
2. Contracting Officer:	
a. Name	a. Paul E. Cassel (Vice President, Flight Operations) b. Karl H. Magnussen c. Art Parra d. Dan Allen
b. Office	a. Federal Express Corporation b. Raytheon Company c. Flight Operations Administration, Federal Express Corporation d. FedEx Express
c. Address	a. 3131 Democrat Road Memphis, TN 38118 USA b. 1001 Boston Post Road East Marlborough, MA 01752-3789 USA c. 3131 Democrat Road, Bldg. C Memphis, TN 38118 USA d. 3131 Democrat Road Memphis, TN 38118 USA
d. Contract Type	a. FP b. CPFF c. T&M d. FP
e. Telephone	a. NA b. 508.490.2075 c. 901.224.5116 d. 901.224.5114
f. Email Address	a. NA b. Karl_H_Magnussen@raytheon.com c. ArParra@fedex.com d. daniel.allen@fedex.com

F.3.2.1.8 Metron Harmony at LaGuardia

Metron Harmony at LaGuardia

- Predictive airline traffic management solution
- Installed for Delta Air Lines connecting Operations Control Center in Atlanta with ramp operations at New York's LaGuardia Airport (LGA)
- Integrates real-time, national, regional and local traffic flow demand operation

A. Company/Division Information:	
1. Offeror Name	METRON
2. CAGE Code	3F6S4
3. DUNS Number	11-846-3475
B. Contract Specifics:	
1. Program Name	Metron Harmony at LaGuardia
2. Contracting Agency/Customer	Delta Air Lines
3. Contract Number	C101, C102
4. Contract Type	FP
5. Period of Performance	11 January 2010 to 31 January 2015
6. Final Contract Value	$2.23M

C. Description of Contract Work Scope Performed as Prime or Subcontractor:

Delta Air Lines has deployed Metron Harmony for Airlines, an integrated, predictive airline traffic management solution to improve the efficiency of operations at LGA and the overall Delta operations network. Metron Harmony for Airlines provides integrated display, analysis and operations management capabilities connecting Delta's Operations Control Center in Atlanta with its ramp tower operations at LGA.

D. Define the system configuration(s) and deployed operating locations for this contract's equipment.

In this initial deployment, Metron Harmony for Airlines will enhance LGA ramp tower and ground operations by integrating real-time national, regional and local traffic flow demand information with Delta's operational data to allow the airline to stay ahead of impending Irregular Operations (IROPS).

E. Primary Customer Points of Contact:	
1. Program Manager:	
a. Name	Lorne Cass
b. Office	Delta Air Lines, Inc.
c. Address	1010 Delta Boulevard Atlanta, GA 30320 USA
d. Contract Type	FP
e. Telephone	404.715.1945
f. Email Address	lorne.cass@delta.com

Metron Harmony at LaGuardia	
2. *Contracting Officer:*	
a. Name	Lorne Cass
b. Office	Delta Air Lines, Inc.
c. Address	1010 Delta Boulevard Atlanta, GA 30320 USA
d. Contract Type	FP
e. Telephone	404.715.1945
f. Email Address	lorne.cass@delta.com

F.3.2.1.9 Concept Engineering and Development – Departure Flow Management (DFM)

Concept Engineering and Development -- Departure Flow Management (DFM)

- Developed DFM concept
- Provides ARTCC and ATCT users an improved departure release process
- Performed operational tests to validate concept and procedures
- DST designed to improve coordination of departures from multiple airports over shared and congested NAS resources

A. Company/Division Information:	
1. Offeror Name	METRON
2. CAGE Code	3F6S4
3. DUNS Number	11-846-3475
B. Contract Specifics:	
1. Program Name	Concept Engineering and Development – Departure Flow Management (DFM)
2. Contracting Agency/Customer	Federal Aviation Administration (FAA)
3. Contract Number	DTFAWA-08-C-00069
4. Contract Type	CPFF
5. Period of Performance	1 March 2008 to 30 June 2011
6. Final Contract Value	$19,621,346

C. Description of Contract Work Scope Performed as Prime or Subcontractor:

Under contract to the FAA, Metron Aviation designed, developed, and tested the DFM concept. DFM is a decision support tool and process designed to provide ARTCC and ATCT users an improved departure release process that increases departure flow efficiency by streamlining the coordination of departures from multiple airports over shared and congested NAS resources through automation, decision support, and communication capabilities. DFM provides a flexible and reactive tools and procedures to account for uncertainty on the surface and in en route airspace. Metron Aviation developed and initial operational capability, performed an operational analysis, designed the system and associated requirements and provided technical and analytical support towards the field site evaluations.

D. Define the system configuration(s) and deployed operating locations for this contract's equipment.

In November 2009, the FAA began a long-term operational trial of DFM at Los Angeles ARTCC (ZLA) and ATC Towers (ATCTs), supported by Metron Aviation engineers. Prior to the long-term field trial, Metron Aviation led pre-operational field trials at ZLA and several ATCTs in three phases. Phase 1 provided a quantitative and qualitative understanding of current activities at ZLA, as related to the process applied to specific TMIs. Metron Aviation used a test team to develop an accurate understanding of the current procedures for departure operations within ZLA and adjacent ARTCCs. In Phase 2, Metron Aviation used the DFM prototype to "shadow" current operations. This phase validated the prototype in terms of: (a) stability and accuracy of algorithms, (b) reliability of software, (c) connectivity between ZLA, the ATCTs, and the DFM server at the ATCSCC, and (d) usefulness and completeness of the functionality. In Phase 3 of testing, facility personnel used the prototype in live operations. This phase resulted in: (a) an assessment of the DFM software, software interface, and operational/communications procedures in an operational setting, and (b) an evaluation of the trajectory modeling, slot identification, and release time calculation algorithms in an operational setting. The field trial participants validated and widely accepted the DFM concept as an improvement to the departure release process. Metron Aviation obtained additional feedback on the DFM concept from questionnaires and interviews with the

Concept Engineering and Development - Departure Flow Management (DFM)	
ARTCC and ATCT users. Several recommendations for changes to the system, algorithms, interface, and operational concept were identified during the operational test.	
E. Primary Customer Points of Contact:	
1. Program Manager:	
a. Name	Mike McKinney
b. Office	Federal Aviation Administration (FAA)
c. Address	800 Independence Avenue, SW Washington, DC 20591 USA
d. Contract Type	CPFF
e. Telephone	202.493.5458
f. Email Address	mike.mckinney@faa.gov
2. Contracting Officer:	
a. Name	Leslie Fisher
b. Office	Federal Aviation Administration (FAA)
c. Address	800 Independence Avenue, SW Washington, DC 20591 USA
d. Contract Type	CPFF
e. Telephone	202.493.5943
f. Email Address	leslie.fisher@faa.gov

F.3.2.1.10 Enhanced Substitution Module (ESM)

Enhanced Substitution Module (ESM)

- Designed, developed, and supports this industry leading solution for 16 major and regional commercial airlines
- Automates repetitive tasks through advanced algorithms
- Evaluation of complex priority scenarios
- Reduces ATC delays and taxi time
- Post-operations analysis and reporting capability

A. Company/Division Information:	
1. Offeror Name	METRON
2. CAGE Code	3F6S4
3. DUNS Number	11-846-3475
B. Contract Specifics:	
1. Program Name	Enhanced Substitution Module (ESM)
2. Contracting Agency/Customer	a. Air Canada b. Air Tran Airways c. Alaska Airlines d. American Airlines e. American Eagle Airlines f. Atlantic Southeast Airlines g. Comair h. Delta Air Lines i. FedEx j. Jazz Aviation k. JetBlue l. NetJets m. Southwest Airlines n. Spirit Airlines o. US Airways p. Virgin America
3. Contract Number	Multiple
4. Contract Type	FP; license agreement
5. Period of Performance	1 January 2001 to 1 April 2014 (annual and multiyear agreements include new sale for 2011)
6. Final Contract Value	$0.5M+

C. Description of Contract Work Scope Performed as Prime or Subcontractor:

Acting as prime contractor Metron Aviation designed, developed and maintains the ESM, an automated flight substitution aid for airline users. ESM is an add-on component to the FAA's Flight Schedule Monitor (FSM) that provides resource alerts, advanced modeling and decision support to enable strategic schedule management for flights controlled by Air Traffic Control (ATC) traffic management initiatives.

ESM also includes algorithms for automating repetitive tasks and evaluating complex priority scenarios to choose preferred swaps. Messaging functionality is supplied for communicating

Enhanced Substitution Module (ESM)
changes both to the Federal Aviation Administration's (FAA) Traffic Flow Management System (TFMS) and within an airline's operations center. ESM provides a reduction of ATC delays for an airline's flights that translate directly into cost savings for the carrier. Daily savings for a hub carrier, at a single regulated airport, can easily reach dozens of hours and over hundreds of thousands of dollars. ESM is also used for post-operations analysis which supports operational lessons learned.
D. Define the system configuration(s) and deployed operating locations for this contract's equipment. Acting as the prime contractor Metron Aviation has configured, deployed and is under contract to support the ESM at the following customer sites: a. Air Canada, Mississauga, ON, Canada b. Air Tran Airways, Orlando, FL c. Alaska Airlines, Seattle, WA d. American Airlines, Fort Worth, TX e. American Eagle Airlines, Fort Worth, TX f. Atlantic Southeast Airlines, Atlanta, GA g. Comair, Erlanger, KY h. Delta Air Lines, Atlanta, GA i. FedEx, Memphis, TN j. Jazz Aviation LP, Halifax, NS, Canada k. JetBlue, Forest Hills, NY l. NetJets, Columbus, OH m. Southwest Airlines, Dallas, TX n. Spirit Airlines, Miramar, FL o. US Airways, Pittsburgh, PA p. Virgin America, Burlingame, CA

E. Primary Customer Points of Contact:	
1. Program Manager:	
a. Name	Numerous
b. Office	a. Air Canada b. Air Tran Airways c. Alaska Airlines d. American Airlines e. American Eagle Airlines f. Atlantic Southeast Airlines g. Comair h. Delta Air Lines i. FedEx j. Jazz Aviation k. JetBlue l. NetJets m. Southwest Airlines n. Spirit Airlines o. US Airways p. Virgin America

c. Address	a. 5935 Airport Road, 10th Floor Mississauga, ON L4V 1W5 Canada b. 9755 Air Tran Boulevard, Orlando, FL 32827 USA c. 2651 South 192nd Street Seattle, WA 98188 USA d. 4601 Highway 360 Fort Worth, TX 76155 USA e. 4601 Highway 360 Fort Worth, TX 76155 USA f. 990 Toffee Terrace Atlanta, GA 30354 USA g. 88 Comair Boulevard, Erlanger, KY 41018 USA h. 1030 Delta Boulevard, Atlanta, GA 30354 USA i. 3465 Airway Boulevard, CTC Module F, 4th Floor Memphis, TN 38116 USA j. 310 Goudey Drive Enfield, NS B2T 1E4 Canada k. 118-29 Queens Boulevard, Forest Hills, NY 11375 USA l. 4111 Bridgeway Avenue Columbus, OH 43219 USA m. 2702 Love Field Drive Dallas, TX 75235 USA n. 2800 Executive Way Miramar, FL 33025 USA o. 4000 East Sky Harbor Boulevard Phoenix, AZ 85034 USA p. 555 Airport Boulevard, Suite 450 Burlingame, CA 94010 USA

Enhanced Substitution Module (ESM)	
d. Contract Type	FP
e. Telephone	Numerous
f. Email Address	Numerous
2. *Contracting Officer:*	
a. Name	Numerous
b. Office	Numerous
c. Address	Numerous
d. Contract Type	FP
e. Telephone	Numerous
f. Email Address	Numerous

F.3.2.1.11 Traffic Flow Management Modernization (TFM-M) – Flight Schedule Monitor (FSM)

Traffic Flow Management Modernization (TFM-M) – Flight Schedule Monitor (FSM)

- Metron Aviation develops, deploys and maintains CATMT technologies
- Supports and maintains FSM, a keystone FAA TFM decision support tool designed by Metron Aviation to implement and manage traffic flow management initiatives

A. Company/Division Information:	
1. Offeror Name	METRON
2. CAGE Code	3F6S4
3. DUNS Number	11-846-3475
B. Contract Specifics:	
1. Program Name	Traffic Flow Management Modernization (TFM-M) – Flight Schedule Monitor (FSM)
2. Contracting Agency/Customer	a. KENROB b. CSC
3. Contract Number	a. DTFAWA-03-D-03032 b. DTFAWA-04-C-00045
4. Contract Type	a. T&M b. T&M
5. Period of Performance	a. 8 September 2003 to 9 September 2007 b. 17 September 2007 to 30 September 2011
6. Final Contract Value	a. $14,758,105 b. $12,446,586 Total of $27,204,961

C. Description of Contract Work Scope Performed as Prime or Subcontractor:

Metron Aviation is a subcontractor to CSC on the FAA TFM-M program. Metron Aviation's role is to enhance and maintain the decision support tools that are core to the FAA's TFM system:

- Flight Schedule Monitor (FSM)
- Flight Schedule Analyzer (FSA)
- Post Operations Evaluation Tool (POET)
- Route Management Tool (RMT)
- Integrated Reporting Information System (IRIS)

These tools, which are collectively over a million Source Lines of Code (SLOC), provide the FAA with the real-time capabilities (FSM, RT-FSA, RMT) and analysis reporting tools (FSA, POET, IRIS) to effectively optimize the capacity of the FAA's airspace. In particular, FSM was the world's first highly advanced TFM platform and remains the cornerstone of system-wide situational awareness and traffic flow control in the National Airspace System (NAS) today. Developed by Metron Aviation beginning in 1995, FSM provides users with up-to-date, real-time information on the future behavior of all flights operating to or from the 800+ largest airports in the country, as well as any flights planned to pass through key regions of the NAS. FSM's interfaces present information in the format most valuable to the user, whether as a profile of projected demand at an airport over time, detailed information on a specific flight, or any of a number of other specialized views.

Because of the value of the information it provides, FSM is used regularly at over 90 FAA facilities, seven NAV CANADA facilities and by 25 airlines, and is an integral part of daily operations management for NAS managers and users. The FAA uses FSM to issue, monitor and manage

Traffic Flow Management Modernization (TFM-M) -- Flight Schedule Monitor (FSM)	
its most important traffic demand control strategies, including Ground Delay Programs (GDP), Ground Stops (GSs) and Airspace Flow Programs (AFPs). When an FAA Traffic Manager sees a potential demand/capacity imbalance that will occur at an airport or within some airspace, the manager uses the modeling capabilities in FSM to compute the best departure time to assign to each flight to bring demand levels down to the system capacity. The FAA Traffic Manager then uses FSM to transmit those departure times directly to both the flight operators and the control towers. TFM in the U.S. would not be efficient without FSM. FSM allows necessary delays to be taken on the ground rather than in the air. The results are much safer and more efficient, saving flight operators over $400M per year in fuel costs alone.	
D. Define the system configuration(s) and deployed operating locations for this contract's equipment. Metron Aviation develops, deploys, and maintains new CATMT technologies, such as the Airspace Flow Program (AFP), and the legacy DSTs that precede them, such as Flight Schedule Monitor (FSM), the DST used operationally to implement AFPs and other traffic management initiatives (TMIs) such as Ground Delay Programs. CATMT and legacy DSTs are built on the ETMS/TFMS infrastructure and utilize TFMS data and messaging. In addition, when FSM is used to implement TMIs, FSM creates data and messages that are processed by the ETMS/TFMS hub and become part of the TFMS data set. Therefore, Metron Aviation has an in-depth knowledge of the TFMS automation system and data, as well as the legacy ETMS system. Beginning with the initial deployment of FSM in 1995, Metron Aviation has been developing DSTs that utilize the ETMS/TFMS infrastructure and data, and that the FAA uses to support improved TFM. Metron Aviation is a subcontractor to CSC on the TFM-M program enhancing and maintaining the Decision Support Tools (DSTs) that are core to the FAA's Traffic Flow Management (TFM) system. The TFM-M program is the initiative to upgrade the infrastructure and automation that support TFM and consists of two interdependent programs – TFMS, which replaces the legacy Enhanced Traffic Management System (ETMS), and CATMT, new capabilities and DSTs deployed to help traffic management specialists support more effective TFM.	
E. Primary Customer Points of Contact:	
1. Program Manager:	
a. Name	a. Gene Hayman b. Dan Makanoff
b. Office	a. KENROB b. NA
c. Address	a. 44084 Riverside Parkway, Suite 125 Leesburg, VA 20176-5102 USA b. 200 Decadon Drive Egg Harbor Township, NJ 08234-3831 USA
d. Contract Type	a. T&M b. T&M
e. Telephone	a. 703.729.7300, x105 b. 609.677.8596
f. Email Address	a. NA b. dmakanof@csc.com

Traffic Flow Management Modeling Analysis (TFM-MA)	Traffic Schedule Monitor (TSM)
2. Contracting Officer:	
a. Name	a. Alba Apolito-Howes b. Richard Leibson
b. Office	a. KENROB b. CSC Civil Group
c. Address	a. 44084 Riverside Parkway, Suite 125 Leesburg, VA 20176-5102 USA b. 7459A Candlewood Drive Hanover, MD 21076 USA
d. Contract Type	a. T&M b. T&M
e. Telephone	a. 703.729.7300, x101 b. 410.684.6342
f. Email Address	a. NA b. dlehman@csc.com

F.3.2.1.12 Metron Harmony for Air Navigation Service Providers (ANSPs) (South Africa)

Metron Harmony for Air Navigation Service Providers (ANSPs) (South Africa)	
■ Increases capacity utilization ■ ATFM system implements traffic flow initiatives for both airport and airspace ■ Balances air traffic demand with capacity	
A. Company/Division Information:	
1. Offeror Name	METRON
2. CAGE Code	3F6S4
3. DUNS Number	11-846-3475
B. Contract Specifics:	
1. Program Name	Metron Harmony for Air Navigation Service Providers (ANSPs) (South Africa)
2. Contracting Agency/Customer	South Africa Air Traffic and Navigation Services
3. Contract Number	W2195-S07-003
4. Contract Type	FP
5. Period of Performance	a. 1 May 2007 to 1 May 2010 b. 3 May 2010 to 11 July 2010 c. 16 May 2011 to 31 December 2014
6. Final Contract Value	a. $1,249,574 b. $246,051 c. $1,230,000 Total of $3,975,199

C. Description of Contract Work Scope Performed as Prime or Subcontractor:

Metron Aviation aided South Africa's Air Traffic and Navigation Services (ATNS) in the deployment of an advanced ATFM system to enhance capacity and safety. The solution utilizes end-to-end CDM to increase capacity utilization and enables airlines to optimize operations by dynamically managing their allocated slots. Over the last decade, tourism and travel in South Africa has steadily increased by approximately 7% each year. With the increase in aircraft, passengers and total air traffic movements, South Africa needed to more efficiently manage airspace while enhancing safety. When South Africa was awarded the FIFA 2010 World Cup™, airspace optimization and management became an even larger challenge. The ATFM system gives ATNS advanced tools for strategic planning, as well as pretactical and tactical management of traffic flows within the available capacity of the Air Traffic Management (ATM) system. The system provides the comprehensive ATFM capabilities to model and implement traffic flow initiatives for both airport and airspace volumes in South Africa. Traffic flow initiatives are used to dynamically balance air traffic demand with capacity to keep traffic flowing as smoothly and efficiently as possible.

D. Define the system configuration(s) and deployed operating locations for this contract's equipment.

The ATFM system is deployed at ATNS' Central Airspace Management Unit (CAMU) and provides a system-wide view for managing the entire region, approximately 10% of the global airspace.

Matrix Item	[illegible]
E. Primary Customer Points of Contact:	
1. Program Manager:	
a. Name	Remi Pham
b. Office	Thales Australia
c. Address	Thales Australia Centre WTC Northbank Wharf, Atrium Lobby Level Siddeley Street Melbourne VIC 3005 Australia
d. Contract Type	FP
e. Telephone	+61 38 630 4554
f. Email Address	remi.pham@thalesgroup.com.au
2. Contracting Officer:	
a. Name	Markus Fey
b. Office	Thales ATM Ltd.
c. Address	WTC Northbank Wharf, Concourse Level Siddeley Street Melbourne VIC 3005 Australia
d. Contract Type	FP
e. Telephone	+61 38 630 4000
f. Email Address	NA

F.3.2.1.13 Metron Harmony for Air Navigation Service Providers (ANSPs) (Australia)

Metron Harmony for Air Navigation Service Providers (ANSPs) (Australia)	
■ Developed and installed foundation for ATFM and regional coordination to enhance capacity, efficiency and safety of Australian airspace ■ Maintains operations of system for international TFM customer	
A. Company/Division Information:	
1. Offeror Name	METRON
2. CAGE Code	3F6S4
3. DUNS Number	11-846-3475
B. Contract Specifics:	
1. Program Name	Metron Harmony for Air Navigation Service Providers (ANSPs) (Australia)
2. Contracting Agency/Customer	IFM/Airservices Australia
3. Contract Number	a. 08-513 b. C130, C131, C132
4. Contract Type	a. FFP b. FP, CPFF
5. Period of Performance	a. 16 June 2008 to 17 November 2012 b. 29 April 2010 to 30 April 2015
6. Final Contract Value	a. $738,213 b. $5,087,000 Total of $5,825,213

C. Description of Contract Work Scope Performed as Prime or Subcontractor:

Airservices Australia selected Metron Aviation to support its long-term gate-to-gate CDM vision. Airservices Australia is responsible for providing air navigation services in approximately 11% of the world's total airspace and manages air traffic operations for 63 million passengers on more than 4 million domestic and international flights every year.

Airservices Australia initially deployed Metron Harmony for ANSPs to provide the foundation for ATFM and regional coordination to enhance the capacity, efficiency and safety of the Australian airspace. The contract covers a 15-year period and provides the framework for future collaboration.

Metron Harmony for ANSPs will be used to smooth demand to available capacity for airports and controlled airspace throughout Airservices area of responsibility. The system provides CDM capabilities for Airservices operations groups, airlines and regional stakeholders. Metron Harmony for ANSPs is deployed at the National Operations Center (NOC) in Canberra, control towers, area control centers and airline operations centers as well as being used by Australian military units.

D. Define the system configuration(s) and deployed operating locations for this contract's equipment.

Airservices Australia awarded Metron Aviation a 15-year contract for the delivery, implementation, training and long term support of Metron Harmony for ANSPs, which will enable Airservices to remain on the forefront of ATFM, CDM technology and safeguarding to bring its key clients, the airlines, the benefits they require to survive in the strongly competitive airline market.

Matrix Harbour for Air Navigation Services Australia	
E. Primary Customer Points of Contact:	
1. Program Manager:	
a. Name	a. Matthew Sheppard b. Peter Curran
b. Office	a. Airservices Australia b. Airservices Australia
c. Address	a. Locked Bag 747, Eagle Farm QLD 4009 Airport Drive Brisbane Airport Brisbane Australia b. Locked Bag 747, Eagle Farm QLD 4009 Airport Drive Brisbane Airport Brisbane Australia
d. Contract Type	a. FFP b. CPFF
e. Telephone	a. +61 73 866 3757 b. +61 73 866 3635
f. Email Address	a. matthew.shepperd@airservicesaustralia.com b. peter.curran@airservicesaustralia.com
2. Contracting Officer:	
a. Name	a. Matthew Sheppard b. Peter Curran
b. Office	a. Airservices Australia b. Airservices Australia
c. Address	a. Locked Bag 747, Eagle Farm QLD 4009 Airport Drive Brisbane Airport Brisbane Australia b. Locked Bag 747, Eagle Farm QLD 4009 Airport Drive Brisbane Airport Brisbane Australia
d. Contract Type	a. FFP b. CPFF
e. Telephone	a. +61 73 866 3757 b. +61 73 866 3635
f. Email Address	a. matthew.shepperd@airservicesaustralia.com b. peter.curran@airservicesaustralia.com

F.3.2.1.14 Time-Based Flow Management (TBFM)

Time-Based Flow Management (TBFM)	
■ Enhance existing Traffic Management Advisor (TMA) decision support tool ■ Software design and development of system enhancements	
A. Company/Division Information:	
1. Offeror Name	METRON
2. CAGE Code	3F6S4
3. DUNS Number	11-846-3475
B. Contract Specifics:	
1. Program Name	Time-Based Flow Management (TBFM)
2. Contracting Agency/Customer	Lockheed Martin Corporation
3. Contract Number	DTFAWA-10-C-00052
4. Contract Type	CPFF and T&M
5. Period of Performance	7 May 2010 to 29 April 2020
6. Final Contract Value	$15,711,002

C. Description of Contract Work Scope Performed as Prime or Subcontractor:

The Time-Based Flow Management (TBFM) contract is 10-year contract to enhance the existing Traffic Management Advisor (TMA) decision support tool and evolve it into a key component of the FAA's Next Generation Air Transportation System (NextGen). This will help optimize the flow of aircraft into capacity-constrained areas, decrease delays through better predictability of airspace use, and improve fuel efficiency. TMA is currently used by Traffic Management Specialists to optimize the flow of aircraft into capacity-constrained areas using time based separation, otherwise known as metering. TBFM will build upon existing TMA functionality to fulfill user operational needs and Next Generation Air Transportation System (NextGen) commitments. This includes the addition of departure management functionality, re-architecting to provide gate-to-gate metering, and development of functional enhancements.

D. Define the system configuration(s) and deployed operating locations for this contract's equipment.

Under this contract, Metron provides engineering services to support the sustainment of the existing TMA functionality, re-architecture to the new TBFM system, and the design, development, testing and implementation of enhancements that transition TMA into TBFM supporting NextGen trajectory based operations. Tasks include:

- Sustainment support for current operations
- System engineering requirements and algorithm development
- Concept Exploration and Development – Develop initial Concept of Operations (ConOps) for system enhancements through modeling, analysis and demos and refine this ConOps into requirements and system specifications
- Software design and development of system enhancements
- System testing of enhancements
- Subject Matter Expert (SME) support to operations

Time-Based Flow Management (TBFM)	
E. Primary Customer Points of Contact:	
1. Program Manager:	
a. Name	Luanne Kovalcik
b. Office	Lockheed Martin Corporation
c. Address	9231 Corporate Boulevard Rockville, MD 20850 USA
d. Contract Type	CPFF and T&M
e. Telephone	301.640.3463
f. Email Address	luanne.kovalcik@lmco.com
2. Contracting Officer:	
a. Name	Sue Pappert
b. Office	Lockheed Martin Corporation
c. Address	9231 Corporate Boulevard Rockville, MD 20850 USA
d. Contract Type	CPFF and T&M
e. Telephone	301.640.3463
f. Email Address	sue.pappert@lmco.com

F.3.2.1.15 Tower Flight Data Manager (TFDM)

Tower Flight Data Manager (TFDM)	
■ TFDM concept integrates ATCT and airport surface management capabilities into a single platform	
A. Company/Division Information:	
1. Offeror Name	METRON
2. CAGE Code	3F6S4
3. DUNS Number	11-846-3475
B. Contract Specifics:	
1. Program Name	Tower Flight Data Manager (TFDM)
2. Contracting Agency/Customer	MIT Lincoln Laboratory
3. Contract Number	FA8721-05-C-0002
4. Contract Type	Fixed Price Level of Effort (FPLOE)
5. Period of Performance	1 February 2009 to 31 January 2011
6. Final Contract Value	$4,508,148

C. Description of Contract Work Scope Performed as Prime or Subcontractor:

Metron Aviation, under contract to MIT Lincoln Laboratory, provides the FAA AJT with concept engineering support, simulation environment development, and decision support tool analysis for the TFDM. The principal activities within the Metron Aviation concept development approach include analysis of the existing ATCT operational environment and assessment of the impacts of TFDM integration into the ATCT environment. Metron Aviation participates in meetings with SMEs that provide a good understanding of the operational ATCT environment. Metron Aviation has started the early phases of concept development for TFDM including use cases, scenarios, and storyboard development for routine and nonroutine operations. Metron Aviation prepares operational context materials for TFDM user team meetings and provides simulation support for the development and validation of prototype software. This project culminated in validation of the operational feasibility of TFDM via a pre-operational trial during the last week of April and first week of May 2011.

D. Define the system configuration(s) and deployed operating locations for this contract's equipment.

The TFDM program represents an ongoing operational concept development and validation effort between the FAA, MIT Lincoln Laboratory, and Government contractors, including Metron Aviation. The proposed TFDM concept integrates ATCT and airport surface management capabilities into a single platform that enables application of DSTs that in turn reduce taxi time, reduce fuel usage and emissions, and increase departure time predictability.

E. Primary Customer Points of Contact:	
1. Program Manager:	
a. Name	John Bereiwerisio
b. Office	MIT Lincoln Laboratory
c. Address	244 Wood Street Lexington, MA 02420-9108 USA
d. Contract Type	FPLOE
e. Telephone	781.981.1774
f. Email Address	bereiwerisio@ll.mit.edu

[redacted]	
2. Contracting Officer:	
a. Name	Mark Weber
b. Office	MIT Lincoln Laboratory
c. Address	244 Wood Street Lexington, MA 02420-9108 USA
d. Contract Type	FPLOE
e. Telephone	781.981.7403
f. Email Address	markw@ll.mit.edu

F.3.2.1.16 NY/NJ/PHL Airspace Environmental

NY/NJ/PHL Airspace Environmental	
■ Performed on multiple New York Metro airspace analysis, design, configuration and policy programs ■ Metron Aviation SME staff includes highly experienced, former FAA New York traffic management personnel	
A. Company/Division Information:	
1. Offeror Name	METRON
2. CAGE Code	3F6S4
3. DUNS Number	11-846-3475
B. Contract Specifics:	
1. Program Name	NY/NJ/PHL Airspace Environmental
2. Contracting Agency/Customer	Northrop Grumman Corporation
3. Contract Number	a. DTFA05-00-C-01286 b. DTFA01-98-F-03014
4. Contract Type	a. FFP b. T&M
5. Period of Performance	a. 7 September 2000 to 1 July 2007 b. 31 January 2003 to 9 March 2004
6. Final Contract Value	a. $2,023,212 b. $581,698 Total of $2,604,910

C. Description of Contract Work Scope Performed as Prime or Subcontractor:

The NY/NJ/PHL Airspace Redesign Project was a major FAA project created to alleviate the strain and complexity of the current airspace while simultaneously remaining environmentally sensitive.

Metron Aviation provided an extensive analysis of the NY/NJ/PHL airspace to evaluate the possible alternatives to enhance the use of the airspace. As a part of the redesign effort, the FAA is required to produce an Environmental Impact Statement or EIS that describes the environmental effects associated with each alternative. The alternatives range from do nothing to a complete reworking of the airspace. The study covered a five-state region and included 21 airports. Metron Aviation's role was to aid the airspace design team in discovering noise changes created by their designs and then to present the findings in the EIS to the public.

The primary tools used to discover these changes included the Airspace Design Tool (ADT) and the Noise Integrated Routing System (NIRS). ADT was used to identify current air traffic patterns using historical radar data. From these traffic patterns noise backbones were created and imported into NIRS to compute noise. This analysis created the "baseline" that defined the current noise levels. ADT was used to manipulate the baseline backbones to model alternative designs created by the airspace design team. The alternative backbones were run through NIRS to provide the airspace design team and the public some idea as to the noise impact of the changes in airspace use.

D. Define the system configuration(s) and deployed operating locations for this contract's equipment.

As a pioneer member of the Collaborative Decision Making (CDM) community, Metron Aviation has worked in close cooperation with stakeholders to design and develop innovative operational capabilities, and associated procedures, which have yielded quantifiable benefits to the National Airspace System (NAS). We have worked with design teams on the NY/NJ/PHL Redesign Environmental Impact Statement (EIS) project to develop alternative routes to the airspace

NONFIT Airspace Environment	
that addressed several of the capabilities identified in the FAA's NGIP, such as Area Navigation (RNAV)/Required Navigation Performance (RNP) procedure development.	
E. Primary Customer Points of Contact:	
1. Program Manager:	
a. Name	Susan M. Daniel
b. Office	NA
c. Address	12005 Sunrise Valley Drive Reston, VA 20191 USA
d. Contract Type	FFP and T&M
e. Telephone	NA
f. Email Address	NA
2. Contracting Officer:	
a. Name	Susan M. Daniel
b. Office	NA
c. Address	12005 Sunrise Valley Drive Reston, VA 20191 USA
d. Contract Type	FFP and T&M
e. Telephone	NA
f. Email Address	NA

F.3.2.1.17 Systems Engineering 2020 (SE-2020)

Systems Engineering 2020 (SE-2020)	
■ Cornerstone NextGen systems engineering program ■ Developing operational concepts for implementing several key NextGen concepts	
A. Company/Division Information:	
1. Offeror Name	METRON
2. CAGE Code	3F6S4
3. DUNS Number	11-846-3475
B. Contract Specifics:	
1. Program Name	Systems Engineering 2020 (SE-2020)
2. Contracting Agency/Customer	Federal Aviation Administration (FAA)
3. Contract Number	DTFAWA-10-D-00033
4. Contract Type	CPFF
5. Period of Performance	29 June 2010 to 28 June 2015
6. Final Contract Value	$1,146,918,066
C. Description of Contract Work Scope Performed as Prime or Subcontractor: As prime contractor on the FAA Systems Engineering 2020 (SE-2020) program (awarded June 2010), Metron Aviation provides innovative research, mission analysis and concept development for the FAA's strategic program for implementing the Next Generation Air Transportation System (NextGen). The 10-year contract awarded to Metron Aviation has a value of $1.15B, making it the largest single award to a small business in FAA history. The SE-2020 program benefits the FAA through the development of the next generation of the National Airspace System (NAS) by performing engineering work that will help transform and modernize the nation's airspace into NextGen.	
D. Define the system configuration(s) and deployed operating locations for this contract's equipment. The work performed by Metron Aviation will complement work performed under additional SE-2020 contracts. The firms will conduct research and missions analysis to see how NextGen concepts, procedures and technologies can be integrated into the current system.	
E. Primary Customer Points of Contact:	
1. Program Manager:	
a. Name	Kenneth M. Carter
b. Office	Federal Aviation Administration (FAA)
c. Address	800 Independence Avenue, SW, Room 929 Washington, DC 20591 USA
d. Contract Type	CPFF
e. Telephone	202.267.8460
f. Email Address	kenneth.m.carter@faa.gov

2. *Contracting Officer:*	
a. Name	Debbie Frye
b. Office	Federal Aviation Administration (FAA)
c. Address	950 L'Enfant Plaza North, SW Washington, DC 20024 USA
d. Contract Type	CPFF
e. Telephone	202.385.6483
f. Email Address	debbie.frye@faa.gov

F.3.3 Pre-Employment Screening Procedures

Raytheon has rigorous procedures for pre-employment screening for all Raytheon new hire employees including criminal background check and drug testing. For further details, see Section F.4. Raytheon has worked for the PANYNJ on the PIDS project and has a clear understanding of the additional pre-employment screening required by the PANYNJ through the Secured Workers Access Consortium (SWAC). Raytheon has existing clearance procedures for requesting site access badges to PANYNJ airport facilities and grounds/perimeter. For the PIDS project, the PANYNJ provided on-site training to Raytheon personnel prior to site badge issuance. We would anticipate this would be required for the JFK SMS project as well. All site access card applications pass through Raytheon Security Management. Airport identification credential information requirements are satisfied in accordance with PANYNJ Airport Manager's Bulletin No. 2009-02. SWAC, NDA, and site access application documents on record with Raytheon include:

- SWAC Application Procedure
- PANYNJ Non-Disclosure and Confidentiality Agreement
- PANYNJ Security Handbook
- PANYNJ Access Level/Escort/DRVR/Name Change Form (Add Form)
- PANYNJ Access Level/Escort/DRVF/Name Change Form (Delete Form)
- Escort Authorization Form
- Identification Card Disposition Application
- Application for Port Authority Airport Identification Card
- Internal Tracking Form Used for Application for Port Authority Airport Identification Card

Raytheon will comply with PANYNJ airport safety and emergency policies as a component of the JFK SMS project. Raytheon has become very familiar with the safety and emergency procedures of the Port Authority based on our continuing work on the PIDS project.

For discussion of disaster recovery plans, see Section F.1.1.10.10.

F.3.4 Organizational Chart

Figures F-37 and F-38 show the organization charts for Raytheon Company and the Network Centric Systems Business Unit, respectively. Figure F-39 depicts the Raytheon JFK SMS organization chart.

Bill Swanson is the Raytheon Company CEO. NCS President Dan Crowley reports to Bill Swanson. Andy Zogg (Command and Control Systems Vice President) reports to Dan Crowley. Bill Nevits, the JFK SMS Program Manager, reports to Andy Zogg. As shown by the flat reporting chain, any issues that might arise on the project will get to the highest levels in the corporation quickly for immediate resolution.

F.3.5 Staffing Plans

The Raytheon Team is prepared and properly staffed to work the JFK SMS program on Day 1. As can be seen by Figure F-40, our approach, using mostly a commercially available product (the Metron Aviation Harmony solution), allows for a quick integration and implementation effort, and provides for on-time delivery with low risk. Raytheon personnel will operate primarily out of their Massachusetts-based operations. Metron Aviation personnel will operate primarily out of their corporate offices in the Washington, DC, area. Both Raytheon and Metron Aviation personnel will also operate in the NY area during installation, integration and test. See Sections F.3.4 and F.3.6 for mapping of functions and responsibilities for the respective staff positions.

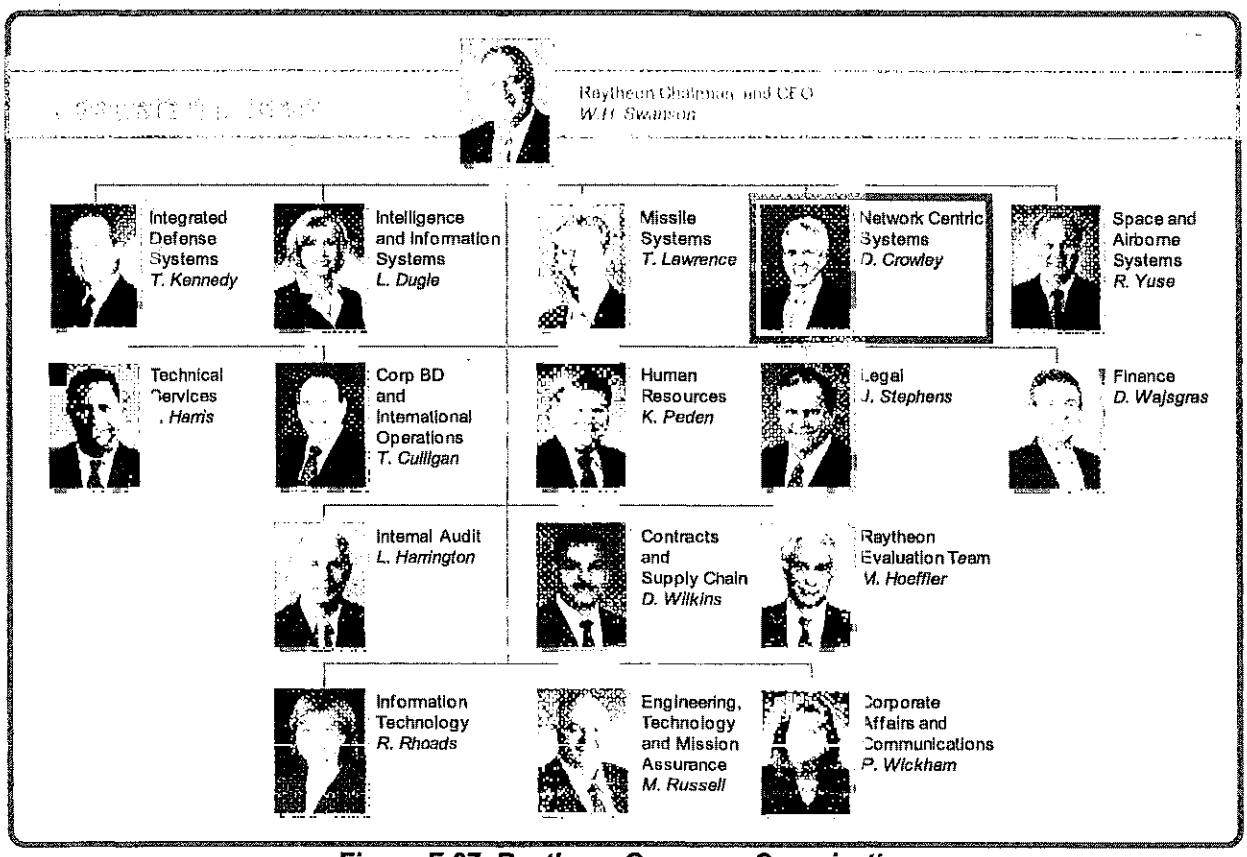


Figure F-37. Raytheon Company Organization

F.3.6 Job Titles (and Associated Roles and Responsibilities (Section F.3.9))

Figure F-41 depicts the JFK SMS job titles, and associated roles and responsibilities.

F.3.7 Port Authority Human Resources Expected by Contractor

Raytheon has significant experience working with customers on projects with the complexity and staffing requirements envisioned for the JFK SMS program. Raytheon recommends that the Port Authority plan on having the following personnel with the approximate percentage of time needed for the duration of this project:

- Program Manager (PM) – Estimated to be 80% time from contract award through Operational Test of Phase B; some additional PM support will be needed after the completion of Operational Test (Phase B)
- Contract Manager (CM) – Estimated to be 50% time from contract award through Operational Test of Phase B; some residual CM support will be needed after the completion of Operational Test (Phase B)
- Lead Systems Engineer (SE) – Raytheon anticipates that the PANYNJ will want to have a technical lead to review and approve the design reviews and documentation submitted by Raytheon for this project
- Other Port Authority personnel as desired to support the above three listed personnel; these support personnel might include Quality, Logistics, Finance, Training, and other specialty personnel as deemed necessary to support PM, CM and Lead Engineer
- Port Authority Security personnel assistance in obtaining the access permissions required

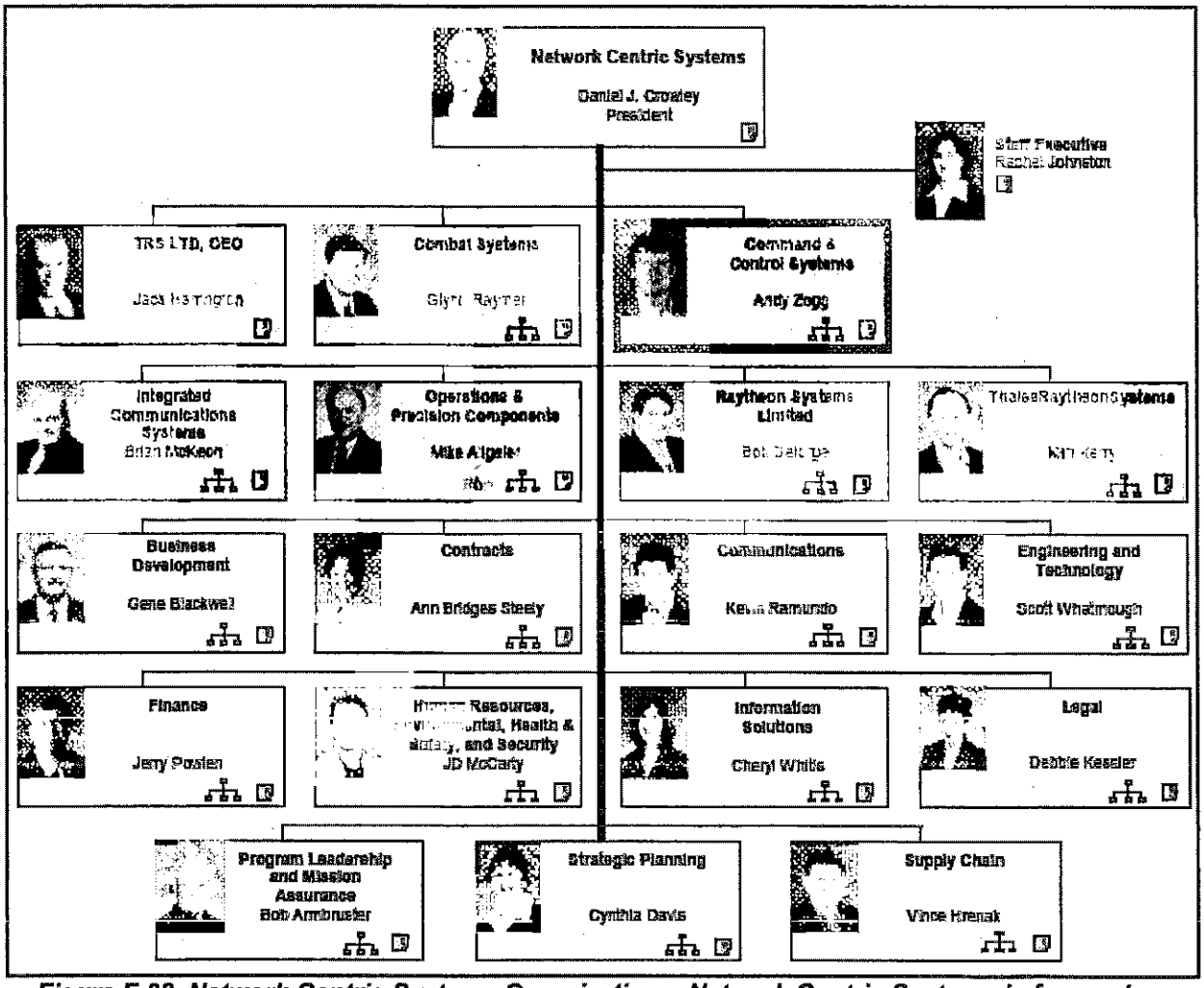


Figure F-38. Network Centric Systems Organization – Network Centric Systems is focused on Command and Control, and Air Traffic Management (ATM)

F.3.8 Customer Furnished Equipment (CFE) and Customer Furnished Support

The following CFE are needed from the Port Authority in order for the project to proceed:

- Seating for up to five Raytheon team personnel should be in an office environment with desks, telephone, and internet access (55K bandwidth) for the SMS Manager and SMS Operators at JFK Airport. Raytheon will need unlimited availability to the Port Authority LAN/WAN and the internet at the JFK Operations Center at no cost during the period of performance of this contract. Up to five parking spaces for Raytheon Team vehicles will be provided at no cost to Raytheon.
- Floor space within ready access to this office for a lockable supply cabinet to hold spare components for the Raytheon-provided SMS equipment (this lockable supply cabinet will be approximately 3-foot by 4-foot footprint and stand approximately 6 feet tall).
- Customer-furnished data feeds are needed to interface to the SMS delivered by Raytheon. See Section F.1.1.5.1 for the specific data feeds required from the Port Authority. Raytheon will need unlimited availability to these external system data feeds 30 days prior to the start of system operational testing. See Section F.3.1, Figure F-35, for this system operational testing date.
- Access by Raytheon Team individuals (screened by the Port Authority) to the necessary locations at JFK Airport and other sites to allow the installation and checkout of the Raytheon delivered and

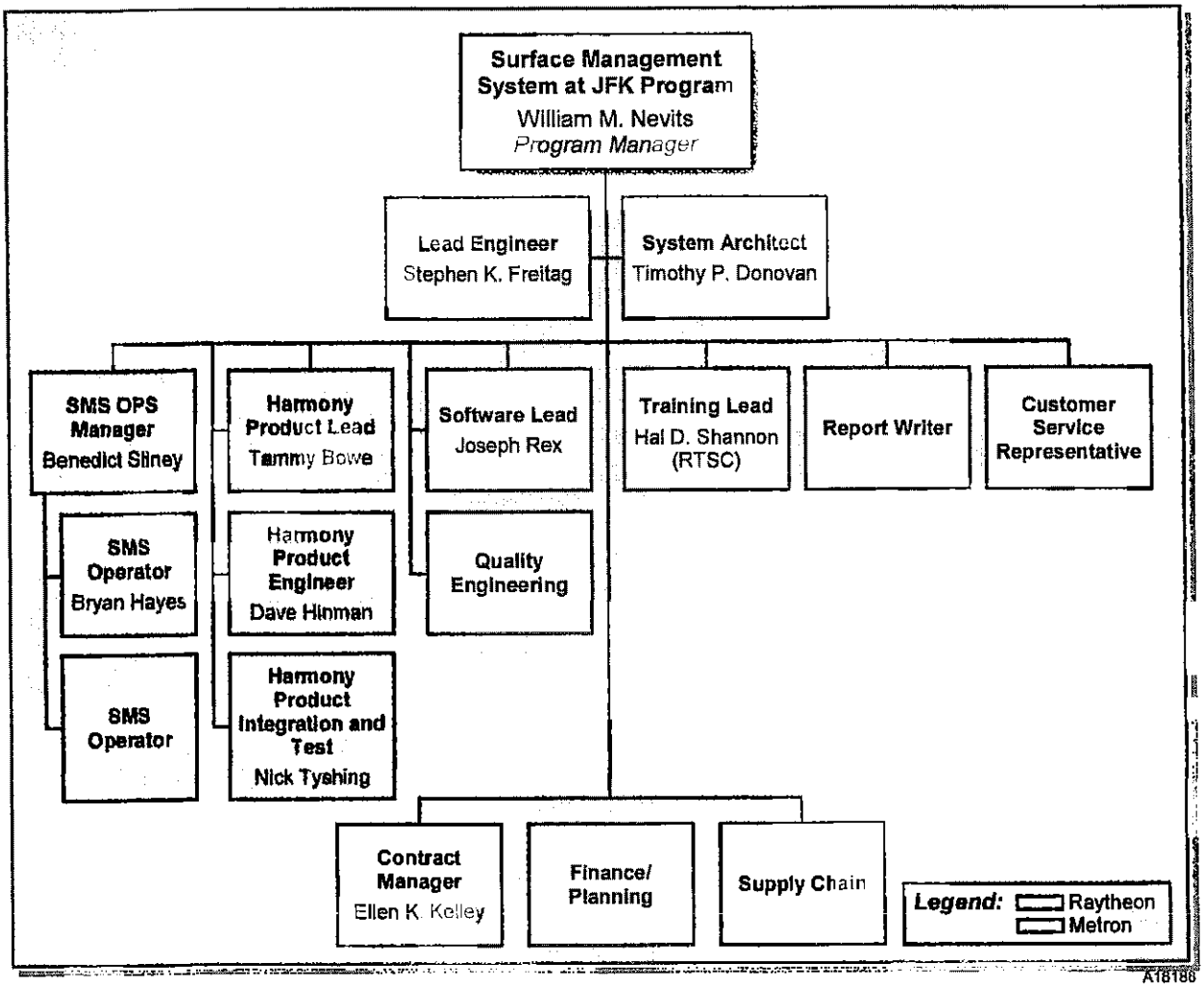


Figure F-39. Program Organization – Our streamlined, highly skilled team ensures success

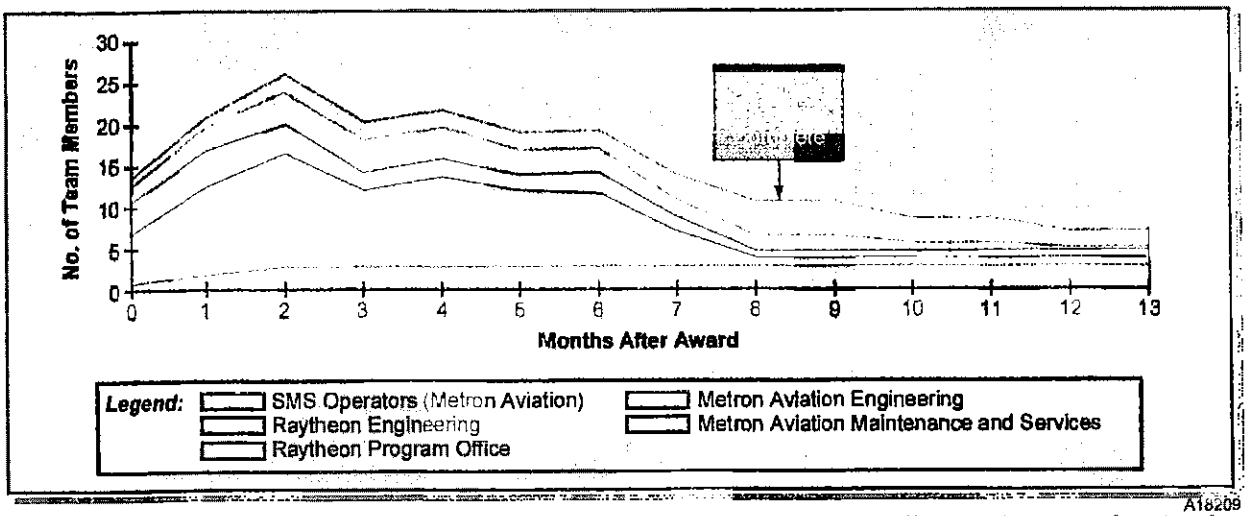


Figure F-40. Staffing Plan – Low risk COTS products ensure on-time delivery with a moderate-size team

Title	Roles/Responsibilities
Program Manager (PM)	■ Overall responsibility and authority to represent Raytheon Team on all program decisions ■ Coordinates all Raytheon technical and contractual inputs, and delivers all contract products to PANYNJ ■ Provides Port Authority with "one face to the customer" for clear chain of authority and decision-making ■ Empowered by Raytheon Executive Management to represent company
Contract Manager	■ Provides Raytheon contractual position on all program decisions ■ Is legally bound person to obligate company on all contractual matters ■ Works directly with Program Manager to ensure customer receives clear responses and program decisions for all open issues
System Architect	■ Provides overall guidance and top level system design vision for JFK SMS program ■ Leads system design review and leads any required trade studies for system level solutions
Lead Engineer	■ Provides day-to-day technical guidance of Raytheon scope of JFK SMS program ■ Interfaces with System Architect to address and resolve any systems issues and priorities ■ Provides day-to-day leadership of Raytheon technical team
Harmony Product Lead	■ Responsible for ensuring successful delivery and ongoing operational usage of Metron Harmony product suite to meet critical operational needs of customer base ■ Leads project efforts to success by ensuring project scope and timelines are carefully mapped out in project plan and completed to satisfaction ■ Ongoing follow-up and coordination of project team members, stakeholders and customer to ensure project commitments remain on track ■ Management and mitigation of potential risks, and issue resolution, as identified through continuous monitoring and control activity ■ Provides ongoing support for meetings, presentations, and proposals with regard to costs, timelines, and procedures for Metron Aviation's service delivery and technical support
Harmony Product Engineer	■ Responsible for providing systems engineering support to Harmony for Airlines product, including establishing requirements for product, as well as designing and documenting algorithms within product ■ Responsible for analyzing operation and predictions produced by product to ensure it and its embedded algorithms continue to operate as planned ■ As opportunities for improvement present themselves, controls their introduction into system through updated requirements and algorithms
Harmony Product Integration and Test	■ Responsible for all aspects of deploying and supporting Harmony product, including: - Adaptation work - Coordination with vendors and outside entities for external data sources and connectivity - Completion of pre-acceptance testing and user acceptance test coordination - Delivery of training and training materials - Configuration of system monitoring tools - Installation of system upgrades and releases - Customer coordination and change management procedures for deployment ■ Focused on maintaining integrity and availability of Harmony product though ongoing system health monitoring and providing quality customer support
SMS Operations (OPS) Manager	■ Responsible for all aspects of day to day implementation effort for JFK SMS Operations ■ Ensures contracted service levels are deployed on schedule and in accordance with contract requirements ■ Available on a 24/7 basis to address any extraordinary issues or problems

Figure F-41. Job Titles and Associated Roles/Responsibilities – We have the right team with the right skill mix to ensure a successful program

Title	Roles/Responsibilities
Software Lead	■ Provides day-to-day technical guidance for Raytheon software team ■ Reviews software development and test plans to ensure requirements are being satisfied and testing will prove allocated requirements ■ Provides day-to-day leadership of Raytheon software development team
Customer Service Representative	■ Handles all day-to-day issues, anomalies or degradations in SMS service ■ Primary point of contact to SMS user community ■ Provides 24/7 support to SMS user community ■ This team conducts routine maintenance actions for SMS administration, to include addition, deletion and modification to user profiles
Report Writer	■ Designs, develops, document modifies and works with SMS user community to provide useful database products for SMS mission ■ Significant experience in various databases is required to be effective in this position ■ Provides end user training on capabilities of SMS and various reports able to be generated by deployed system
Training Lead	■ Responsible for all aspects of operator and off-site user training, ensuring SMS operators at JFK meet qualifications as specified by FAA and PANYNJ, and in accordance with contract directives
Finance Lead	■ Raytheon Team Financial Lead shall be responsible for all aspects of project financial tasks, including any and all reporting, invoicing and other financial tasks for project
Supply Chain	■ Raytheon Team Supply Chain Lead shall be responsible for all subcontracts management, and procurement of vendor products and services

Figure F-41. Job Titles and Associated Roles/Responsibilities – We have the right team with the right skill mix to ensure a successful program (continued)

installed SMS equipment. The specific locations and specific personnel to be granted access will be discussed and mutually agreed after contract award.

- PANYNJ will provide all of the required training infrastructure (classroom space, computers, internet connections, projectors capable of displaying information on an instructor's computer, etc.). Raytheon assumes that all offsite training locations will be within the New York City Metroplex area and will provide the same training infrastructure as described above for the onsite courses.

F.3.9 Roles and Responsibilities

The roles and responsibilities, as well as job title descriptions, are provided in Figure F-41.

F.3.10 SMS Contract Manager and SMS Program Manager

The Raytheon Team will have Ms. Ellen Kelley as Contract Manager and Mr. William (Bill) Nevits as Program Manager for the JFK SMS program. Both Ellen and Bill bring exceptional experience to this project. See Section F.3.11 for resumes of all key personnel for the JFK SMS program. When reviewing the resumes of our Team, notice the world class experience brought to this project by the Raytheon Team. This project is extremely important to the Raytheon Team members and will receive the highest level of support in the team member companies. See Section F.3.11 for more information on the Raytheon Team.

F.3.11 Qualification of Support Team

Resumes of the Raytheon Team identified to work this very important project are shown in Figure F-42. Their significant experience and expertise ensures a low risk, best value solution for the JFK SMS Program.

	William M. Nevits
Company	**Raytheon**
Position (Function and Responsibility)	Program Manager
Educational Background	■ Certified Raytheon Program Manager ■ Numerous Raytheon learning courses, including Raytheon Six Sigma Expert Training and Management Development Program ■ BS, State University of New York
Work Experience	Mr. Nevits is a certified Raytheon Program Manager capable of leading complex software intensive development programs. He has over 20 years experience in managing air traffic management programs with his primary focus being Raytheon's AutoTrac and STARS family of automation programs. He is fluent in all aspects of program management across all life cycle phases including project planning, scheduling, earned value, risk and opportunity management, team building, project metrics and status reporting. Mr. Nevits is currently the Raytheon Program Manager for the Terminal Data Distribution System (TDDS) Program being developed for the U.S. FAA. This TDDS will adhere to the evolving FAA System Wide Information Management (SWIM) standards to net enable a number of legacy systems by replacing point-to-point interfaces with SWIM-compliant service-oriented interfaces that will improve capacity, efficiency and security for all NAS users. In this role, Mr. Nevits is responsible for all phases of program planning and execution. In addition, Mr. Nevits has been supporting Raytheon's new business capture activities in the ATC market by focusing on domestic and international proposals. On these efforts, he served as the Proposal Manager and had overall responsibility for the preparation and timely delivery of Raytheon's proposal. Prior to his present position, Mr. Nevits was the AutoTrac III Product Line Manager responsible for the initial development and deployment of the AutoTrac product line that will be deployed for operational use in Mumbai and Delhi, India, the UAE GCAA and Dubai. In this position he was responsible for the design, implementation, cost, and schedule performance for the initial release of the AutoTrac III system. Mr. Nevits was previously the Raytheon Program Manager for the German DFS VATCAS ATC Automation program. In this position he had responsibility for all aspects of Raytheon's performance, including meeting the technical, cost, and schedule requirements of the contract, as well as customer objectives and expectations for the products provided by Raytheon. Mr. Nevits managed Raytheon's Transportation Systems Software Department with responsibility for overall technical, schedule, and budget performance of the STARS, P1, and Norwegian ATC software programs. He has over twenty years experience in real-time software development including positions as the Software Development Manager for the Amsterdam Advanced Automation (AAA) ATC System and the Software Manager for the P1/Langen ATC Automation System (ATCAS) program developed by Raytheon for the DFS. Mr. Nevits was also the Lead Software Engineer for Raytheon's Secondary Surveillance Radar and worked on its subsequent upgrade to Mode S. Mr. Nevits' work experience also includes significant contributions in applications for Graphics User Interfacing (GUI) and in satellite communications.
	Ellen K. Kelley
Company	**Raytheon**
Position (Function and Responsibility)	Contract Manager
Educational Background	■ MBA with a specialization in Government Contracts and Procurement, Western New England College ■ BA, University of Delaware
Work Experience	Ms. Kelley has been at Raytheon for 7 years. She is presently the Raytheon Contracts Manager for the Air Traffic Management group of C2S. Ellen is responsible for all aspects of contract management and administration for multiple large programs. She acts as primary customer interface for internal and external customers. Responsible for preparation and support to teaming and other contractual agreements, proposals, negotiations, contractual financial setup and cash collection, formal correspondence, customer and internal audits, and administration. Prior to joining Raytheon, Ellen worked as International Contracts and Procurement manager for Metcalf & Eddy, Inc in Wakefield, MA, and as Contracts Administrator for Charles River Associates in Boston, MA, and Gradient Company in Cambridge, MA.

Figure F-42. Team Member Qualifications – We have the right team with the right experience for the JFK SMS effort

Timothy E. Donovan	
Company	**Raytheon**
Position (Function and Responsibility)	System Architect
Educational Background	■ BA, Computer Science, and BA, Mathematics, Boston College, 1986
Work Experience	Mr Donovan is currently a Senior Principle Systems Engineer for CNS/ATM Systems in the Systems Engineering Center of the Network Centric Systems (NCS) division of Raytheon with extensive experience creating system and software architectures for C2 and ATC automation systems. ■ 2007 to Present, Raytheon Company, Domestic ATC Pursuits, System Architect – Mr. Donovan has been focused on developing advanced technologies for NEXTGEN ATM systems, including architectures introducing ADS-B, SWIM, and DATACOM into the terminal environment, and systems to provide en route traffic management, arrival sequencing, airport surveillance and ground vehicle tracking capabilities to commercial air carriers. Mr. Donovan is a contributing member to the GEIC/ITAA recommendations for transition to SWIM segment 2. ■ 2007, Raytheon Company, SBS Proposal, System Architect – Mr. Donovan created a distributed, service-based system and software architecture for the Automatic Dependent Surveillance Broadcast (ADS-B) proposal, a $1.8B program to provide a nationwide surveillance network consisting of over 800 ground stations with an operational availability of 99.999%. ■ 2004 to 2007, Raytheon Company, DD(X), Software Architect ■ 2004, Raytheon Company, SLAMRAAM, Software Architect ■ 2002 to 2004, Raytheon Company, ERAM, Software Architect – Mr. Donovan developed a scalable, distributed, object-oriented application architecture integrating new and legacy software components to replace existing en route ATC automation with an extensible and interoperable platform supporting the insertion of advanced user capabilities. Lockheed Martin is the prime contractor for ERAM. ■ 2001, HNS, Spaceway Satellite Terminal, Software Architect, Blueprint Technologies ■ 2000, ARINC, VDLM2, Software Architect, Blueprint Technologies – Mr. Donovan led the construction effort for the air to ground router used to connect aircraft with ground networks using OSI protocols. The components of VDLM2 are embedded systems developed using the Rational Unified Process (RUP) and are written in C++. VDLM2 is the selected link technology for the FAA'S NEXTGEN DATACOM. ■ 1997 to 2000, Lockheed Martin, URET CCLD, Software Architect – Mr. Donovan created a component based software architecture providing the necessary foundation for conflict probe while isolating the HCS FDP and enabling its future replacement by ERAM without requiring a reimplementation of URET. This architecture was developed using object-oriented analysis and design methodologies. ■ 1995 to 1997, Lockheed Martin, P470, Software Lead ■ 1991 to 1995, Lockheed Martin, DSR, Software Engineer – Mr. Donovan was responsible for the architecture, design, development, integration and testing of the display subsystem of DSR. This is a distributed UNIX system written in Ada that integrates the HCS with raster graphics workstations developed by Raytheon. ■ 1989 to 1991, IBM, AAS, Systems Engineer -- Mr. Donovan was responsible for design and requirements definition for the display subsystem of AAS. This program included a distributed fault tolerant infrastructure integrating the HCS with modern display technology and ATM applications.
Relevant Publications	■ "A Component Architecture for URET CCLD," T. Donovan, M. Glasgow, Proceedings of 44th Annual ATCA Technical Program, November 1999
Patents	■ "Position Validation for ADS-B Reports," U.S. provisional patent, filed June 2007 ■ "Bistatic Radar Processing for ADS-B Sensors," U.S. provisional patent, filed October 2008 ■ "Ground Vehicle Tracking System," U.S. provisional patent, filed October 2008

Figure F-42. Team Member Qualifications – We have the right team with the right experience for the JFK SMS effort (continued)

Stephen K. Freitag	
Company	**Raytheon**
Position (Function and Responsibility)	Lead Engineer
Educational Background	■ Numerous Raytheon learning courses, including Raytheon Six Sigma Specialist Training ■ MS, Worcester Polytechnic Institute ■ BS, Clarkson University
Work Experience	Mr. Freitag is an Engineering Fellow in the NCS North East Software Engineering Center's Command and Control System Department. Mr. Freitag is currently the Integration Lead for the VerteSense internal research and development program. In this role he has overall responsibility for the integration of the sensor subsystem as well as Java based application servers and display clients. Prior to this assignment, he was lead for the Dispatch Operations Subsystem as well as the System Management and Monitoring Subsystem of the Los Angeles Regional Interoperable Communications system technical proposal. In this role he was responsible for coordinating many subcontractors to develop a proposed solution in these two areas. Mr. Freitag also has significant experience in the Air Traffic Management domain. He was the lead for simulator integration for the AutoTrac III product line. He also led the design and development of the redundancy architecture for the Paperless (Flight) Strip System (PSS) delivered to the Deutsche Flugsicherung (DFS). He has worked the FAA Next Generation Air/Ground Communications system (Nexcom) with responsibilities for design, development and integration of voice communications management software. Mr. Freitag also performed a number of development and lead roles of varying responsibilities for over seven years on the FAA Standard Terminal Automation Replacement System (STARS) program. During this time period he led the software team researching the use of advanced weather products in terminal automation systems. This activity involved coordinating with the FAA Human Factors Lab, FAA Air Traffic Controller working groups and systems engineers to refine requirements to prototype integration of advanced weather products into STARS. Mr. Freitag has also had experience in the development of Vessel Traffic Control systems including the system installed into Valdez, Alaska after the Exxon Valdez oil spill.
Relevant Publications	■ "Advanced Weather Products on Terminal Automation Systems," 46th Annual Air Traffic Control Association Conference Proceedings, Fall 2001, pp. 88-92
Tammy J. Bowe	
Company	METRON
Position (Function and Responsibility)	Harmony Product Lead
Educational Background	■ Project Management Professional Certification (PMP), 2011 – Member, Minneapolis Project Management Institute (PMI) chapter ■ MBA (Concentration in Finance/Marketing; Completed 1st Half of Requirements at Marquette University), University of St. Thomas, St. Paul, MN ■ BBA (Comprehensive Management Information Systems Major, Accounting Minor), University of Wisconsin
Work Experience	Accomplished IT professional with extensive background in the aviation industry and a passion for airline operations and efficiency. Ability to deliver highly integrated software solutions in a distributed environment for mission critical airline Operations Control Center business functions. Active CDM member and participant for 13 years, focusing on GDPE workgroup efforts to improve operational efficiency. Proven strengths in solutioning/designing/developing/deploying highly customized automation solutions, managing teams to meet/exceed project timelines and customer expectations, and facilitating significant automation cutovers while protecting against operational risk. Results-oriented leadership style based on building strong team, customer, and vendor working relationships. PMP certified. ■ April 2011 to Present, Metron Aviation, Dulles, VA, Senior Systems Engineer, Commercial Products and Solutions – Responsible for ensuring the successful delivery and ongoing operational usage of Metron Harmony product suite to meet critical operational needs of a varied customer base. All aspects of product life cycle, focus on ensuring unique needs of each customer are well understood and delivered. Lead project efforts to success by ensuring project scope and timelines are carefully mapped out. Monitor potential risks via continuous monitoring and control activity. Involved in solutioning, scoping, resourcing, planning, and monitoring of project deliverables through team collaboration, follow-up, and strong understanding of customer needs.

Figure F-42. Team Member Qualifications – We have the right team with the right experience for the JFK SMS effort (continued)

- August 1990 to July 2010, Northwest Airlines/Delta Air Lines, Eagan, MN:
  - 2007 to 2010, SOC/OCC Operations Automation Manager:
    - Manager of SOC Operations Automation IT team chartered with providing a state-of-the-art suite of mission critical applications for Flight Operations. Led team that collaboratively provided 24x7 system reliability and availability for a wide range of applications to support Flight Dispatch, Meteorology, Aircraft Routing, Operations Planning, and Strategic Planning Team. Devoted to establishing an IT vision to provide industry leading solutions to customer base, and ongoing development of strong cohesive team members. Provided SOC/OCC automation services to Northwest Airlines, Pinnacle Airlines, and Delta Air Lines.
    - Successfully led team of 20+ IT professionals in completion of Delta Air Lines merger related activity to consolidate operations in Operations Control Center (OCC/SOC). Work completed on a very aggressive schedule with extreme sensitivity to timeline and potential impact to operations. Complex work required coordination across entire organization to merge critical business functions and applications in a manner that imposed the least risk to ongoing continued operations. Served as subject matter expert in business functions, data interfaces, and system interactivity. Played key role in scoping, sizing, designing, coordinating across business functions, project staffing, managing timeline, and cut-over planning.
    - Successfully led team in major effort to replatform and replace all NWA SOC applications that previously resided on Mac OS with a Windows solution. Tasked with transitioning to new platform without interrupting operations or introducing risk. Project fast tracked to completion within 24 months. Played key role in sizing, planning, staffing, solutioning, developing, and delivering full transition. Served as project manager for one of the major deliverables, Flight Explorer, a vendor product which was significantly enhanced to meet NWA needs. Responsible for specifying software requirements, contract deliverables, managing timeline, maintaining vendor relationships, and ensuring quality products were delivered.
    - Built and maintained strong business relationships with external vendors for critical SOC applications. Provided technical specifications and delivery requirements, established Service Level agreements and means to monitor and measure, oversaw ongoing support contracts with software vendors, and monitored quality of deliverables.
    - Represented NWA at CDM airline industry meetings as a key technical member of the CDM workgroup supporting Ground Delay Program Enhancements (GDPE) effort. Focused on addressing concerns of airport and enroute congestion to make more efficient use of the National Air Space (NAS). Efforts included architecting and implementing crucial data exchanges between SOC and FAA, developing and agreeing upon new procedures and policies to be shared between FAA and airlines, and integrating software solutions. Designed and implemented a number of automation solutions to manage and monitor FAA imposed flight delays. Worked closely with Volpe Transportation Center to continually improve data quality.
    - Managed and prioritized outstanding project work for Ops Automation team to ensure on-time deliverables. Provided work direction to team members to balance meeting customer expectations/requests as well as meeting high level of reliability and stability required for critical SOC applications.
    - Ensured all software SLAs were met or exceeded. Included working closely with user groups to understand business needs integral to meeting service level agreements and establishing a means to measure performance.
    - Completed business continuity plans by ensuring detailed disaster recovery steps were documented, tested, and in place for all critical systems in event of a major data center disruption.
    - Key member of project team that architected, developed, and implemented the Operations Database, a distributed relational database that houses all Flight Operations data in a high availability environment. Responsibilities included the evaluation and selection of software/hardware, data modeling, researching data sources, and leading a development team to build the required data interfaces and Tuxedo hooks.
    - Provided full IT support for all business automation needs of the Pinnacle Airlines SOC in Memphis, TN. This included custom needs of SOC, as well as remote support for Flight Dispatch group.
    - Played key role in successfully implementing Operations Management System (OMS) in SOC. This multiyear project entailed pulling information from several legacy systems at Northwest Airlines, placing it into a relational database, and presenting information in a graphical tool used by SOC to manage aircraft routing and airline schedule integrity, real-time. Responsible for leading design and development of several data interfaces, working

Figure F-42. Team Member Qualifications – We have the right team with the right experience for the JFK SMS effort (continued)

	directly with vendor supplying graphical user interface portion of software to ensure data and system needs are met, and working with key users to ensure customer needs were met. - 2006 to 2007, Solutions Architect/Team Leader - 1999 to 2006, Operations Consultant - 1990 to 1999, Senior Operations Analyst/Programmer positions - 2003 and 2009, Northwest Airlines Team Excellence Award Recipient ■ 1994 to 1995, Minneapolis Technical College, Minneapolis, MN – Part-time evening instructor for "Visual Basic Programming", and substitute instructor for 'C' programming. Technical summary is as follows: ■ Platforms - Unix servers (Solaris, AIX, HPUX), Windows, Mac OS ■ Languages/DB Tools – Distributed client/server computing utilizing services and pub/sub technology. Both thick and thin client implementations. C/C++, Unix scripting, Perl, PHP, SQL, HTML, Java, Websphere, Relational Database modeling, Sybase and Open Client api libraries, Tuxedo, MQ, ERwin, MS project
	David J. Hinman
Company	METRON
Position (Function and Responsibility)	Harmony Product Engineer
Educational Background	■ BA, Mathematics and Computer Science, Central College, Pella, IA, 1983
Work Experience	Over 25 years of experience managing, developing, and researching information systems. Management responsibilities have included managing teams of up to 40 people, including development, site support, testing, training, and administrative personnel. Developed and implemented project plans (technical, schedule and budget), and regularly delivered high quality products on time and within budget. Technical tasks have spanned all phases of software and systems engineering, including requirements analysis, algorithm development, design, architecture, implementation, testing, integration, and fielding and training for deployed systems. ■ January 2011 to Present – Metron Aviation, Principal Systems Engineer, Harmony for Airlines: - Perform system engineering duties for Harmony for Airlines product, including review of requirements, and development of program level requirements for new features of product. - Work with customers to fully understand their wants and needs, and translate these items into implementable development requirements. - Analyze available external data feeds to provide necessary information to predict aircraft movement in and around the airport surface. - Provide adaptation updates to ensure the product can operate in different airport environments for different airline customers. ■ December 2003 to January 2011, Flatirons Solutions: - Consultant, Federal Aviation Administration (FAA) Time Based Flow Management (TBFM): • Participate with FAA System Operations Engineering Support to educate the new TBFM contractor on the current TBFM system and the planned enhancements. Additionally, work with FAA personnel to evaluate the new contractor's approach for various system enhancements. • Exploring and documenting concepts as a support engineer with the FAA in the Concept Engineering Working Group (CEWG). Concepts are being developed based on TMA, adaptation and aeronautical information experience. Concepts will provide roadmap to future TBFM system and will be used to obtain funding and to support acquisition efforts for the future TBFM. Concepts are documented in a Concept of Operations with a related system-wide Concept of Use document. • Perform system engineering duties for the TBFM contract, including review of requirements and design, and development of program level requirements for new concepts for use in the TBFM contract. • Worked with FAA System Operations Engineers to determine the scope of work for the recently awarded TBFM contract. • Worked with FAA cost team to estimate the cost of developing and maintaining concepts for the recently awarded TBFM contract. • Generated and developed the concepts which will be used to transform TMA to the TBFM system. The developed concepts included description of the idea and potential implementation approaches as well as benefits and risks of the concepts.

Figure F-42. Team Member Qualifications – We have the right team with the right experience for the JFK SMS effort (continued)

- Consultant, Federal Aviation Administration (FAA) En Route Automation Modernization (ERAM):
  - Actively involved as a member of the Lockheed Martin systems engineering team
  - Contributed to the ERAM Adaptation Data Mapping task designing and implementing a system to provide insight into ERAM adaptation. Application built on top of a MS Access database which contains the mapping of adaptation items to their sources and input screens.
  - Application was built using C#, .Net and ASP.Net.
  - Assisted in developing Flight Object and Flight Object documentation as a member of the ERAM team for communications both internal and external to ERAM
- Chief Contributor, Automated Flight Service Station – Data Management (AFSS – DM) project:
  - Chief contributor on the Automated Flight Service Station – Data Management (AFSS – DM) project with Lockheed Martin, which is part of their AFSS modernization program with the FAA.
  - Designed and developed the database to hold data migrated from site survey files and National sources. The database application was MS SQL Server residing on a Server 2003 platform.
  - Managed data analysts charged with converting site data elements into formats which could be ingested into the database. The elements, validated by the analysts, included flight plans, points of contact, dial codes, and facility directives; the original formats were PDF, Word, and Excel.
- Chief Contributor, Airport Access Control Pilot Program (AACPP) project for Department of Homeland Security (DHS) Transportation Security Administration (TSA) – Designed and developed the central database to hold all analysis data from up to 20 remote pilot locations. The data was ingested from the remote locations throughout the day to support analysis of the recorded security information. The database application was MS SQL Server residing on a Server 2003 platform.

■ February 1984 to November 2003, Northrop Grumman Information Technology, Program Manager:
- Program Manager, National Airspace (NAS) Adaptation Services Environment (NASE):
  - Managed nine-member software team designing, developing, and deploying the NASE Web portal to support FAA automation specialists.
  - Managed technical aspects of the team, presiding over team's Configuration Control Board, determining release contents, and holding a weekly status meeting with FAA team members.
  - Performed site surveys and installations of releases with increasing functionality and complexity.
  - Analyzed user needs and modeled system requirements.
  - Designed and developed J2EE components, which operated within the ATG Dynamo server to support portal users.
  - Designed and maintained Oracle database housing and serving all of the source aeronautical data to the NASE portal users. Aeronautical data from ACES (Host), NASR and NFDC was available on the portal. Data warehouses created from source data and provided to communities of users.
- Director of Technology/Team Lead, FAA Center-TRACON Automation System (CTAS) Passive Final Approach and Spacing Tool (pFAST):
  - Operated as the pFAST Decision Support Tool Software Chief Engineer/Software Team Lead for the FAA.
  - Managed software team of 25 responsible for implementing functional enhancements, resolving problem reports, creating support and analysis tools, and supporting shared development with NASA.
  - Confirmed pFAST functionality of scheduled software releases, coordinated functional enhancements with the pFAST Adaptation Site teams, and supported System level testing and regression testing prior to releasing the software to the FAA.
  - Responsibilities included managing technical aspects of the team, presiding over the Technical Review Board for the team, determining the contents for each release, training of new team members, and holding a weekly Software team meeting.
  - Performed systems engineering efforts for pFAST contract. Work included requirements development, system design and architecture and test planning efforts.
  - Co-authored several technical reports, including Requirements Definition Documents, Design Documents, and Interface Control Documents.

Figure F-42. Team Member Qualifications – We have the right team with the right experience for the JFK SMS effort (continued)

	• Significant accomplishments included all software releases (10) were delivered on time and under budget, with no site-generated critical defect reports; and overseeing maintenance of more than 900,000 lines of C and C++ code, including development of over 75,000 lines of C code to implement site-required functionality. Performed work on Sun Solaris workstations. - pFAST Adaptation Chief Engineer/Team Lead for FAA, FAA CTAS pFAST Adaptation: • Managed 20 adaptation engineers in 5 site teams and was responsible for effort's overall management and approach. Adapted site-independent NASA software using published aeronautical information to operate at terminal radar approach control (TRACON) facilities supporting major airports. The adapted software served as a decision support tool for FAA ATM and controllers to provide efficient usage of available arrival runways. • Designed and developed an initial set of DFW adaptation from derived requirements. • Authored and reviewed several documents, including requirements documents, test plans, interface control documents (ICDs), and adaptation design procedures and templates. - Director of Labs, CLEAR: Commercial Applications: • Responsibilities included: technical product direction, creation of development processes, and management of release schedules. • Responsible for all of the products created in this lab, which included relational database query and reporting tools as well as applications to manage the database access by those tools. The applications were developed using C++, C, Java, and some SQL scripts. • Applications work with Oracle, Sybase, SQL Server and DB2. Product/technical skills: ■ ***Project Management*** – Microsoft Project, Microsoft Office (Word, Excel, PowerPoint, Visio, Outlook), eRoom, XPlanner, COCOMO and SEER/SEM cost estimation models ■ ***Content Technologies*** –: Documentum, Adobe Acrobat, XML ■ ***Languages*** – C/C++/C#, Java, MACRO-11, Visual Basic, Pascal, Ada, SQL, Perl, XML, Xpath, Xquery, XSLT, PHP, Spring Framework, Tag Libraries ■ ***Databases*** – Microsoft SQL Server, Oracle, Sybase, IBM DB2, Microsoft Access ■ ***Development Tools and Applications*** – SQL, XML, XSL, JSP, HTML, Java Script, Microsoft Developer Studio, Eclipse, Development Methodologies (Agile, RUP and UML), Requirements and Design Systems (Rational Rose, Rational RequisitePro, DOORS), Configuration Management and Defect Tracking systems (Rational ClearCase, Rational DDTS, Rational ClearQuest, Subversion), XML Editors and Tools (Altova XML Suite, Oxygen, PTC Arbortext, XMLSpy), Source Analysis Tools (Imagix) ■ ***Operating Environments*** – Windows (multiple versions), UNIX (Solaris, AIX, Linux), VAX/VMS, RSX-11, IAS
Relevant Publications	■ "CTAS pFAST Site Adaptation Requirements Methodology," Greg Feldman, David Hinman, 45th Annual Air Traffic Control Association Conference Proceedings, Fall 2000
	Nicholas Tyshing
Company	METRON
Position (Function and Responsibility)	Harmony Product Integration and Test
Educational Background	■ BS, Aerospace Engineering, Embry-Riddle Aeronautical University, 2008
Work Experience	■ Member of team at Metron Aviation supporting the deployment, end user testing and on-site support of surface optimization tool for Delta Air Lines. ■ Member of team creating the presentation for the SE 2020 proposal aiding with the Access database as a data analyst. ■ Project manager on tire safety issue with Honeywell and Continental Airlines by contributing in the creation of safety inspections. ■ Supported Development of Cargo handling System with Telair International for the 767-300BCF. ■ Worked in team environment at The Boeing Company to create an Access database to track a pilot program's progress in cutting engineering costs. Work history: ■ January 2011 to Present, Metron Aviation, Dulles, VA, Systems Analyst, Commercial Products and Solutions: - Provide day-to-day customer support of the Metron Harmony product suite. - Provide end user testing support for Metron Harmony product suite. - Prepare and conduct end user and system administration training. - Support sales process through demonstration of Metron Harmony product suite.

Figure F-42. Team Member Qualifications – We have the right team with the right experience for the JFK SMS effort (continued)

	■ November 2009 to January 2011, TASC, Inc. (formerly Northrop Grumman Advisory Services), Washington, DC: - October 2010 to Present, Systems Engineer, FAA Wake Turbulence Research Program: • Helped secure new business within the FAA's Air Traffic Organization's (ATO) Systems Operations Services (AJR) • Engineering and Programmatic support for the FAA's Wake Turbulence Research Office - November 2009 to October 2010, Systems Engineer, Implementation and Integration for FAA NextGen Program: • Direct Programmatic Support for the FAA's NextGen Integration and Implementation (I&I) office, assisting management in a portfolio of projects. • System Engineering support for the FAA NextGen program. • Aide in proposal writing and data analysis for potential new contracts. • Conduct research for potential new business development. ■ May 2008 to August 2008, Continental Airlines, Houston, TX, Co-Op Engineer, Systems Engineering – Involved in project management on various safety related projects. Provided on-site assistance to technicians working on engineering projects. Investigated reoccurring system failures that caused disruption to daily operations. ■ May 2007 to August 2007, Boeing Company, Everett, WA, Student Intern, Structures Engineering at Technical Services – Participated in pilot program to help reduce engineering costs for group. Investigated discrepancies in engineering drawings. Accommodated customer requests and provided direct feedback to customer. ■ June 2003 to September 2006, Capitol Cable and Technology, Gaithersburg, MD, Comprehensive Sales Assistant – Operated as an interface between the sales department and customers, aided in customer service related tasks, assisted in the management of the showroom and warehouse. Relevant skills are CATIA V5/V4, MatLab, NEINastran, Microsoft Access, Microsoft Office
	Joseph Rex
Company	**Raytheon**
Position (Function and Responsibility)	Software Lead
Educational Background	■ BS, St. Joseph's College, Bangalore, India, 1986 ■ MS, Computer Applications, Regional Engineering College, Trichy, India, 1989
Work Experience	Mr. Rex has worked with Raytheon since January 1997, both in software development and in Systems Engineering for various Air Traffic Management related programs. Since May 2009, Mr Rex has been working as the Software Lead on the System Wide Information Management (SWIM) Terminal Data Distribution System (TDDS) program. Mr. Rex was the function lead on Arrival Management (AMAN) function for the next generation Air Traffic Management automation system, AutoTrac III, developed for international customer (India, UAE, Dubai) from 2006 to 2009. Mr. Rex was the lead software engineer on the Paperless Strip System (PSS), an electronic flight strip based automation capability, developed for the Deutsche Flugsicherung (DFS), the German Air Traffic Control service provider from 2004 to 2006. He worked as a systems engineer on the requirements for the Air/Ground communication software for the Next Generation Communication program for the Federal Aviation Administration from 2003 to 2004. Mr. Rex worked on a multiyear internal research and development project to develop a generic Data Link Component for ATC systems. He assumed dual role as a task manager and technical lead for this IRAD program from 2000 to 2003. Prior to this Mr. Rex worked on a voice recognition system for the FirstPlus Air Traffic Control Tower simulator for the BelgoControl customer from 1999 to 2000 in the capacity of a software developer. The voice recognition system was used to recognize tower control phraseology and to automatically action controller commands. From 1997 to 1999, he worked on Autotrac ATM system for various international customers, such as China, Mongolia, Norway and Oman. During this period he spent a four months working with the FAA on the Oceanic Development and Support System (OSDS). Prior to joining Raytheon, Mr. Rex worked for CAE Electronics Ltd, Montreal, Canada (1990 to 1996). At CAE Mr. Rex worked in developing an oceanic flight data processing system, an air ground data link communication capability. These systems were developed for Air Navigation Service Providers of Iceland, Portugal and New Zealand. Previous to working on the ATC project Mr. Rex worked with the Space simulation department in developing real time measurement instrumentation for the robotic arm simulation. Before joining CAE, Mr. Rex worked for a year with PSI Data Systems, Bangalore, India, from 1989 to 1990. Here he developed data acquisition software to acquire data from the space simulation chamber for Indian Space Research Organization.

Figure F-42. Team Member Qualifications – We have the right team with the right experience for the JFK SMS effort (continued)

Relevant Publications	■ "CNS/ATM – Experiences and Examples," J. Rex, G. Watson, International Symposium of Electronics in the Air Transport Industry, Hong Kong, China, November 1998 ■ "ATC Data Link Component," M. Allouche, J. Rex, Air Traffic Control Association, 47th Annual Meeting, Washington, DC, November 2002 ■ "Implementing SOA Using Apache Open Source Technology," J. Rex, T Donovan, Raytheon Information Systems and Computing Symposium, El Segundo, CA, June 2011
	Harold D. Shannon
Company	**Raytheon**
Position (Function and Responsibility)	Training Lead
Educational Background	■ Raytheon Six Sigma ■ Federal Aviation Administration (FAA): - Air Traffic Control - Traffic Flow Management Coordinator - En Route Traffic Flow Management - Air Route Traffic Control Center - Approach Control - Control Tower (Operator and Examiner) - Management by Team Action - Labor Relations - Fundamentals of Supervision - Briefing and Presentation Techniques - Management and Leadership - Facility Administration for International Customer - Orientation to Defense Readiness ■ Teaching Certification, University of Tennessee ■ Bachelor of Business Science, Aviation Management, Texas Wesleyan University
Work Experience	Harold Shannon is presently the Raytheon Senior Instructional Systems Design and Lead Instructor for International Air Traffic Control and ATC Systems with many years training experience, specializing in technical development and editing documentation for design, training and installation of ATC systems and equipment. He has been in this role for more than 14 years. His role requires development of detailed training courses not only on ATMS and Airport Security equipment but also basic and advanced ATC procedures and Air Traffic Controller certification to ICAO standards. Prior to joining the Raytheon team, Mr. Shannon was Training Director and Project Consultant for two small 8A firms, where he co-authored the Minimum Aviation System Performance Standard (MASPS) for AOC – ATM "Ground to Ground" ATM Information Exchange (RTCA/SC169/WG 5) for the FAA. This was after 8 years as an Adjunct Professor at the University of Oklahoma, serving as an ATC Instructor and ISD Specialist, ATC Subject Matter Expert and Supervisor of En Route Traffic Control and Flight Service Instructional Systems Design teams. In addition, Mr. Shannon was employed for 36 years as a full performance ATC and Supervisory ATC Specialist for FAA and U.S. Navy.
	Benedict Sliney
Company	METRON
Position (Function and Responsibility)	SMS OPS Manager
Educational Background	■ Juris Doctor, St. John's University School of Law, 1978 ■ BS, Professional Studies, Dowling College,1974
Work Experience	Mr. Sliney has over 30 years of experience working the Federal Aviation Administration with over 37 years of direct experience in the NY/NJ airspace. He has served in several capacities in the NY TRACON as well as LaGuardia Air Traffic Control Tower. In addition, Mr. Sliney provided ATC services for JFK, LGA, and EWR airports. As National Operations Manager for the FAA Air Traffic Control System Command Center, responsible for the safety of the National Airspace System, Mr. Sliney responded to the 9-11-2001 national emergency where he ordered the landing of all aircraft. Combined with his extensive NY area experience and NAS understanding, Mr. Sliney will provide unparalleled management and operational knowledge to the Port Authority SMS. ■ 2008 to 2009, Metron Aviation, Inc. - Mr. Sliney worked for Metron Aviation providing Subject Matter Expert (SME) knowledge for key FAA research projects. In this role he continued to support the advancement of TFM through transforming his in depth knowledge and understanding of the NAS and New York area to Metron Aviation team members in support of FAA contracts.

Figure F-42. Team Member Qualifications – We have the right team with the right experience for the JFK SMS effort (continued)

	■ 1969 to 2006, Federal Aviation Administration (FAA), Operational Manager, NY TRACON – Following his USAF service, he began with the FAA as an ATC Specialist at Quonset RATCC in Rhode Island in early 1969. After full qualification at Quonset, he transferred to the NY Common IFR Room, the predecessor to the NY TRACON, where he served in several capacities. Following qualification as a radar air traffic controller at the Kennedy, LaGuardia, and Newark sectors, he served as an Evaluations, Proficiency, and Development Specialist and later headed that department, charged with ensuring the training and proficiency of air traffic control specialists at the CIFRR. During this period, he was engaged in the development and implementation of training programs and analysis of the operations and effectiveness of the ATC services provided. After a transfer in 1976 to LaGuardia Air Traffic Control Tower, where he served a joint role as a fully qualified first line supervisor and training officer, and led a team of air traffic controllers providing ATC services at the airport tower, he returned to the CIFRR in 1977 as a first line supervisor, serving once again in all three sectors. He was promoted to a second level operational manager shortly thereafter. After a 1-year tenure as a fully qualified operational supervisor at Otis TRACON on Cape Cod providing air traffic services to the Cape and Islands, in 1980, he returned to the now NY TRACON, once again in a supervisory position. The PATCO strike soon followed and Mr. Sliney, like many managers, returned to active air traffic control to provide ATC services for JFK, LGA and EWR airports and to train the new work force which he continued to do until 1982, when he left the FAA to practice law. Over the next decade, he returned to the FAA for two 1-year periods, first in 1985, when he returned to develop and write the lesson plans for a traffic management course for the NY TRACON and later in 1990 as Traffic Management Officer, heading the first Traffic Management Unit at that facility providing, for the first time, traffic management services and analysis of air traffic flow and operation. Following a successful law career, Mr. Sliney returned to the FAA in 2000 on a full time basis at the Air Traffic Control Systems Command Center. After qualifying as a specialist providing the analysis and implementation of traffic management initiatives on a nationwide basis for the next 10 months, he then took the position of National Operations Manager, responsible for the safe and efficient use of the entire National Airspace System (NAS). On his first day in that position, 9-11-2001, in response to the ongoing national emergency of that day, he ordered the landing of all aircraft. Shortly after 9-11, Mr. Sliney was charged to head the Command Center as Manager, Tactical Operations Branch. Following the return to post 9-11 normalcies in the NAS, in late 2002, he returned to the NY area as Manager of the Airspace and Procedures Branch in the Eastern Regional Office. Pursuing his personal desire to be engaged in operational matters, in 2003, he transferred to the NY TRACON as an Operational Manager, where he managed the day-to-day air traffic and traffic management operations until his retirement in November 2006. ■ 1964 to 1968, USAF, Air Traffic Controller – Mr. Sliney began his career in 1964 as an air traffic controller, serving 4 years with the USAF here in the U.S. and abroad in Vietnam.
	Bryan J. Hayes
Company	METRON
Position (Function and Responsibility)	SMS Operator
Educational Background	■ Embry-Riddle Aeronautical University, Professional Aeronautics, 1980 to 1982 ■ University of North Dakota, Natural Geographies, 1978 to 1979 ■ Airline Operations Training, Flushing, NY, Flight Dispatcher's License, 1975 to 1976 ■ Private Pilot License, Single Engine, Land, 1974 ■ Nassau Community College, Liberal Arts, 1973 to 1975
Work Experience	Thirty five years combined experience in aviation, air traffic control operations in the Federal Aviation Administration, and United States Air Force, and an extensive management background. Six years of experience as a Frontline Manager at Newark Tower, Newark, New Jersey. Lead negotiator/ consensus and collaborative problem solving between FAA, PANYNJ and National Airspace System (NAS) stakeholders by implementing breakthrough, foundational changes to specific airport surface movement areas. Alleviated airport "choke points" and increased traffic throughput. Two years experience in Eastern Regional Headquarters in Air Traffic Requirements Division, project lead for New York Metropolitan Area, New Tower Programs, Mobile Tower Deployment Program, Tower Cab Design prototype and mockup at the William J. Hughes Technical Center, Atlantic City, NJ. Three years experience in Eastern Tactical Operations as a subject matter expert in the development and implementation of Traffic Flow Management Systems and some Foundational Tier One technologies such as: Traffic Situational Displays, Airport Surface Detection Equipment (ASDE – Model X), Time Based Metering procedures and applications platforms.

Figure F-42. Team Member Qualifications – We have the right team with the right experience for the JFK SMS effort (continued)

As a temporary Program Manager, Mr. Hayes worked extensively with the Free Flight Phase One Program Office, Management and Labor organizations and applied organization change principles and consensus problem solving techniques to implement the Departure Spacing Program at key New York and New Jersey facilities.

Seven years experience as Operations Manager of a large Terminal environment at the Potomac TRACON, Warrenton, VA. This facility serves as the parent radar approach and departure control function for DCA, IAD, RIC and BWI Metroplex airports and uses foundational Next Generation (NextGen) technologies throughout its daily operations.

- 2003 to 2010, Federal Aviation Administration (FAA):
  - Operations Manager, Potomac TRACON (PCT), Warrenton, VA – Mr. Bryan Hayes served as the manager of the daily Air Traffic Controller operations room at the Potomac Consolidated TRACON. He routinely made operational decisions that affect the NAS in the Baltimore, Washington Reagan, - Dulles and Richmond metro areas. He successfully lead a varying and dynamic group of Front Line Managers, Supervisory Traffic Management Coordinators, Traffic Management Coordinators, Air Traffic Controllers, Airway Facility Technicians and Internet/Web Technician sand Administrative personnel in an active Terminal Approach Control facility.
  - September 2000 to September 2003, Tactical Operations ATT-4, Eastern Regional Office, One Aviation Plaza, Jamaica, NY – Bryan Hayes served as an air traffic subject matter expert in Eastern Regional Tactical Operations (ATT-4) National Airspace System (NAS), to identify Traffic Flow Management system dynamics, performance metrics, and organizational trends and delay information analysis. Monitored system performance, identified trends in systems demand and sought procedural and technical methodologies, in which to improve system capacity. Mr. Hayes worked with foundational technologies involving Traffic Management Displays, Time Based Metering, Traffic Management Advisor and multicenter metering. Bryan provided organizational direction to field managers on procedural changes and reporting requirements. Mr. Hayes was part of a larger team that laid the framework for customer based strategies, which eventually evolved in to the development of collaborative thinking models.

    Mr. Hayes organized, deployed and implemented the Departure Spacing Tool (DSP) program. Mr. Hayes was able to influence new requirements, install, train and implement, new bargaining unit agreements over system wide use. This system automatically queues up departure sequences to balance access to common departure points serving the NY/NJ areas. The system is currently installed at the following airports: Newark, New Jersey, Teterboro, New Jersey, JFK Kennedy, New York, LaGuardia, New York, Long Island MacArthur, New York and White Plains, New York and New York Center, Long Island, New York.

    Shortly after 09-11-2001, Mr. Hayes helped organize and implement an Air Traffic First Responders Team to represent the FAA, at Mayor Rudy Giuliani's request, which was located at Pier 92, on the Hudson River, New York City. Bryan's team manned that station 24 hours a day, 7 days a week, for a year. This communications system eventually evolved into the Domestic Events Network (DEN) system now in use at key locations across the country today.
- 1997 to 2000, Occupational Health and Safely Committee (OSHECOMM)
- November 1997 to September 2000, Requirements Specialist, Eastern Regional Office, One Aviation Plaza, Jamaica, NY
- September 1991 to November 1997, Supervisor, Newark Tower, Newark, NJ
- October 1987 to September 1991, Traffic Management Coordinator, NY Terminal Radar Approach Control, NY TRACON
- Eastern Region/HQ:
  - December 2002 to September 2003, Labor/Management Specialist
  - 1999 to 2003, Tactical Operations. Program Coordinator
  - 1997 to 1999, Eastern Region, FAA Requirements Specialist
  - Air Traffic Controller, Full Performance Level, Supervisor, Manager
  - September 2003 to July 2010, Potomac TRACON (PCT) TRACON, Operations Manager
  - 1991 to 1997, Newark Tower (KEWR), Supervisor
  - 1987 to 1991, NY TRACON (N90), Traffic Management Coordinator
  - 1983 to 1991, NY TRACON (N90), Air Traffic Controller
  - 1982 to 1983, IND Tower/TRACON, Air Traffic Controller
- 1976 to 1980, United States Air Force (USAF)

Figure F-42. Team Member Qualifications – We have the right team with the right experience for the JFK SMS effort (continued)

F.3.12 Customer Services Experience

Raytheon provides a full spectrum of technical, scientific and professional services to its federal, international, defense and commercial customers worldwide. It specializes in training, logistics, engineering, product support, and operational support services and solutions for the Mission Support, homeland security, space, civil aviation, counter proliferation and counterterrorism markets.

The NAS, the most complex aviation system in the world, encompasses infrastructure (communications, navigation, surveillance, weather, and automation), procedures, airspace structure, and personnel necessary to provide safe, efficient, and secure air travel within and around the U.S. Raytheon built, installed, and integrated primary elements of the U.S. ATC infrastructure such as Standard Terminal Automation Replacement System (STARS), En Route Automation Modernization (ERAM), Integrated Terminal Weather System (ITWS), Precision Runway Monitor (PRM) and systems, and supports the training of every air traffic controller through ATCOTS. Knowledge beyond the design and operation of individual NAS components is essential to understand how NAS equipment comes together to support the safe separation of aircraft.

Raytheon's solution deployments for over 30 years in NAS elements have included customer services such as training, operation maintenance, site maintenance, depot level maintenance, engineering support, data collection and analysis services, and logistical support.

Raytheon's Standard Terminal Automation Replacement System (STARS) has been deployed to 160 ATC sites. Raytheon's customer services solution has included training of 4150 FAA controllers, 24x7 help line with on-call service available, 24x7 depot logistics services, and second level engineering support.

Under the Air Traffic Control Optimum Training Solutions (ATCOTS) contract, Raytheon provides trained instructors to deliver training at the FAA Academy in Oklahoma City, OK, at the FAA ATC facilities nationwide, as well as having responsibility 316 training locations. Raytheon provides ATC training across all four domains: en route, tower, terminal and TRACONs, and is engaged in the total training process. In addition to air traffic controllers, Raytheon support training of active U.S. Army warfighters, NASA astronauts, and trains most General Motors and Mr. Goodwrench technicians and salespersons globally.

F.3.13 Certified Environmentally Friendly Form

ATTACHMENT G - Certified Environmentally Preferable Products/Practices

Proposer Name: Raytheon Company **Date:** 8 August 2011

In line with the Port Authority's efforts to promote products and practices which reduce our impact on the environment and human health, Proposers are encouraged to provide information regarding their environmentally preferable/sustainable business practices as they relate to this contract wherever possible. Proposers **must** complete this form and submit it with their response, if appropriate. Proposers **must** submit appropriate documentation to support the items for which the Proposer indicates a "Yes" and present this documentation in the proper sequence of this Attachment.

1. Packaging

Has the Proposer implemented any of the following environmental initiatives? **(A checkmark indicates "Yes")**

_✓_ Use of corrugated materials that exceed the EPA recommended post-consumer recycled content

_✓_ Use of other packaging materials that contain recycled content and are recyclable in most local programs

_✓_ Promotes waste prevention and source reduction by reducing the extent of the packaging and/or offering
packaging take-back services, or shipping carton return

____ Reduces or eliminates materials which have been bleached with chlorine or chlorine derivatives

_✓_ Eliminates any packaging that may contain polyvinyl chloride (PVC), or polystyrene or heavy metals

If yes, a description of the practices being followed must be included with the submission.

2. Business Practices / Operations / Manufacturing

Does the Proposer engage in practices that serve to reduce or minimize an impact to the environment, including, but not necessarily limited to, the following items? **(A checkmark indicates "Yes")**

_✓_ Recycles materials in the warehouse or other operations

_✓_ Use of alternative fuel vehicles or vehicles equipped with diesel emission control devices for delivery or transportation purposes

_✓_ Use of energy efficient office equipment or signage or the incorporation of green building design elements

_✓_ Use of recycled paper (that meets federal specifications) in their marketing and/or resource materials

_✓_ Other sustainable initiative

If yes, a description of the practices being followed must be included with the submission.

3. Training and Education

Does the Proposer conduct/offer a program to train or inform customers and employees of the environmental benefits of the products to be offered under this contract, and/or does the Proposer conduct environmental training of its own staff?

☐ Yes ☐ No If yes, Proposer must attach a description of the training offered and the specific criteria targeted by the training.

☑ Not applicable

4. Certifications

Has the Proposer or any of its manufacturers and/or subcontractors obtained any of the following product / industry certifications? **(A checkmark indicates "Yes")**

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_✓_ ISO 14000 or adopted some other equivalent environmental management system
_✓_ Other industry environmental standards (where applicable), such as the CERES principles, LEED Certification, C2C Protocol, Responsible Care Codes of Practice or other similar standards
____ Third Party product certifications such as Green Seal, Scientific Certification Systems, Smartwood, etc.

If yes, Proposers must attach copies of the certificates obtained.

5. Other Environmental Criteria
Proposers are encouraged to respond to criteria specifically indicated in this RFP as "Management Approach" (and attach the appropriate documentation) to receive consideration in the evaluation.

I hereby certify, under penalty of the law that the above statements are true and correct.

Ellen K. Kelley **Name** 8 August 2011 **Date**
Ellen K. Kelley

Raytheon Competition Sensitive/Raytheon Proprietary
Export-Restricted Data
1106-1002
Use or disclosure of data contained on this sheet is subject to the restriction on the title page of this proposal.

F.4 Contractor Identity Check/Background Screening Plan

Raytheon has an existing process for Contractor Identity Check/Background Screening and Drug Testing administered by Raytheon Human Resources (HR) Talent Acquisition for new employees and for existing employees when required. Raytheon contracts with HireRight Incorporated to conduct the required Identity Check Background Screening and Drug Testing. This background checking is conducted according to the desired investigation parameters such as frequency of investigation and minimum number of years of employment history or verification of what an employee documented they have done in the specified minimum number of years preceding the date of the investigation.

For the JFK SMS project, Raytheon shall maintain a Contractor Identity Check/Background Screening Plan for all of the years of the contract. The Plan shall include, but not be limited to, the following:

- The length of time researched for the identity check background screening on new hires, which shall be at a minimum of 10 years of employment history
- Verification of what an existing employee documented they have done in the last 10 years preceding the date of the investigation
- Raytheon's resource utilization of HireRight Incorporated to perform screening new hire and existing employees
- Frequency of screening as determined by Human Resources policies and contractual requirements
- Raytheon's acknowledgement that this plan is separate and apart from airport specific or legally required credential, such as SIDA

F.5 Business Risk

Raytheon shall submit a risk assessment and succession plan to the Port Authority that assesses the business risk in taking on the significant amount of new work that will be required under this Contract. Raytheon's risk assessment plan will take into account all work currently under contract, as well as work that is under contract to companies which Raytheon owns, controls or has an interest.

Raytheon has 72,000 employees conducting $25B sales in 2010 with over 1400 employees dedicated to Air Traffic Management Projects worldwide. Our staffing plan (Section F.3.5) has identified the requirement for 15 full-time equivalent Raytheon personnel to work on the JFK SMS. If any surge capacity is needed to complete the SMS project, Raytheon can easily leverage its existing ATM-experienced resources, without jeopardizing ongoing contracts.

Metron Aviation is our teammate and major subcontractor for the JFK SMS program. Metron Aviation has approximately 200 employees, with more than 20 employees dedicated to the Surface Management business area. Our staffing plan (Section F.3.5) has identified the requirement for approximately four full-time equivalent Metron Aviation Engineering personnel to work on the JFK SMS. If any surge capacity is needed to complete the SMS project, Metron Aviation can easily leverage its existing SMS-experienced resources, without jeopardizing ongoing contracts. Additionally, Metron Aviation will be providing the SMS Manager and SMS Operators for this project. Metron Aviation has available highly experienced former controllers with significant relevant JFK experience to support the SMS Manager and Operator positions for this program.

F.5.1 Program Risk

Apart from the business risk, we have also identified the JFK SMS program risks. Figure F-43 is a risk table that identifies the top three program risks and its associated mitigation strategies. By implementing some of the risk strategies now, prior to contract award, such as leveraging Raytheon's Independent Research and Development (IRAD) and alerting the Port Authority of the risks during acquisition, this will enable the Port Authority and Raytheon to deliver on a low risk approach to the program upon contract award.

Risk	Mitigation Strategy
Schedule impact of securing external data feeds	On contract, work with Port Authority to ensure ongoing timely delivery of data feeds. Leverage Metron Aviation's authorized Class I ADSI subscriber status to ensure timely availability of this feed. Request FAA external feeds prior to contract award.
Operational schedule of Phases A and B	Leverage Raytheon's IRAD in NextGen Common Automation Platform to mitigate deployment risk and enable us to meet aggressive operational schedule. Combining Phases A and B into 1 delivery enables us to deliver 2 weeks early. See Section F.3.1 for more details on our combined delivery rationale.
Transitioning of current prototype to Raytheon's SMS solution	On Day 1, establish an Integrated Product Team (IPT) with user community to ensure usability of SMS capabilities.

Figure F-43. SMS Solution Major Risks – Early mitigation of major risk items ensures a low risk approach to SMS delivery for JFK

F.6 Demonstrations

Raytheon will present a demonstration of the proposed system to the Port Authority on 14 October 2011. The demonstration will highlight the system and services proposed and how the fully operational version of the system will look and behave.

The demonstration will highlight the proposed system and services, including the capabilities Raytheon has developed as part of its NextGen Common Automation Platform IRAD activities.

Demonstration highlights the look and behavior of the system and services

- Proposed demonstration date of 14 October 2011
- Simulated demonstration
- User interface and graphical base map
- Reporting capabilities
- Live operation demonstration of LGA
- Demonstration system available for further week for hands-on evaluation

F.6.1 Independent Research and Development (IRAD) Plan

Every year, Raytheon invests in its own product line through internal investments called Independent Research and Development (IRAD). We have an ongoing multiyear IRAD focused on a NextGen Common Automation Platform that includes technology and capabilities targeted at NextGen Surface and Tower. The capabilities developed under our IRAD are also beneficial to the Port Authority for the SMS at JFK and other customers, and they include the following:

- Service Oriented Architecture
- Interfaces to weather services
- Interfaces to flight information display system
- Collaboration server and client
- Reports and statistics generation
- System monitoring and control
- User administration and control

(Note: Raytheon and the Port Authority understand that the IRAD effort described herein constitutes IRAD within the meaning of Federal Acquisition Regulation 31.205-18 and case law.)

F.6.2 Demonstration Summary

The demonstration will highlight the capabilities of the system and services, and the look and feel of the user interface for the proposed system. The demonstration will include:

- Surface situational awareness
- Operational alerts
- User interface
- Departure queue management
- Reporting capabilities:
  - Surface demand monitoring
  - Report generation
- Playback – The demonstration will be performed as a playback of simulated data.
- Standalone demonstration system using simulated data
- Live operation demonstration of the system installed at LaGuardia

If an earlier date for the presentation is required, the format of the demonstration system may be adjusted accordingly.

F.6.3 Demonstration System Setup

The demonstration system will be comprised of an application server, a database server, a simulation server, and one or more web clients (refer to Figure F-44). Access to these servers for the demonstration will be through a web browser only. The simulation server will use recorded surveillance data from JFK and other predefined data to drive the SMS. It will simulate:

- Surveillance data
- Flight Data, EDCT
- Runway configuration, departure restriction

For the demonstration, the web clients will be at the Port Authority facility connecting to the web server running on the application server at the data center.

The complete demonstration system or just the web client may be installed at a location of the Port Authority's choosing, and will be remain at this location for further evaluation for a week. In addition, support personnel will available via telephone or email to assist the Port Authority.

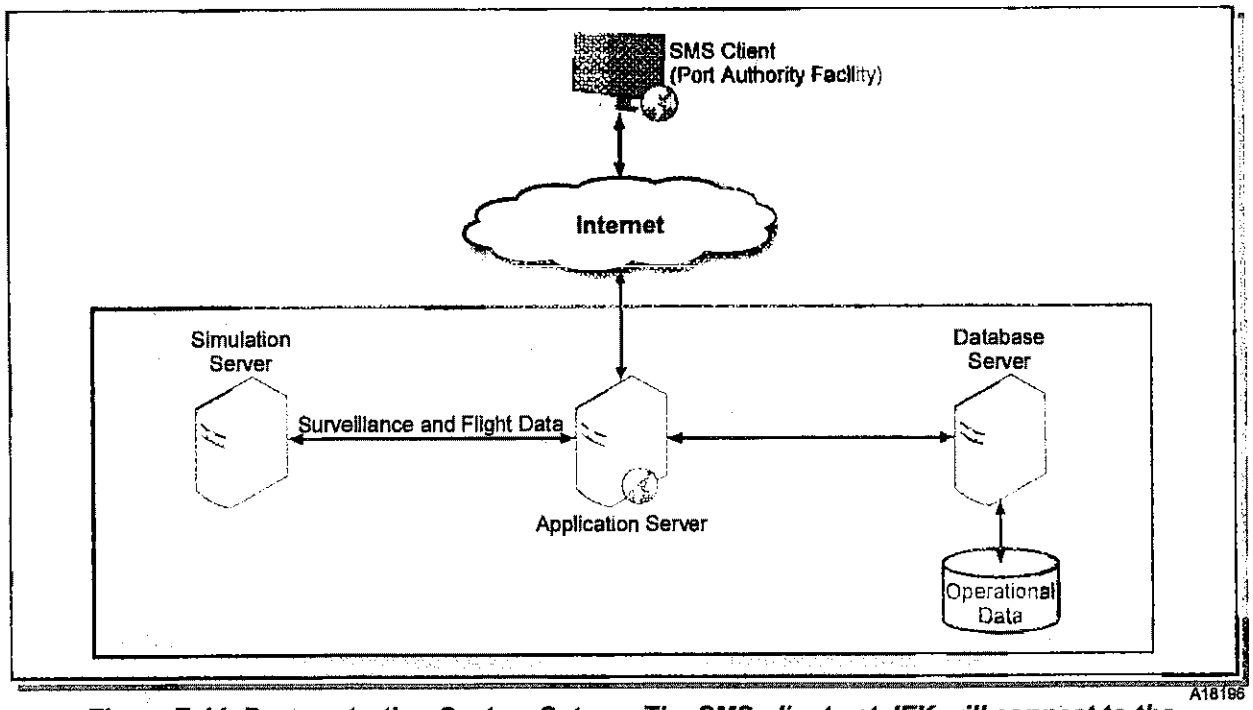

Figure F-44. Demonstration System Setup – The SMS clients at JFK will connect to the demonstration system via the internet

F.7 Acknowledgement of Addenda

THE PORT AUTHORITY OF NY & NJ

PURCHASING SERVICES DIVISION
ONE MADISON AVENUE 7TH FL.
NEW YORK, NY 10010

Date: July 7, 2011

ADDENDUM #1

To prospective Proposers on Request for Proposals (RFP) # 24997 for Surface Management System at John F. Kennedy International Airport (JFK)

☒ **Proposals due back on August 8, 2011, no later than 2:00 P.M.**

☒ Proposals originally due on July 11, 2011, no later than 2:00 P.M.

The following changes/modifications are hereby made to the solicitation documents:

1. Delete Attachment B, Contract Specific Terms and Conditions, Section 5. "Insurance Procured by the Contractor" in its entirety and replace with the attached revised "Insurance Procured by the Contractor".

All answers to Prospective Proposers' questions will be submitted at a later date.

This communication should be initialed by you and annexed to your proposal upon submission.

In case any Proposer fails to conform to these instructions, its proposal will nevertheless be construed as though this communication had been so physically annexed and initialed.

THE PORT AUTHORITY OF NY & NJ

KATHY LESLIE WHELAN, MANAGER
PURCHASING SERVICES DIVISON

PROPOSER'S FIRM NAME: Raytheon Company

INITIALED: EKK

DATE: 8 August 2011

QUESTIONS CONCERNING THIS ADDENDUM MAY BE ADDRESSED TO LESLEY BROWN, WHO CAN BE REACHED AT (212) 435-3969.

Revised

Insurance Procured by the Contractor

The Contractor shall take out, maintain, and pay the premiums on Commercial General Liability Insurance, including but not limited to premises-operations, products-completed operations, and independent contractors coverage, with contractual liability language covering the obligations assumed by the Contractor under this Contract and, if vehicles are to be used to carry out the performance of this Contract, then the Contractor shall also take out, maintain, and pay the premiums on Automobile Liability Insurance covering owned, non-owned, and hired autos in the following minimum limits:

Commercial General Liability Insurance - $25 million combined single limit per occurrence for bodily injury and property damage liability.

Automobile Liability Insurance - $2 million combined single limit per accident for bodily injury and property damage liability.

In addition, the liability policy (ies) shall name The Port Authority of NY and NJ and City of NY, as additional insured, including but not limited to premise-operations, products-completed operations on the Commercial General Liability Policy. Moreover, the Commercial General Liability Policy shall not contain any provisions for exclusions from liability other than provisions for exclusion from liability forming part of the most up to date ISO form or its equivalent unendorsed Commercial General Liability Policy. The liability policy (ies) and certificate of insurance shall contain cross-liability language providing severability of interests so that coverage will respond as if separate policies were in force for each insured. These insurance requirements shall be in effect for the duration of the contract to include any warrantee/guarantee period.

The certificate of insurance and liability policy (ies) must contain the following endorsement for the above liability coverages:

"The insurer(s) shall not, without obtaining the express advance written permission from the General Counsel of the Port Authority, raise any defense involving in any way the jurisdiction of the Tribunal over the person of the Port Authority, the immunity of the Port Authority, its Commissioners, officers, agents or employees, the governmental nature of the Port Authority, or the provisions of any statues respecting suits against the Port Authority."

The Contractor shall also take out, maintain, and pay premiums on Workers' Compensation Insurance in accordance with the requirements of law in the state(s) where work will take place, and Employer's Liability Insurance with limits of not less than $1 million each accident.

In addition, the policy (ies) shall include the Authority and its wholly owned entities as an additional insured and the policy (ies) and its certificate must be specifically endorsed

to contain a provision that the policy may not be canceled, terminated, or modified without thirty (30) days' prior written notice to the Port Authority of NY and NJ, Att: Facility Contract Administrator, at the location where the work will take place and to the General Manager, Risk Financing.

The Port Authority may at any time during the term of this agreement change or modify the limits and coverages of insurance. Should the modification or change results in an additional premium, The General Manager, Risk Financing for the Port Authority may consider such cost as an out-of-pocket expense.

Within five (5) days after the award of this agreement or contract and prior to the start of work, the Contractor must submit an original certificate of insurance, to the Port Authority of NY and NJ, Facility Contract Administrator, at the location where the work will take place. This certificate of insurance MUST show evidence of the above insurance policy (ies), stating the agreement/contract number prior to the start of work. The General Manager, Risk Financing must approve the certificate(s) of insurance before any work can begin. Upon request by the Port Authority, the Contractor shall furnish to the General Manager, Risk Financing, a certified copy of each policy, including the premiums.

If at any time the above liability insurance should be canceled, terminated, or modified so that the insurance is not in effect as above required, then, if the Manager shall so direct, the Contractor shall suspend performance of the contract at the premises. If the contract is so suspended, no extension of time shall be due on account thereof. If the contract is not suspended (whether or not because of omission of the Manager to order suspension), then the Authority may, at its option, obtain insurance affording coverage equal to the above required, the cost of such insurance to be payable by the Contractor to the Port Authority.

Renewal certificates of insurance or policies shall be delivered to the Facility Contractor Administrator, Port Authority at least fifteen (15) days prior to the expiration date of each expiring policy. The General Manager, Risk Financing must approve the renewal certificate(s) of insurance before work can resume on the facility. If at any time any of the certificates or policies shall become unsatisfactory to the Port Authority, the Contractor shall promptly obtain a new and satisfactory certificate and policy.

The requirements for insurance procured by the Contractor shall not in any way be construed as a limitation on the nature or extent of the contractual obligations assumed by the Contractor under this contract. The insurance requirements are not a representation by the Authority as to the adequacy of the insurance to protect the Contractor against the obligations imposed on them by law or by this or any other Contract.

Cits# 3710

THE PORT AUTHORITY OF NY & NJ

PURCHASING SERVICES DIVISION
ONE MADISON AVENUE 7TH FL.
NEW YORK, NY 10010

Date: July 25, 2011

ADDENDUM #2

ECK

REQUEST FOR PROPOSALS# 24997 FOR SURFACE MANAGEMENT SYSTEM AT JOHN F. KENNEDY INTERNATIONAL AIRPORT (JFK)

Proposals are due back on August 8, 2011, no later than 2:00 P.M.

Originally Proposal due on July 11, 2011, no later than 2:00 P.M.

CHANGES/MODIFICATIONS:

The following changes/modifications are hereby made to the solicitation documents:

1. Throughout the document, remove and replace Enhanced Traffic Management System (ETMS) with Traffic Flow Management System (TFMS)

2. Delete Attachment B, Part I, Section 9, d., and replace with:

   (d) Must pass a drug screening test, including a comprehensive ten-panel drug screen or its equivalent, to include screens for the following.

Amphetamines	Methaqualone	Benzodiazepenes 6MAM – if indicated
Barbiturates	Methadone	Opiates
Marijuana	Propoxyphene	Morphine – if indicated
Phencyclidine (PCP)	Cocaine	Codeine – if indicate

   Tests shall be administered by and at the sole expense of the Contractor, at the commencement of this Contract or immediately prior to working at the Airport under this Contract, and randomly thereafter at the written request of the Port Authority.

The Contractor shall furnish to the Port Authority, prior to the Commencement Date and at any time during the period of the Contract, including Option and/or Extension Periods, if any, at no expense to the Port Authority, information concerning the requirements and qualifications of the Contractor's personnel as listed above and shall submit evidence substantiating said qualifications and requirements to the satisfaction of the Port Authority.

3. Remove from Attachment C, Scope of Work, 41, requirement 7, "A site specific manual shall also be provided to document the specific site related configuration and operations/maintenance."

4. In Attachment C, Scope of Work and Specifications, 2, Table of Contents, VIII. B. and in Attachment C, Scope of Work and Specifications, 4, I. A. paragraph 2, remove "30-Day Operational Test" and replace with "14 Day Operational Test".

5. Change all references to Base Date of Operational Usage to February 15, 2012. .

6. Delete the following sentence from *Attachment C, 45, IX.B.13,* "System Documentation shall be provided in both a bound copy and an electronic version in a machine-readable form, which is viewable with the Microsoft Office 2007 suite of tools and Auto-Cad (if used)." and replace it with, "System Documentation shall be provided in both a bound copy and an electronic version in a machine-readable form, which is editable with the Microsoft Office 2007 suite of tools and Auto-Cad (if used)."

7. In Exhibit 5, Application Controls Checklist, General, delete sixth (6th) bullet point, which reads "Remote access should be restricted and documented in accordance with PA policy." and replace with: "Remote access should be restricted and documented in accordance with the security requirements stated in Attachment C Section V.B. Security Requirements and industry best practices."

8. Delete the last sentence in Attachment B, Sec. 16, subsection B.

9. Delete the word "workstation" from fourth (4th) bullet point in Attachment C, Scope of Work and Specifications, Section V.M (page 31 of 51)

10. Replace the words "Code of Conduct" in Attachment C, Scope of Work and Specifications, Section IV.C.25 and 26 with "Procedures".

11. Add Exhibit 10 – Surface Flow Metering Procedures

12. Add Exhibit 11 – Ramp Tower Guidance for Metering Procedures at JFK

13. Change all references to the date in which Phase B must be operational to August 1, 2012.

QUESTIONS AND ANSWERS

The following information is available in response to questions submitted by prospective Proposers. The responses should not be deemed to answer all questions, which have been submitted by Proposers to the Port Authority. It addresses only those questions, which the Port Authority has deemed to require additional information and/or clarification. The fact that information has not been supplied with respect to any questions asked by a Proposers does not mean or imply, nor should it be deemed to mean or imply, any meaning, construction, or implication with respect to the terms.

The Port Authority makes no representations, warranties or guarantees that the information contained herein is accurate, complete or timely or that such information accurately represents the conditions that would be encountered during the performance of the Contract. The furnishing of such information by the Port Authority shall not create or be deemed to create any obligation or liability upon it for any reason whatsoever and each Proposers, by submitting its proposal, expressly agrees that it has not relied upon the foregoing information, and that it shall not hold the Port Authority liable or responsible therefor in any manner whatsoever. Accordingly, nothing contained herein and no representation, statement or promise, of the Port Authority, its Commissioners, officers, agents, representatives, or employees, oral or in writing, shall impair or limit the effect of the warranties of the Bidder required by this Proposal or Contract and the Proposers agrees that it shall not hold the Port Authority liable or responsible therefor in any manner whatsoever.

The Questions and Answers numbering sequence will be continued sequentially in any forthcoming Addenda that may be issued.

QUESTION 1:
General Contract Provision 3a – Please explain the intent of this provision given the criticality of communication to the success of the system, and as a supporter of the propagation of similar systems throughout the National Air Space.

ANSWER 1:
Because communication is necessary, permission will be forthcoming upon execution of the Contract.

QUESTION 2:
General Contract Provision 4a – The Port Authority is requesting proposals for a commercial service. The service is to be delivered via a combination of JFK specific processes and the adaptation of existing, transferable technologies owned by contractors. Please confirm the Port Authority has no intention of claiming ownership rights of contractor developed technologies adapted or introduced in conjunction with this service offering.

ANSWER 2:
The Port Authority has no intention of claiming ownership rights of pre-existing contractor developed technologies.

QUESTION 3: General Contract Provision 28 – Please confirm that the service offering being procured under this RFP will NOT "control, collect, dispense, contain, manage, administer, or monitor revenue "owned" by the Port Authority".

ANSWER 3:
The service offering being procured under this RFP will not "control, collect, dispense, contain, manage, administer, or monitor revenue "owned" by the Port Authority."

QUESTION 4:
Contract Specific Terms and Conditions 8 – Job Classifications – Describing the types of skills needed to provide the service makes assumptions about the technology used, but the technological solution will vary from contractor to contractor. We recommend limiting the description of skills needed to key personnel. We recommend classifying the SMS manager and the Contract Manager as key personnel and allowing the technological offering to dictate the other skill sets needed.

ANSWER 4:
If the proposer offers an alternative solution tailored to its particular technological offering, the proposer should propose it.

QUESTION 5:
Contract Specific Terms and Conditions 13, 14, and 22 refer to the ability of the Port Authority to direct changes in level of contract support. Please confirm these directed changes are eligible for equitable adjustment(s) to the contract.

ANSWER 5:
The Contract Specific Terms and Conditions 13 and 14 will be paid in accordance with Attachment C. Section X. F. at the associated Proposed Maximum Hourly Rate in Cost Proposal Form, Table 5. Contract Specific Terms and Conditions, Section 22 will be paid in accordance with the terms in that section, Attachment B, pages 50 and 51, Section 22.

QUESTION 6:
Contract Specific Term and Condition H – Union jurisdiction. Please disclose whether current staff performing same or similar role is currently under Union jurisdiction and whether there are any pending complaints that would put union jurisdiction in question.

ANSWER 6:
The current staff is not under Union jurisdiction and the Port Authority is unaware of any pending complaints that put union jurisdiction into question.

QUESTION 7:
Contract Specific Term and Condition 9 – please provide guidance on what is required for the physical exam.

ANSWER 7:
Please refer to CHANGES/MODIFICATIONS item 2.

QUESTION 8:
Contract Specific Term and Conditions 18 and 20 – please inform us when to expect a decision on the allocation of space and parking for pricing purposes.

ANSWER 8:
There is no charge to the contractor for the rental of space or parking.

QUESTION 9:
Demonstration – please estimate the date(s) contemplated for the demonstration in relation to proposal submission, and the projected duration of the demonstration. Please confirm that the demonstration is also an opportunity to present the contractor's offering as a whole.

ANSWER 9:
Presently a presentation date (s) has not been confirmed. However, presentations may provide Proposers an opportunity to present their proposal submissions. Proposer demonstrations may not exceed four hours.

QUESTION 10:
Scope of Work – Requirement D1a, page 10, defines the predictive window as 4 hours in advance. Please confirm that this window applies to all predictive requirements within phases A and B.

ANSWER 10:
Yes.

QUESTION 11:
Scope of Work – Requirement 19, page 9 – How will cancellations and time changes be provided by the airline and airport operators? FIDS?

ANSWER 11:
A feed from FIDS will be made available to the Contractor, however the Service must be capable of accepting manual inputs for amendments.

QUESTION 12:
Scope of Work – Requirement 23, page 9 – Please provide a list of supporting tools. Are these tools intended to be data sources for the system or stand alone tools. If stand alone tools, are they intended to be run on SMS operator desktops?

ANSWER 12:
A supporting tool, such as FIDS, is intended to be a data source for the system. If Users are able to provide data (i.e. readiness indicators) in an alternate, automated fashion and the data is deliverable and readable, the required open architecture of the system should be able to receive and process such data to increase predictability.

QUESTION 13:
Scope of Work – Requirement 25, page 9 – please provide a copy of the Code of Conduct established by the Port Authority.

ANSWER 13:
Please see CHANGES/MODIFICATIONS, items 10, 11 and 12. These Procedures are living documents, subject to continuous improvement as lessons are learned. It is the intention of the Authority and Users for the Procedures to remain amendable to continue growth and program improvement.

QUESTION 14:
Scope of Work – Requirement 31, page 9 - Please provide an industry standard of the current terminology and nomenclature. Will meeting the base map requirements from pages 12-17 constitute meeting interoperability requirement?

ANSWER 14:
FAA's NextGen Implementation Plan, FAA Pilot/Controller Glossary, and the FAA FAR/AIM are recommended source of current terminology and nomenclature.

QUESTION 15:
Scope of Work – Requirement b, page 10 – "Provide alert notifications that correspond to specific operational events." Is this covered by the events defined on pages 8 and 9 at IV.C. 17: Automate alerts for critical events such as: aircraft arriving at key locations both Enroute and/or on the ground (such as a metering location or arrival fix), arrival aircraft assigned to a gate that is currently occupied, and when the taxi time of an aircraft exceeds a user-defined number of minutes. Users shall select the method of notification, to include, but not limited to: on screen display highlighting the aircraft that triggered the alert condition, audible workstation alarm and electronic methods such as email, text message, etc.) to an individual or groups." And throughout section 4?

ANSWER 15:
Attachment C, Scope of Work, page 10, IV. D. 1. B. states "Provide alert notifications to specific operational events." This is covered by events defined Attachment C, Scope of Work, pages 8 and 9, IV. C. 17, "Automate alerts for critical events such as: aircraft arriving at key locations both Enroute and/or on the ground (such as a metering location or arrival fix), arrival aircraft assigned to a gate that is currently occupied, and when the taxi time of an aircraft exceeds a user-defined number of minutes. Users shall select the method of notification, to include, but not limited to: on screen display highlighting the aircraft that triggered the alert condition, audible workstation alarm and electronic methods such as email, text message, etc.) to an individual or groups."

QUESTION 16:
Scope of Work – Requirement ii, page 18 – "the user shall set thresholds based on stated criteria for those alerts based on exceeding or falling below set criteria. The System shall provide the User the ability to monitor any data point in real time or in the system database and create an alarm that will notify the User when the data point either exceeds or falls below a threshold value set by the user." Please define what "data points" must be configurable for alerts.

ANSWER 16:
As stated in Attachment C, Scope of Work, Section IV.D.4.o.ii, any data point used for operational purposes, whether raw, unprocessed data from a sensor reading, or processed data stored in the database, such as a time count, the result of a calculation, etc.

QUESTION 17:
Scope of Work – Requirement b, page 17 – "Active aircraft icons positioned on the surface graphical display will indicate scheduled gate/stand occupation for aircraft in the aircraft data tag." What is the difference between an active and inactive flight? Is there an expectation to display inactive flights?

ANSWER 17:
An active flight has the intention of departing or has recently arrived. Often, aircraft with a transponder turned on relates to an inactive flight whereas an aircraft with a transponder turned off is inactive. The System should graphically depict if a gate is occupied even when occupied by an aircraft with the transponder turned off, as required in Scope of Work, page 17, section D. k. a. to represent an inactive flight.

QUESTION 18:
Scope of Work – Requirement a, page 20- "Region of Interest Report (i.e. departure or deicing queue)- Provides a list of all aircraft that are currently within a selected, configurable ROI along with the time of entry, time of exit, and total occupancy time." – This requirement asks for a report of aircraft that are within the ROI but also asks for the time the aircraft has left the ROI and implies the aircraft is no longer with the ROI. Is it intended for these reports to be after the fact?

ANSWER 18:
The Region of Interest (ROI) report described in Attachment C, 20, IV. E. 2.a. is intended to be after the fact. The Region of Interest report, Attachment C, 23, IV. E. 4. a, is in real time and dynamic.

QUESTION 19:
Scope of Work – Requirement X, page 45-47 – Please confirm that scheduled maintenance does not count against the "up-time" of the system.

ANSWER 19:
Authority-approved, scheduled downtime during the scheduled preventive maintenance window does not count against the operational availability of the system.

QUESTION 20:
Scope of Work – Requirement e, page 19 – Please provide the source, format, and size of the 5 years of historical data we are required to provide access to at the beginning of the contract. Also, please provide a definition of a "hold out".

ANSWER 20:
Once the data is collected, the System shall have the capability to retrieve, at a minimum, 5 years data. Archived data, stored off-line to the System, shall be made available within two days of request.

QUESTION 21: Scope of Work – Requirement 7b and 7c, page 42 – We do not believe that these requirements are relevant to a "software as a service" contract. Administration of our system and applications is considered proprietary data.

ANSWER 21:
The Port Authority specified the minimum requirements for system administration of this critical application for which the Services will be based and they are consistent with industry best practices. If the Proposer agrees to meet or exceed these requirements, state it in the proposal. If the Proposer offers an alternative that meets or exceeds these requirements, state the proposed alternative solution.

QUESTION 22:
Scope of Work – Requirement 7, page 41 – "A site specific manual shall also be provided to document the specific site related configuration and operations / maintenance." We do not believe that there are any site specific configuration requirements because the system is web enabled.

ANSWER 22:
See CHANGES/MODIFICATIONS item 3.

QUESTION 23:
Exhibit 5 – Security requirements, page 15-16 – Most specific security requirements listed have no relevance to our system.

ANSWER 23:
The system will be audited by the Port Authority's Audit Department independent of the SAS-70 Level 2 Audit and the security requirements are a part of the Contract. If a proposer considers some of the security requirements not relevant to the System, then an adequate explanation as to why they are not relevant must be provided and an exception taken in the proposal.

QUESTION 24:
Would the Port Authority consider re-evaluating the contract proposal schedule if it would attract a greater number of competitive responses?

ANSWER 24:
See Addendum #1, which changed the Proposal Due Date, and Changes/Modifications #5 and #13.

QUESTION 25:
Would the PA consider re-evaluating the operational readiness schedule if it would attract more competitive responses?

ANSWER 25:
See Answer 24.

QUESTION 26:
In Phase A, may we assume that the existing ASDE-X DDU will be directly connected to the PA SMS via PAWNET or existing secure PA subnet? If no, where will the surveillance data come from?

ANSWER 26:
The data will be provided through an agreement with the Federal Aviation Administration.

QUESTION 27:
In Phase A, may we assume that the existing ASDI (ETMS) feed is directly connected to the PA SMS via PAWNET or existing secure PA subnet?

ANSWER 27:
No, it is not a direct feed.

QUESTION 28:
Has the PA already secured FAA authorization for a direct feed for ASDE-X DDU data for the winning contractor?

ANSWER 28:
No.

QUESTION 29: Has the PA already secured FAA authorization for a direct feed for ASDI (ETMS) data for the winning contractor?

ANSWER 29:
No.

QUESTION 30:
Has the PA considered the impact of external dependencies, such as FAA approvals, in its desired operational readiness schedule?

ANSWER 30:
The Authority understands that the operational readiness schedule is subject to amendment based on the FAA approval process for access to NAS Data.

QUESTION 31:
In Phase B, are the ASDE-X tracks provided by the FAA via the Enterprise Service Gateway (i.e. FTI ED8)?

ANSWER 31:
For access to ASDE-X data, the contractor shall make application to the FAA under sponsorship of the Port Authority. Such data will be accessible through the local Data Distribution Unit and the Enterprise Security Gateway.

QUESTION 32:
How long has the PA been using the current prototype system?

ANSWER 32:
The current system has been in use since March 2010.

QUESTION 33:
How are the ASDE-X and ASDI (ETMS) data provided to the prototype system?

ANSWER 33:
Currently, the data is provided through Memorandum of Agreements between the FAA and the Vendor.

QUESTION 34:
What requirements in Attachment C are met by the current prototype system?

ANSWER 34:
The requirements met by the current prototype are irrelevant to this Request for Proposals.

SEG Not really, they need to know that what is expected of them is what is outlined in Phases A and B.

QUESTION 35:
Has the PA collected and analyzed usability data from the prototype and incorporated the requirements into Phase B?

ANSWER 35:
Yes, but not formally.

QUESTION 36:
The schedule in the SOW is extremely aggressive considering the scope described in the RFP. Will the Authority reconsider the program schedule? *(RFP, all, all)* –

ANSWER 36:
Please refer to Answer 24.

QUESTION 37:
Intellectual Property (IP):
The terms stipulate, "all process flows, codes, ... figures or delineations, which are prepared or compiled in connection with this Agreement shall become the exclusive property of the Authority, and the Authority shall have the exclusive right to use or permit the use of them and any ideas or methods represented by them for any purpose and at any time without other compensation than that specifically provided herein."

Our proposed solution to meet the SOW system specification requirements will include the provisions of an existing commercial product suite. Will the Authority reconsider its position and give the contractor co-ownership rights to data first produced under this contract similar to federal

government contracts with civil agencies such as the FAA and NASA? Specifically, the contractor who develops Intellectual Property should be given the same rights to co-ownership. Perhaps the Authority would consider modifying the IP terms similar to those in the FAA government contracts, specifically AMS Clause 3.5-13 Rights in Data - General (January 2009). *(Attachment B Part III, 5, 4)*

ANSWER 37:
See Attachment C, 26, V., D., 1. Data Ownership
The Authority will not claim rights to the provisions of an existing commercial product suite. Additionally, the Authority will not give the contractor co-ownership rights to data first produced under this contract similar to federal government contracts with civil agencies such as the FAA and NASA.

QUESTION 38:
Training Provided by the Contractor:
This term states, "The Contractor will be compensated for training hours. No compensation will be paid for any required training of the Project Manager and manager."

How and at what rate(s) will the Contractor be compensated for the training hours for its personnel? There are no provisions in the Cost Proposal Forms for hourly compensation, other than the Supplemental Work, which is effective November 1, 2012. *(Attachment B Part I, 46, 17(e))*

ANSWER 38:
The statement "The Contractor will be compensated for training hours" refers to training provided by the Contractor to Port Authority and airline staff and representatives who will be using the services provided by the System. The Contractor will not be compensated for training its own personnel, as stated in Section 17 (b).

QUESTION 39:
Space Provided for Contractor:
18(a) - This term states, "The Authority may furnish to the Contractor, subject to availability, and without charge to the Contractor, ..."
18(e) – This term states, "In the event the Authority does not furnish the Contractor with Space, the Contractor will be required to obtain its own space... The Authority shall pay to the Contractor for the monthly cost of such space as set forth in the Contractor's Cost Proposal Form and accepted by the Authority."

For purposes of this work, will the Authority be providing the Contractor with Space or will the Contractor be required to rent Space? If rental is required, on which Cost Proposal Form(s) should the rental fees be identified? *(Attachment B Part I, 46, 18(a), 18(e))*

ANSWER 39:
The Contractor is not required to rent space. Proposers are required to utilize Building 145, General Aviation Terminal, 1st Floor, JFK, for their proposed system operation (See Attachment B, pg 36, Section 8, SMS Operator). Proposers will not have the option of

proposing to locate their system operation at a different JFK location or off-site outside of JFK property.

QUESTION 40:
References: Specifically Statement on auditing Standards No. 70-Level 2 (SAS-70 level 2). Why is this certification required for essentially a Firm Fixed Price contract? Would the Authority consider eliminating this requirement? If not eliminated, when is the certification required? Companies which are not publicly traded typically do not require this or similar certifications. *(Attachment C, SOW, 4, 1.B)*

ANSWER 40:

- **SAS-70 Level 2 certification is required to ensure that the system is designed and built to meet the security requirements included in the RFP and that the contractor employs those security policies and practices in the operation of its System, in accordance with the Scope of Work Section IX. B.9.**
- **The requirement will not be waived.**
- **The certification is required to be furnished as part of acceptance testing, see the system, Scope of Work Section VIII. A.13.**

QUESTION 41:
Please clarify the Authority's plan to ensure access to third-party data sources is granted and technical documentation is provided in a timely manner, i.e. FAA and Tenant Airlines? Examples of external data sources included in this question are DSP, TMA, EDC, ARMT, EFSTS, RAPT, ITWS, CIWS, ACARS, and TDLS. Please clarify how to interpret the NY Center, ATCT and TRACON as data sources. Additionally, in the event access is denied or a data interface cannot be established for technical or any other reason, what is the Contractor's responsibility after good faith is exercised? *(Attachment C, 4, I.A)*

ANSWER 41:
Under sponsorship of the Port Authority, the Contractor will be required to complete and submit Form 1200-5 to the FAA and receive written approval. Additionally, the Contractor shall become an approved CDM Service Provider under sponsorship of the Port Authority. It is the responsibility of the Contractor to interpret information and/or data received from FAA sources, and to provide the communications network that enables the exchange and display of information. If the Proposer has any reason to believe they will not be approved, they should state the reason.

QUESTION 42:
There are numerous system administration requirements, including database administration and training that are not consistent with the procurement of a Hosted web solution. Would the Authority consider that these requirements be limited to system availability, data integrity, archive data storage and access, and diverse geographic disaster recovery. The contractor's design and hosted solution support approach will have to address all necessary system administration and database administration functions to meet these requirements. *(Attachment C, 4, I.A)*

ANSWER 42:
The Port Authority specified the minimum requirements for system administration of this critical application for which the Services will be based and they are consistent with industry best practices. If the Proposer agrees to meet or exceed these requirements, state it in the proposal. If the Proposer offers an alternative that meets or exceeds these requirements, state the proposed alternative solution.

The Authority requires administrative access to examine and modify some of the system data, such as parameter settings, threshold values, user accounts, etcetera as needed for proper system monitoring and analysis. Administrative training should be provided at a level to support this capability.

QUESTION 43:
Please define the Authority's use of the term "pre-tactical" in the context of the functions described in the SOW. Please define the Authority's use of the term "tactical" in the context of the functions described in the SOW. *(Attachment C, 6, IV.A)*

ANSWER 43:
Tactical - Planning for the purpose of achieving an immediate of short-term goal.
Pre-tactical – Planning for the purpose of achieving a near or mid-term goal.

QUESTION 44:
Has the Authority been granted access to the existing FAA ASDE-X surface surveillance data for the entire airport movement and non-movement areas for the duration of the contract period? Please confirm the authorized access will be extended to the contractor. *(Attachment C, 7, IV.A)*

ANSWER 44:
Please see response to question 27.

QUESTION 45:
Please clarify if this is a Phase A or Phase B requirement. *(Attachment C, 8, IV.C)*

ANSWER 45:
As indicated in the title, Functional Requirements of Initial Implementation – Phase A, the items listed within Attachment C, 8, IV. C are in Phase A.

QUESTION 46:
The SOW requirements do not seem to reflect the procurement of a hosted web-based solution. Please confirm that the Authority is seeking to deploy a fully hosted solution for which the proposer will maintain all server level and database level administration, thereby providing a clear division of responsibility required to meet the high availability / fault tolerance requirements. Accordingly, a fully hosted web-based solution would provide only user administration functionality (e.g., user account management and user access roles) to the Authority users. *(Attachment C, 30, V.G)*

ANSWER 46:
The Authority is seeking to deploy a fully hosted solution for which the proposer will maintain all server level and database level administration, thereby providing a clear division of responsibility required to meet the high availability / fault tolerance requirements. The Port Authority will not provide any database administration, which will be responsibility of the Contractor, although we will have the capability to query the database and extract system data. The Authority also requires administrative access to examine and modify some of the system data, such as parameter settings, threshold values, user accounts, etcetera as needed for proper system monitoring and analysis.

QUESTION 47:
Please provide a list of NAS Operators which have already committed to provide access to relevant JFK operational data. Please list all planned NAS Operator interfaces that the SMS will establish connectivity to for access to this data. *(Attachment C, 11, IV.D.3.f)*

ANSWER 47:
Local JFK stakeholders (Users) will continue to provide relevant information manually. It is expected that the Service will have features as described throughout Attachment C that enable user-friendly manual updates to readiness indicators. If NAS Operators choose to provide such information in an automated fashion, the open architecture required shall be capable of accepting and processing such information.

QUESTION 48:
Please clarify the role of the SMS in ensuring safety critical taxi and runway conformance monitoring? *(Attachment C, 18, IV.D.4.o)*

ANSWER 48:
The intention of the subject section is not to ensure safety critical in taxi and runway conformance monitoring. The intention is to alert users that one or more of their aircraft are involved in an off-nominal event and prompt them to take necessary action.

QUESTION 49: The requirement for the Authority to approve all screen layouts for existing products is not a practical approach to achieve the aggressive contract schedule and introduces significant risk for the contractor. Would the Authority consider removing this requirement? *(Attachment C, 30, V.I)*

ANSWER 49:
No, however, we will expedite the review of screen layouts as necessary to maintain the project schedule.

QUESTION 50:
The "Cost Proposal Form" states that 25% payment will be made after successful completion of a 30 day operational test. In Attachment C of the RFP the request is for a 14 day operational test. Please confirm the duration of the operational test. *(Attachment B, 57, 57)*

ANSWER 50:
See CHANGES/MODIFICATIONS item 4.

QUESTION 51:
Please identify applicable local codes. *(Attachment C, 4, I.B)*

ANSWER 51:
Applicable electrical codes for equipment installation.

QUESTION 52:
When is the approval request for the hosting facility location to be submitted? In what format and by what medium is the approval request for the hosting facility location to be submitted? How much time will it take for the Authority to indicate approval of the hosting facility location approval once the proposed hosting location information has been submitted? *(Attachment C, 5, II.A*

ANSWER 52:

- **The approval request for the hosting facility location should be submitted in accordance with the project schedule proposed by the Contractor. The submittal should be scheduled to allow the Contractor to perform all work necessary to meet or exceed the project Implementation schedule stated in Attachment C. Section II A.**
- **See Attachment C IX.A.2 for the submittal format.**
- **See Attachment C IX.A.1 for the Submittal review time.**

QUESTION 53:
Please clarify that the Authority's use of the term "current contract" refers to the contract expected to be awarded as described in this RFP and not a separate existing contract. If this is referring to an existing contract, please identify the contract title, contractor, and period of performance. *(Attachment C, 5, II.A)*

ANSWER 53:
The Port Authority has an agreement with the Aviation Development Council to provide Passur IROPSnet and Sensis Aerobahn computer software services to JFK Airport. Passur IROPSnet services have been provided to the airport for approximately 8 years and Sensis Aerobahn Services have been available for approximately 2 years. The Port Authority does contract directly with Passur or Sensis Aerobahn for these services.

QUESTION 54:
Please clarify the Base Date of Operational Usage on or before 2011. Should the date be 2012? *(Attachment C, 5, II.B)*

ANSWER 54:
See CHANGES/MODIFICATIONS item 5.

QUESTION 55:
Please clarify the Authority's use of the term "SMS Site". Please clarify which positions are expected to be staffed onsite (Authority facility) and which positions are expected to be staffed off-site, where off-site is a facility that is not owned or leased by the Authority. Please clarify the responsibilities of the SMS Operator. *(Attachment C, 5-6, III)*

ANSWER 55:
SMS Site refers to the location at JFK, Building 145 where the site visit took place during the Pre-proposal meeting on June 17, 2011. It is assumed that the SMS Operator is the only position that is expected to be staffed at the SMS Site. Please refer to Attachment B, Contract Specific Terms and Conditions, 35, Section 8 for detailed explanation of Job Classifications. A proposed plan indicating how the Contractor will staff the Service to meet the terms of the Contract and Specifications is expected.

QUESTION 56:
Please describe the Authority's standard operating procedures as related to aircraft metering and specifically departure management. *(Attachment C, 8, IV.C)*

ANSWER 56:
Exhibit 10 and Exhibit 11 includes task-specific versions of the current procedures. They living documents, subject to continuous improvement as lessons are learned. It is the intention of the Authority and Users for the Procedures to remain amendable to continue growth and program improvement.

QUESTION 57:
Please clarify this requirement and how the access of the 15 users is different from the 3200 authorized users: "*16. Provide live flight tracking of inbound and outbound flights from the surface to 10,000 feet and within an 100-mile radius of the airport for 15 Port Authority Users.*" *(Attachment C, 8, IV.C)*

ANSWER 57:
The 15 Port Authority Authorized Users affected by this requirement are described in Attachment C, 29, V, F, 1. g. Such Users are not direct participants in Surface Management but will benefit by having access to flight tracking information.

QUESTION 58:
Please clarify the Authority's use of the term "flight tracking software". *(Attachment C, 31,V. M. bullet 4)*

ANSWER 58:
See Attachment C, 8, IV. C. 16

QUESTION 59:
Please confirm that any identified supporting tools would be addressed as Supplemental Work. *(Attachment C, 9, IV.C)*

ANSWER 59:
Integration of FIDS data is not Supplemental Work and should be accounted for in the cost proposal Integration of "other data" sources addressed in the document will be treated as Supplemental Work when or if they become available.

QUESTION 60:
Please clarify that integration with any "Other data" will be addressed as "Supplemental Work". *(Attachment C, 11, IV.D.3)*

ANSWER 60:
Integration of FIDS data is not Supplemental Work and should be accounted for in the cost proposal. Integration of "other data" sources addressed in the document will be treated as Supplemental Work when or if they become available. Integration of "other data" sources addressed in the document will be treated as Supplemental Work when or if they become available.

QUESTION 61:
Please clarify the Authority's use of the terms "Estimated" and "Predicted" times of arrival and departure. *(Attachment C, 12, IV.D.4.a)*

ANSWER 61:
The estimated time may come from a source such as TFMS, TMA or the Operator. The System shall provide the predicted or forecasted time through calculation.

QUESTION 62:
Please explain the specific aircraft movement that this requirement is trying to determine travel time. Is this all on the surface at JFK or is this a representation of the total time for the flight leg? *(Attachment C, 12, IV.D.4.a)*

ANSWER 62:
Attachment C, 12, IV.D.4.a refers to the specific aircraft movement on the surface at JFK.

QUESTION 63:
Please provide the format of the physical details of the airport layout to be made available at contract award. *(Attachment C, 13, IV.D.4.c)*

ANSWER 63:
After contract reward and within five business days of request by the Contractor, the Authority will provide to the Contractor, an electronic version in AutoCAD or PDF format containing all required details.

QUESTION 64:
Please clarify that the airport layout provided by the Authority will contain all required features (i.e. runways, hold bars, taxiways, ramps, gates/stands, and other fixed elements). *(Attachment C, 13, IV.D.4.d)*

ANSWER 64:
After contract reward and within five business days of request, the Authority will provide to the Contractor, an electronic version in AutoCAD or PDF format containing all required features.

QUESTION 65:
Please clarify the Authority's use of the terms 'calendar days', 'business days', 'working days' and 'days' throughout the RFP. *(Attachment C, 19 IV.D.5.E, 26 V.D.1, 39 IX.B.5, 46 X.A.2)*

ANSWER 65:
Calendar days: 1 day
Business days: Monday-Friday, not including Federal Holidays
Working days: Refers to the individual employee's work schedule
Days: 24 hours, analogous to Calendar day

QUESTION 66:
Does the requirement to extract XML include the voice recordings from monitored local frequencies? *(Attachment C, 28, V.D.10)*

ANSWER 66:
No. Please refer to Attachment C, 10, IV. D. 1. E. for voice playback capability requirements.

QUESTION 67:
Function based access control would provide access to general functionality including map display, reports, flight lists, alerts, etc., but not be data focused as listed here with airport terminal data, ramp area data, and airline data identified. Please describe the expected functionality associated with this level of control (e.g., if a user doesn't have airport terminal data access, can a data tag include the expected parking gate - or is parking gate considered airline data). *(Attachment C, 28, V.F)*

ANSWER 67:
Due to the mixed operating environment at JFK, some terminal operators and airlines require access to multiple Airline's information where others do not. This expected functionality is required to protect proprietary information while enabling ease of job function.

QUESTION 68:
The hardware and software used for the system will be "state-of-the-art" however, the timing of third party vendor releases compared to system testing and integration and releases does not seem to make it practical to provide the latest commercially available software and hardware once these phases have initiated. Would the Authority accept software and hardware that has been made commercially available within the last year? *(Attachment C, 30, V.H)*

ANSWER 68:
Yes

QUESTION 69: Is there an "approved Change Management" procedure in existence that the Authority expects to be followed, or will the Contractor be expected to propose such a procedure? *(Attachment C, 31, V.L)*

ANSWER 69:
Contractor is expected to propose an acceptable change management a procedure, which will be reviewed and commented upon in accordance with the submittal requirements stated in Attachment C, Section IX A.

QUESTION 70:
As this is a hosted system, how would the contractor control workstation memory and disk usage? *(Attachment C, 32, VI.A)*

ANSWER 70:
Although the Contractor does not control workstation memory and disk usage, the proposed web-based solution should not require the use of much disk space. The memory performance requirement is waived as the operating system will determine its usage.

QUESTION 71:
Please clarify the term 'Administrative Training'? *(Attachment C, 32-33, VII.B)*

ANSWER 71:
Administrative training is defined in Attachment C, Section V.F.1.h.

QUESTION 72:
Please clarify the respective roles of the Authority and the Proposer in the conduct of the Operational tests. *(Attachment C, 35, VIII.B)*

ANSWER 72:
See Attachment C, VIII.B, "The Port Authority operating staff with the advice and assistance of the Contractor shall perform the Operational Test ...Port Authority staff and Users will operate the System using the latest version of all applicable manuals, printed guides and procedures."

QUESTION 73: There are a number of items specified as part of the project plan that are not consistent with a hosted, web-based application (e.g. installation plans, communications conduit, etc.). Do these requirements apply to the hosted facilities or the installations on the Authority property? *(Attachment C, 37-38, IX.B)*

ANSWER 73:
Any work that impacts the delivery of services for the contract needs to be included in a project plan and schedule to enable the Port Authority to monitor progress towards gaining operational usage and delivery of the services stated therein, such as building a new data center, or installation of specialized equipment, developing new software, configuration of the database, etc.

QUESTION 74:
Please confirm when the Authority will provide specific users, roles, and workstation locations to enable the Contractor to submit the required documentation. *(Attachment C, 40, IX.B.5.a)*

ANSWER 74:
The Authority will respond to Contractor requests for specific information after issuance of a Contract Award Letter.

QUESTION 75:
Are the drawings required for the hosted web-based application and the Authority location? *(Attachment C, 41, IX.B.6.b)*

ANSWER 75:
No, only for Authority locations.

QUESTION 76:
Is this requirement specific to equipment on Authority property? *(Attachment C, 41, IX.B.6.c)*

ANSWER 76:
Yes.

QUESTION 77:
Please clarify the term "master set of all manuals"? *(Attachment C, 44, IX.B.10.b)*

ANSWER 77:
One set of the final edition of all manuals that contain all editing changes.

QUESTION 78:
Is PDF an acceptable file format to submit artifacts to the Authority? *(Attachment C, 45, IX.B.13)*

ANSWER 78:
See Change/Modification #6

QUESTION 79:
Does this requirement refer to oost associated with disaster recovery for the hosted web-based application or for the Authority sites? *(Exhibit 3, 1, I.A.2)*

ANSWER 79:
The requirement refers to costs associated with disaster recovery for the hosted web-based application.

QUESTION 80:
Please clarify that this checklist item refers to the system documentation requirements (section IX.B.5 System Documentation) and would not introduce additional documentation requirements. *(Exhibit 5, 1, General)*

ANSWER 80:
Attachment C Section IX.B.5 System Documentation refers to system documentation that shall be submitted to the Authority as part of the Contract. Exhibit 5, Section 1 General requires the Contractor to have documented procedures for the work it has to perform, as an example, the process to add a new user to the system: the Authority submits a request to the

Contractor to add a new user with certain access privileges, the Contractor adds the new user, records the date and time the new user was added and notifies the Authority that the work was performed. The documented procedure would not necessarily be submitted to the Authority for review and comment but would need to be produced in response to an Audit request.

QUESTION 81:
Please clarify that all requirements associated with "PA policy" are stated explicitly in the SOW. If all requirements associated with "PA policy" are not stated in the SOW, please identify the requirements necessary to meet the "PA policy". *(Exhibit 5, 1, General)*

ANSWER 81:
See Change/Modification #7

QUESTION 82:
For the current system that will be replaced by Phase A, can you please make available the following documents:
- Functional Requirements
- External interfaces and corresponding ICDs
- Hardware and network architecture
- Reporting requirements including sample reports
- # of users
- Type of users (access roles)
- Locations of users

(Attachment C, 4, II.A)

ANSWER 82:
All of the information relevant to the requirements of Phase A are detailed in Attachment C, Scope of Work and Specifications, pages 7 and 8, 4. C.

QUESTION 83:
Please clarify that all components of the system be must considered Fault Tolerant versus Highly Available to meet the requested goal of 99.99% availability. *(Attachment C, 32, VI.B)*

ANSWER 83:
The System shall be redundant and fault tolerant, in accordance with the requirements stated in Attachment C, VI.B, which includes all components of the System.

QUESTION 84:
RFP Section 8.F.1 paragraph 2 states that "The Proposer shall respond to each heading included in the Scope of Work and Specifications, Attachment C". Please confirm that "each heading" for the response is limited to Levels 1 through 3 (e.g., IV.B.1 Hosting the System) which matches the Attachment C Table of Contents. *(RFP, 18, 8.F.1)*

ANSWER 84:
Correct. "Each heading" for the response should cover, at a minimum, levels one through three (e.g., IV.B.1 Hosting the System).

QUESTION 85:
In the RFP there is no specific limit on page count for any of the sections. Please confirm that all material submitted will be read and considered in the proposal evaluations. *(RFP, All, All)*

ANSWER 85:
As per Section 8 page 15 of the RFP "Proposal Submission Requirements", all materials that are submitted with the proposal will be read and considered during the proposal evaluation process providing that the Proposal Submission Requirements are followed.

QUESTION 86:
When will the proposer's presentations/demonstrations be made to the Authority and how much time will be allocated for each presentation/demonstration? *(RFP, 22, 8.F.6)*

ANSWER 86:
See answer 9. The proposer demonstration may not exceed four (4) hours.

QUESTION 87:
In order to provide you with a thorough proposal with comprehensive solutions, we require an extension to the proposal due date. As such, we respectfully request an extension to the proposal due date for the above-referenced solicitation from 11 July 2011 to 12 August 2011.

ANSWER 87:
See answer 24.

QUESTION 88:
Section E Proposal submission requirements asks for documents to be submitted in a "form that can be easily recycled (i.e., no plastic covers or binding)". Does this suggest that all materials must be paper bound? Would submission in a standard three ring binder be acceptable?

ANSWER 88:
All materials do not require paper binding. A three ring binder is acceptable.

QUESTION 89:
With regard to the metering room, would construction activities for outfitting this room need to be done as a tenant project?

ANSWER 89:
No. It will be handled as a maintenance letter since the contractor is not a tenant.

QUESTION 90:
The RFP references a code of conduct that we have not been able to locate. Could you provide a copy of this document or a link to it if it is available on-line.

ANSWER 90:
See CHANGES/MODIFICATIONS, items 11 and 12, which include task-specific versions of the current procedures. They living documents, subject to continuous improvement as

lessons are learned. It is the intention of the Authority and Users for the Procedures to remain amendable to continue growth and program improvement.

QUESTION 91:
Page 18 of RFP Section 1 states the following: "For the maintenance of the SMS equipment, the Proposer shall include a comprehensive preventive maintenance plan...which will include a plan for actively monitoring and reporting on system performance especially as it pertains to key points of failure."

a. We assume this maintenance plan does NOT include the equipment involved in the ASDE-X surveillance system at JFK. Can you please confirm that assumption?

ANSWER 91:
Yes. The assumption is correct.

QUESTION 92:
Will the Port Authority provide full, unfiltered JFK ASDE-X feed, including where available surveillance of the non-movement areas?

ANSWER 92:
Please see the response to question 26.

QUESTION 93:
Prerequisites (RFP Part 1, Section 3, page 9): If the PANYNJ will allow for JV proposers to jointly meet the prerequisite requirements, will they also allow for the experience of Proposer's team-subs (sub contractors) to qualify toward aggregate satisfaction of the prerequisites?

ANSWER 93:
No.

QUESTION 94:
Prerequisites (RFP Part 1, Section 3, page 9): One of the pre-requisites listed is "three (3) years of continuous experience immediately prior to the date of the submission of the its proposal in the development, installation, management, testing and operation of that is specifically tailored to the function of improving overall surface and airspace system efficiency and predictability while enhancing safety..." We assume that experience in providing aircraft metering, surface condition information (including runway status and availability), and collaboration and coordination services during deicing operations at several major airports counts towards the requirement of "improving overall surface ... system efficiency ..." Please confirm this assumption.

ANSWER 94:
As stated in Section 3 "Proposer Prerequisites" page 9, "Proposers who can demonstrate that they can comply with the following prerequisites should submit proposals, as only such proposals from such Proposers will be considered".

QUESTION 95:
Attachment B, Part III, Section 4 (Intellectual Property): It is our intention to provide preexisting software programs to satisfy the contract requirements. However, in some instances these software programs may

require modifications to meet the specific contract requirements. Would such modified software programs be considered preexisting under clause B or "prepared or compiled in connection with this Agreement" under clause A.

ANSWER 95:
Modifications to existing software programs to meet the specific contract requirements would be considered to be "prepared or compiled in connection with this Agreement" under clause A.

QUESTION 96:
Attachment B, Part III, Section 5 (Proprietary Rights): Does the Authority consider this Scope of Work to include "research, development, or consultative services" under this clause? If yes, specifically which of these services?

ANSWER 96:
The Scope of Work may include "research, development, or consultative services."

QUESTION 97:
(RE: same subsection as above) Please explain the term "not custom software" and its meaning under this clause.

ANSWER 97:
"Not custom software" is commercially available, off-the-shelf software or the vendor's standard software that was not specifically developed for this Contract.

QUESTION 98:
The RFP Management Proposal requires a Disaster Recovery Plan, yet it is also a deliverable per the SOW for the contractor. Please clarify the PANYNJ's expectation for both (proposal requirement vs. contract deliverable).

ANSWER 98:
The proposer should prepare a high-level version of the disaster recovery plan that is being proposed to be implemented, for evaluation, and would not include such details as people's telephone numbers. Once a contract is awarded, Contractor shall prepare a detailed disaster recovery plan that contains all of the information required to be included in the disaster recovery plan.

QUESTION 99:
At what point are the proposers expected to demonstrate the capabilities required in Phases A and B?

ANSWER 99:
The Proposers should demonstrate the capabilities within their proposal submission. If additional information is required, the Port Authority may request additional information.

QUESTION 100:
SOW Page 5 of 51: Section 2.B. Base Date of Operational Usage states: "The Base Date of Operational Usage is on or before January 15, 2011." We assume this was a typo and should be 2012?

ANSWER 100:
See Changes/Modifications #5

QUESTION 101:
Page 18 of 51, Attachment C: Alerts to User. The requirement to provide alerts for; "an aircraft enters a runway or taxiway that it is not planned to enter," "an aircraft enters a runway that it is not allowed to enter at this time," and "an aircraft deviates from its predicted path on the airport surface" could require coded-taxi routes or some other mechanism to automatically convey the planned route of movement on the surface for the aircraft/intent of the aircraft. Do you envision the use of any particular FAA system feed that would supplement or enable any of the above alerts?

ANSWER 101:
Currently there are no known coded taxi routes in use at JFK.

QUESTION 102:
Exhibit 5, Checklists, Page 15 of 19, Security Requirements, lists Oracle as the database. Is Oracle required or will any other appropriately capable database be acceptable?

ANSWER 102:
Oracle or another appropriately capable database may be acceptable

QUESTION 103:
SOW Page 33 of 51, Section 2, Training Coach, states: "Contractor shall provide an on-site coach to work at each of the 9 terminal facilities to work directly with the terminal operators and coach them in the use of the system. Coaching shall be conducted concurrently at each terminal facility for a minimum of three days and provide coverage for each of the 2 operational shifts." Please confirm that this means 9 x 3 days simultaneously over two shifts.

ANSWER 103:
9x 3 days is correct.

QUESTION 104:
If the anticipated contract-type is fixed price, what is the PA's interest in a SAS-70 Audit?

ANSWER 104:
To ensure that the system is designed and built to meet the Information Technology (IT) security requirements of the contract and to ensure that the Contractor actually follows the practices and policies for IT security.

QUESTION 105:
Are the work sites in construction areas or near hazardous materials?

ANSWER 105:
The work site is not in a construction area or near hazardous materials.

QUESTION 106:
What, if any, are the OSHA requirements associated with this RFP/contract?

ANSWER 106:
There are no known OSHA requirements associated with this RFP.

QUESTION 107:
Did the PA intend to state duplicative liquidated damages, stated in Attachment B, Sec. 16, subsections B and F.? Both subsections impose $200/day for late distribution of reports pursuant to SOW Section IV, C.

ANSWER 107:
See Change/Modification # 8

QUESTION 108:
Can you please advise if not bidding Phase A, but only a Phase B solution will disqualify or disadvantage an offerer?

ANSWER 108:
As stated in Attachment C, 9, IV, D, Phase B includes all requirements in Phase A in addition to the requirements in Phase B. If a contractor is capable of implementing the requirements of both Phases at one time, it should be presented.

This communication should be initialed by you and annexed to your proposal upon submission.

In case any Proposer fails to conform to these instructions, its proposal will nevertheless be construed as though this communication had been so physically annexed and initialed.

THE PORT AUTHORITY OF NY & NJ

KATHY LESLIE WHELAN, MANAGER
PURCHASING SERVICES DIVISON

PROPOSER'S FIRM NAME: Raytheon Company

INITIALED: EICC

DATE: 8 August 2011

QUESTIONS CONCERNING THIS ADDENDUM MAY BE ADDRESSED TO LESLEY BROWN, WHO CAN BE REACHED AT (212) 435-3969.

Exhibit 10

SURFACE FLOW METERING PROCEDURES

Surface Flow Metering Procedures will be in use during peak periods. Metering operations expand on current practices. The procedures are collaboratively designed to reduce ground congestion, reduce wait time at the runway for takeoff, reduce fuel burn and reduce the amount of time passengers will be held onboard the aircraft.

1. **Surface Flow Metering Procedure:**

   a. Obtain ATIS information. When procedures are in effect the ATIS broadcast will indicate:
   'Metering procedures are in effect.'

   b. After receiving ATC Clearance
      - Contact Ramp Control to obtain expected taxi time and metering location instructions.
      - Expect to hold either on your ramp or in a metering location within a movement or non-movement area of the airport.

NOTE: At this time if the departure delays are increasing, Ramp Control may issue an 'Expect Taxi Time.' This is the time to be at the top of the ramp and ready for taxi to the runway.

1. Metering ON the gate: Ramp Control may issue an Estimated Taxi Time that is later than the regularly scheduled departure time along with instructions to hold at the gate. The Flight Crew must continue to monitor Ramp Control and coordinate pushback clearance to meet Expected Taxi Time. At the Estimated Taxi Time and upon completion of pushback, Flight Crews will be released by Ramp Control to request TAXI FOR DEPARTURE.

2. Metering OFF the gate: Due to gate conflict or ramp congestion, Ramp Control may issue an Estimated Taxi Time and instruct the crew to request an off-ramp metering location from Ground Control. In this case the flight crew must request clearance from Ground Control for taxi to their 'Metering Location.' Once parked in the metering area, continue to monitor BOTH Ground and Ramp Control Frequencies. (Note: Due to the dynamics of the system, estimated taxi time may be amended. RAMP CONTROL will provide updated information to the flight crew; therefore, it is necessary to remain in radio contact as operationally feasible.) The flight crew will hold in the metering area and monitor Ramp Control until released to request TAXI FOR DEPARTURE.

NOTE: While holding in a metering or gated location, Flight Crews must monitor both Ground Control and Ramp Control. DO NOT request taxi for takeoff prior to your Estimated Taxi Time (ETT).

3. GENERAL INFORMATION

a. To ensure the integrity of the Surface Flow Metering Procedures, Flight Crews must coordinate to complete pushback and engine start to meet issued Expected Taxi Time.

b. When operationally advantageous, Ramp Control may issue an 'Expect Engine Start Time' to aid the flight crew in coordination of sequence and preparation of the aircraft for taxi.

c. As changes occur, Flight Crews can expect to receive updates from Ramp Control. Flight Crews shall monitor and maintain radio contact with Ramp Control at all times. Failure to respond to two (2) successive calls or the inability to taxi at the issued time will require the aircraft to be re-sequenced into the departure flow at a later time.

NOTE: *Failure to monitor Ramp Control after being instructed to remain on the frequency for any update/revision shall terminate 3rd Party/ATC liability for any delays incurred.*

d. Flight Crew of commuter/general aviation aircraft that cannot transmit/receive unless the engines are running, shall advise Ramp Control so that an alternative procedure can be arranged.

e. When Ramp Control advises the Flight Crew they are 'RELEASED TO REQUEST TAXI FOR DEPARTURE,' Flight Crew may call Ground Control and request 'TAXI FOR DEPARTURE.'

f. Every reasonable effort will be made to provide advance information on the implementation of these procedures.

g. Due to the ongoing testing and development of the system, changes to the procedures may occur.

h. Standard phraseology will be maintained between the 3rd Party, Terminal Operator and FAA during assignment of metering locations to Flight Crews.

4. DEFINITIONS

- *Expected Departure Clearance Time (EDCT): The runway release time assigned to an aircraft in a controlled arrival time program (terminal or airspace) and shown on the flight progress strip as and EDCT.

- Metering Location: A designated parking area that may be on a movement or non-movement area designed to synchronize surface movement with the current method of time-regulating arrival and departure flows through a terminal area so as not to exceed a predetermined terminal acceptance rate.

- Expected Taxi Time (ETT): The time an aircraft is expected to be first in line at the top of the ramp or metering location and ready for taxi to the runway. Expected taxi time is predicated on the following restrictions: Enroute (Miles in Trail), Local, Expected Departure Clearance Time (EDCT), Airport Conditions (Closures), Weather, Proposed Departure Time, First Fix Availability, Company-Specific Decision Processes.

- *Monitor: (When used with communication transfer) listen on a specific frequency and stand-by for instructions. Under normal circumstances, do not initiate communications.

*Definition used in accordance with the Pilot/Controller Glossary

Exhibit 11

Ramp Tower Guidance for Metering Procedures at JFK

This process is designed to reduce ground and ramp congestion at JFK. Ramp Control Centers are advised to familiarize their staff with this process. Utilization will improve communication, reduce delays, and reduce fuel burn on the surface of JFK.

1. All Ramp Control Centers must access and be logged into the JFK IROPSNET program.

2. All scheduled carriers will be listed in the IROPSNET program. Any changes or additions to the schedule must to be entered into IROPSNET by Ramp Control.

3. JFK Tower will advise the 3rd Party Vendor of the current departure rate for the runway combinations in use and any forecasted changes expected.

4. 3rd Party Vendor will enter the given rate into IROPSNET to generate the list of Estimated Taxi Times displayed in 15-minute buckets. Slot distribution numbers will be transmitted to Ramp Control electronically via IROPSNET.

5. Ramp Control will continuously review IROPSNET and update the planned taxi times for their aircraft. In the event that an aircraft cannot meet the assigned Estimated Taxi Time, Ramp Control may substitute an aircraft that will meet the time; a revised Estimated Taxi Time will be arranged for the delinquent aircraft. If the Airline or Terminal Operator does not have an aircraft for substitute, the slot must be offered back to the community in a timely fashion to ensure reallocation by the 3rd Party Vendor.

6. Ramp Control will advise the 3rd Party Vendor when an aircraft will require an off-ramp metering location. 3rd Party Vendor will assign the metering location to the Ramp Control, who will issue instructions to the pilot. The pilot will communicate the assigned metering location to Ground Control during their taxi request.

Example transmission from Ramp Control to aircraft after pushback is complete:
"Ramp Control: *Speed bird 101, your metering location is on PA short of Q. Continue to monitor me on your #2 for release. Contact Ground on 121.9 when ready for tax to metering location.*"

7. Ramp Control will contact metering aircraft shortly before Estimated Taxi Time to advise engine start and to release aircraft from their metering location. This is the point at which the Flight Crew may request to taxi for departure.

8. Ramp Control will advise 3rd Party Vendor when any situation arises that might disrupt flow of aircraft (i.e. gate conflicts), and when multiple metering locations will be required. This coordination should take place as far in advance as operationally feasible.

9. The 3rd Party Vendor will populate the flights for Unscheduled Carriers/GA aircraft. Any updates or changes to the proposed times must be called in to the 3rd Party Vendor by the Carrier's local operations personnel so that and Estimated Taxi Time can be assigned. Please note: if a delay of more than 5 minutes from the planned time is expected, the Unscheduled Carrier's local operations personnel must communicate the delay in a timely fashion, and prior to missing the time so the slot. The communication can take place via telephone or the IROPSNET chat function and will ensure the slot can be reallocated to the community.

10. In ensure integrity of the procedures set forth, open communication is encouraged between Ramp Control Centers, the 3rd Party Vendor and other partners on and off the field. IROPSNET and/or telephone hotlines will be utilized to enhance open dialogue.

THE PORT AUTHORITY OF NY & NJ

PROCUREMENT DEPARTMENT
ONE MADISON AVENUE 7TH FL.
NEW YORK, NY 10010

Date: August 3, 2011

ADDENDUM #3

To prospective Proposers on Request for Proposals #24997 for SURFACE MANAGEMENT SYSTEM AT JOHN F. KENNEDY INTERNATIONAL AIRPORT (JFK)

☒ **Proposals due back on August 8, 2011, no later than 2:00 PM**

☒ Proposals originally due on July 11, 2011, no later than 2:00 PM

CHANGES/MODIFICATIONS:

The following changes/modifications are hereby made to the solicitation documents:

1. Delete Attachment B, Part I, Section 3, "Duration" and replace with:

Section 3. Duration

(a) The term of the Contract (hereinafter called the "Base Term") is for three (3) year period and is estimated to commence on December 1, 2011 at 12:01 o'clock a.m. (said date and time hereinafter sometimes called "the Commencement Date") and unless sooner terminated or revoked or extended as provided in Paragraph (b) and (c) hereof shall expire on November 30, 2014 at 11:59 o'clock p.m. (said date and time hereinafter sometimes called the "Expiration Date"). The Base Term of the contract as described in Attachment C: Scope of Work, in detail, herein as described below.

- **Implementation Periods:**

  1. Phase A-Commencement Date: On or before February 15, 2012

  2. Phase B-Commencement Date: On or before August 1, 2012

- **Operational Usage:** Host, Operate, Administer and Maintain System - On or before February 15, 2012 at 12:01 o'clock a.m. - November 30, 2014 at 11:59 o'clock p.m., or as otherwise may be extended as set forth below.

(b) The Port Authority shall have the right to extend this Contract for three (3) additional one (1) year Option Periods to November 30, 2017 (hereinafter called the "Option Period") following the Expiration Date, upon the same terms and conditions If the Port Authority shall elect to exercise the Option(s) to extend this Contract, then, no later than thirty (30) days prior to the Expiration Date, the Port Authority shall send a notice that it is extending the Base Term of this Contract, and this Contract shall thereupon be extended for the applicable Option Period. If the Contract provides for more than one Option Period, the same procedure shall apply with regard to extending the term of this Contract for succeeding Option Periods.

(c) The Port Authority shall have the absolute right to extend the Base Term for an additional period of up to one hundred and twenty (120) days subsequent to the Expiration Date of the Base Term, or the Expiration Date of the final exercised Option Period (hereinafter called the "Extension Period"), subject to the same terms and conditions as the previous contract period. The prices quoted by the Contractor for the previous contract period shall remain in effect during this Extension Period without adjustment. If it so elects to extend this Contract, the Port Authority will advise the Contractor, in writing, that the term is so extended, and stipulate the length of the extended term, at least thirty (30) days prior to the expiration date of the previous contract period.

This communication should be initialed by you and annexed to your proposal upon submission.

In case any Proposer fails to conform to these instructions, its proposal will nevertheless be construed as though this communication had been so physically annexed and initialed.

THE PORT AUTHORITY OF NY & NJ

KATHY LESLIE WHELAN, MANAGER
PURCHASING SERVICES DIVISON

PROPOSER'S FIRM NAME: Raytheon Company

INITIALED: EKK

DATE: 8 August 2011

QUESTIONS CONCERNING THIS ADDENDUM MAY BE ADDRESSED TO LESLEY BROWN, WHO CAN BE REACHED AT (212) 435-3969.

F.8 Acceptance of General Contract Provisions

If Raytheon is selected to negotiate on the prospective award, we will need to discuss concerns we have in certain areas within the RFP as outlined below and for which we take specific exception:

- ***Disputes/Claims/Release of Claims*** – The RFP seeks broad sweeping authority for the Port Authority Director and Airport Manager. We would like to incorporate provisions by which claims and disputes can be addressed and resolved with objective standards and in a bi-lateral manner. In addition, we need to discuss the release of claims stipulations in the RFP's payment provisions.
- ***Liability/Indemnifications/Insurance*** – Raytheon will agree to be responsible for matters that we can control and direct damages resulting from our negligent acts or omissions. We cannot assume certain liability and risks as set forth in the RFP, such as liability for negligent acts of the Port or third persons, and acts of God or the public enemy. We would like to establish limitations on both contractor liability and the extent of damages for which we are responsible. We will need to discuss specifics and limitations on the insurance provisions including the requirements for additional insured on the other policies.
- ***Excusable Delay/Force Majeure/Liquidated Damages*** – We would like to include an Excusable Delay/Force Majeure clause. In addition, liquidated damages would be acceptable if they were to be the sole remedies to the Port Authority for non-excusable delays.
- ***Cure Notice/Notice Requirements*** – There are several provisions that would be more amenable to Raytheon if the "cure periods" or notice periods were extended. For instance, as to "Extra Work," we would like to extend the amount of time required to respond, as well as restructure the pricing formula. Also, with regard to defaults and terminations, we would like to extend the cure notice to a reasonable period beyond 5 days.
- ***Escalation/Payment Plan*** – Raytheon's Option pricing will be estimated using our own forward looking escalation indices that are utilized and accepted under Federal Contracts. Raytheon would like to negotiate a mutually agreeable cash neutral payment plan.
- ***Warranties/Intellectual Property/Infringement and Ownership*** – We need to discuss the RFP warranty provisions – 1 year warranties for systems and services, broad warranties that services and intellectual property are fit for purpose, and unconditional guarantees against failures of any kind. Because our offering is based substantially on existing commercial products and will be supported by standard commercial product warranties, the scope of all warranties would need to be limited. In addition, because our offering will be based substantially on existing commercial products, ownership of intellectual property rights therein will be retained by Raytheon and its third party suppliers, with such products being licensed to PANYNJ on standard commercial licensing terms and conditions. To the extent any intellectual property is created in the course of performing the Work, licenses will be granted to PANYNJ that are generally consistent with the rights set forth in the applicable RFP provision, and remedies for potential third party infringement shall be generally consistent with the remedies set forth in the applicable RFP provision.

F.9 Minority/Women-Owned Business Enterprise (M/WBE) Plan

Raytheon is pleased to provide the PANYNJ with its M/WBE Plan as the SMS contractor, using Port Authority certified subcontractors to help meet its M/WBE goals and objectives.

Raytheon will deploy an M/WBE Plan that benefits the PANYNJ goals and objectives

- Comprehensive and cost effective strategy for M/WBE participation
- Proven M/WBE vendors
- Corporate level M/WBE Plan and support
- Dedicated SBLO

Raytheon's Master Subcontracting Plan is shown in Appendix D, and provides the PANYNJ (the Port Authority) with the details of our company-wide M/WBE subcontractor participation commitment, our strategy to achieve that commitment and past performance metrics that demonstrate the level of Raytheon's overall commitment to M/WBEs. Raytheon recognizes and embraces the role that minority and women-owned business enterprises play in the Authority's success. Supplier diversity traditionally introduces new ideas, innovative approaches, flexibility and competition. While Raytheon's approach to M/WBE inclusion may evolve as our work for the Authority progresses, our commitment to M/WBEs will always remain steadfast.

Raytheon will leverage the expertise of its subcontractors to optimize the role of minority and women-owned business participation. This approach will benefit Raytheon and the Authority by ensuring that Raytheon processes and systems are in place to accurately monitor M/WBE commitments, and shall support progress reports and payments required under the contract. Raytheon pledges to empower its Small Business Liaison Officer (SBLO) to develop and implement innovative M/WBE inclusion and to expand our existing broad M/WBE business base by seamlessly integrating existing M/WBE suppliers that have been certified by the Port Authority.

Raytheon shall deploy a comprehensive strategy that is both cost effective and mutually beneficial to you, the customer, and to our suppliers. In our Surface Management System at JFK Subcontracting Plan (Figure F-45), Raytheon has been both deliberate and diligent in the use of M/WBE partners that bring both experience and technological excellence to provide the PANYNJ the best solution as the SMS Contractor. In accordance with Title 49 Code of Federal Regulations (CFR) Part 26 (49 CFR 26), M/WBE subcontracting goals were developed utilizing the proposed work breakdown structure, and the associated bill of materials and services. Items for consideration for minority and women-owned business enterprises were determined by assessing risks to technical, cost and delivery requirements. Items falling into Raytheon's core business were examined for appropriateness, and outsourcing decisions were made based on the M/WBE subcontractor's technical expertise and were matched to achieve the requirements stipulated by the Port Authority with the ultimate objective of minimizing risk for the customer.

Raytheon's overall strategy embeds good faith efforts to optimize inclusion of M/WBE subcontractor participation through the following:

- The services and materials to support the requirements were divided into small portions where feasible to maximize M/WBE subcontractor participation.
- Reasonable advance notification of specific subcontracting and purchasing opportunities has been provided to the listed M/WBEs and reasonable advance notification shall continue throughout the life of the contract.
- All materials and services shall be procured from M/WBEs that have been certified by the Port Authority.
- Timely progress payments shall be made to M/WBEs performing work on the contract.
- M/WBEs shall receive fair treatment throughout the course of the contract.

SURFACE MANAGEMENT SYSTEM AT JFK SUBCONTRACTING PLAN

Raytheon Company Group/Division Name: Network Centric Systems

Date: 8 August 2011 Contract/RFP No: 24997

Plan No: _____ Ref. No.: _____

Modification No.: _____

INDIVIDUAL SUBCONTRACTING GOALS UNDER MASTER SUBCONTRACTING PLAN TBD APPROVED FOR USE DURING FISCAL YEAR 2011-2013 FOR THE UTILIZATION OF:

- **Small Business Concerns**
- **Historically Black Colleges, Universities and Minority Institutions**
- **Small Disadvantaged Business Concerns**
- **Small Women Owned Business Concerns**
- **Veteran Owned Small Business Concerns**
- **Service Disabled Veteran Owned Small Business Concerns**
- **HUB-Zone Small Business**

Submitted By:	RAYTHEON COMPANY
Group	Network Centric Systems
Address	1001 Boston Post Road East
City, State	Marlborough, MA 01752-3789
Plan Administrator:	Benita Fortner
Title	Director, Supplier Diversity Program
Location	Waltham, MA
Telephone	781.522.6337
Supplier Diversity Programs Administrator:	
Name	Valerie D. King
Location	Marlborough, MA
Telephone	508.490.2331
Contract Administrator:	Ellen K. Kelley
Title	Contracts Administrator
Location	Marlborough, MA
Telephone	508.490.1518
Principal Contracting Officer:	Leslie Brown
Agency	NY/NJ Port Authority
Address	One Madison Avenue, 7th Floor, New York, NY
Telephone	212.435.3969
Administrative Contracting Officer:	
Agency	
Address	
Telephone	

Raytheon Group/Division Name: _____

Figure F-45. SMS at JFK Subcontracting Plan – Our plan provides a comprehensive strategy that is both cost effective and mutually beneficial to the PANYNJ

1. CONTRACT INFORMATION

Contract/RFP No.	24997
Description	Surface Management System Contractor
Period of Performance	
Effective Date of Contract	1 December 2011
Change No. _____ Date:	

2. VALUES

Total Current Contract Value	$ 15,923,238.64	
Planned Subcontract Dollars	$ 9,072,302	57%*
Domestic Subcontract Dollars	$ 9,072,302	57%*

* 57% is percentage of total contract value

3. GOALS

For the purpose of this individual subcontracting plan, the following separate percentage goals are hereby expressed in terms of a percentage of the total planned domestic subcontract dollars. The goal for small disadvantaged business concerns includes consideration of Historically Black Colleges and Universities and Minority Institutions in a composite SDBs, HBCUs, and MIs Goal, and while stated separately as a percentage of planned subcontract dollars, is included in the goal for small business concerns and constitutes a subset thereof. Goals for Small Business Concerns owned and operated by Woman or Women, Veteran Owned Small Business, Service Disabled Veteran Owned Small Business, and HUB-Zone Small Business if required as part of this subcontracting plan will be stated separately; but, will be included in the goal for small business concerns and constitutes a subset thereof. These planned subcontract dollars included all first tier subcontracts to be awarded in the performance of this contract but unless specifically and separately stated as stand-alone items do not include the cost of any products or services normally allocated as indirect or overhead.

Raytheon Company hereby commits to continue applying its organized and proven resources in carrying out the government's Supplier Diversity program objectives and hereby agrees to strive for achievement of the following goals:

4. a) Individual Goals

PLANNED SUBCONTRACT BASE:	AMOUNT	PERCENT	
1. Total Dollars	$ 9,072,302	100	%
2. To Large Business	$ 494,403	5.4	%
3. To Small Business	$ 8,577,899	94.6	%

SMALL BUSINESS SUBSETS:	AMOUNT	PERCENT OF ITEM 1 TOTAL	
4. Disadvantaged**	$ 921,068	10.2	%
5. HBCUs/MIs	$ -	-	%
6. Woman-Owned Small Business**	$ 921,068	10.2	%
7. Veteran Owned Small Business			
8. Service Disabled Veteran Owned Small Business			
9. HUB-Zone Small Business			
10. Other Small Business	$ 7,656,831	84.4	%

** Same small business subcontract fulfills both categories

Figure F-45. SMS at JFK Subcontracting Plan – Our plan provides a comprehensive strategy that is both cost effective and mutually beneficial to the PANYNJ (continued)

Justification is required for items 4 & 5 when combined percentages are less than 5%, 6 is less than 5%, 8 is less than 3%, and 9 is less than 2.5%. If item 5 is zero a brief explanation is required.

5. MODIFICATIONS

Upon receipt of a modification to this contract exceeding the $500,000 threshold, ($1,000,000 for construction), Raytheon Systems Company will promptly negotiate applicable revisions to the appropriate subcontract goal reflecting those changes. The following paragraph applies only to contract modifications in excess of the threshold.

Change number _____ dated _____ Increases (decreases) the previous contract value by $ _____ to a new total contract value of $ _____

This change impacts the planned subcontract elements as follows:

PLANNED SUBCONTRACT BASE:	FROM		TO	
1. Total Dollars	$ _____	100 %	$ _____	100 %
2. To Large Business	$ _____	_____ %	$ _____	_____ %
3. To Small Business	$ _____	_____ %	$ _____	_____ %
SMALL BUSINESS SUBSETS:				
4. Disadvantaged	$ _____	_____ %	$ _____	_____ %
5. HBCUs/MIs	$ _____	_____ %	$ _____	_____ %
6. Women Owned Small Business	_____	_____	_____	_____
7. Veteran Owned Small Business	$ _____	_____ %	$ _____	_____ %
8. Service Disabled Veteran Owned SB	$ _____	_____ %	$ _____	_____ %
9. HUB-Zone Small Business	$ _____	_____ %	$ _____	_____ %
10. Other Small Business	$ _____	_____ %	$ _____	_____ %

6. TECHNICAL ASSISTANCE TO SDB CONCERNS

In addition to those actions described in the Annual Subcontracting Plan format in paragraph 3 "Basis for Setting Goals"; paragraph 4 "Source Identification"; paragraph 8 "Implementing Actions to Develop Participation"; and paragraph 11 "Record keeping and Outreach Effort", the following specific efforts will be undertaken to aid SDB concerns receive an opportunity to participate in the performance of this contract as subcontractors and to aid in the achievement of the above stated SDB goal:

In addition to our MBE/WBE process improvement engagements through Raytheon's Six Sigma team, Raytheon shall reach out to the NY/NJ Procurement Technical Assistance Center and the Women's President's Organization to help identify other viable candidates. During the course of performance on the contract, Raytheon will participate in regional MBE/WBE supplier events to augment other activities underway. These efforts will assure Raytheon's commitment remains firm in the provision for providing maximum practicable opportunity and exceeding our best efforts for our Customer.

7. PRINCIPAL PRODUCTS AND SERVICE AREAS

Appendix I attached hereto contains a description of the principal supply and service areas scheduled to be subcontracted, and identification of those areas anticipated to be subcontracted to small business, small disadvantaged business, women owned business, HUB Zone business, veteran-owned business, historically black colleges and universities and minority institutions, and large business concerns.

Figure F-45. SMS at JFK Subcontracting Plan – Our plan provides a comprehensive strategy that is both cost effective and mutually beneficial to the PANYNJ (continued)

APPENDIX I
PRINCIPAL PRODUCTS AND SERVICE AREAS
BY
BUSINESS SIZE CATEGORIES

Raytheon anticipates procurement of the following listed products and services from the following categories of business concerns in support of the referenced contract::

PRODUCT/SERVICE	ALL SMALL BUSINESS CONCERNS							
	SB	LB	SDB	WOSB	VOSB	SDVOSB	SBHZ	HBCU/MI
1. Supply Chain Management	X		X	X			X	
2. Commercial off-the-shelf hardware	X		X	X			X	
3. COTS Surface Management	X							

NOTE: USE A CONTINUATION SHEET FOR ITEMS OVER TEN

Legend:

SB = Small Business
LB = Large Business
SDB = Small Disadvantaged Business
WOB = Women-Owned Business
VOSB = Veteran Owned Small Business
SDVOSB = Service Disabled Veteran Owned Small Business
SBHZ = Small Business HUB-Zone
HBCU = Historically Black College or University
MI = Minority Institution

Figure F-45. SMS at JFK Subcontracting Plan – Our plan provides a comprehensive strategy that is both cost effective and mutually beneficial to the PANYNJ (continued)

F.9.1 Previous M/WBE Participation

Raytheon searched the Port Authority's database of certified suppliers to identify candidate M/WBE subcontractors for the program. Raytheon's M/WBE partners were reviewed through a rigorous supplier selection process prior to subcontract award by using selection criteria based on the technical, cost, quality and schedule requirements of the program. As a responsible partner to the Port Authority, Raytheon has, in the past, worked with the Port Authority's certified sources on a previous contract with the Port Authority. Success was achieved by properly matching the certified M/WBEs with the correct requirements to support the program.

Raytheon's overall strategy has been demonstrated to be successful and enabled Raytheon to place subcontracts with certified M/WBEs in excess of $835M to support all customers during calendar year 2010.

F.9.2 Scope of Work

A gap analysis was performed to identify areas in which M/WBEs could add value, and complement Raytheon's existing resources, capabilities and products/services.

Raytheon will subcontract the following supplies and services to support the PANYNJ's efforts to provide maximum practicable opportunities for M/WBEs for this program:

- Supply chain management
- Commercial Off-the-Shelf (COTS) hardware

F.9.3 Level of Participation

Raytheon is committed to achieving the M/WBE goals as iterated in the RFP, as depicted in Figure F-46.

Ms. Valerie King, Raytheon's SBLO, has the overall responsibility for the development, implementation and management of this M/WBE Subcontracting Plan. Ms. King brings many years of experience to the Raytheon Team administrating small business subcontracting programs and more than 10 years of supply chain management experience.

Ms. King's responsibilities for supporting the Raytheon Team's M/WBE Subcontracting Program include, but are not limited to, the following: outreach, advocacy, counseling and performance reporting.

The associated products and services identified for the M/WBEs are listed in PA 3749B/08-10 (shown in Figure F-47) per RFP instructions.

Authority Supplier Category	Total Contract Value (Base Period)	RFP Subcontract Goal	Raytheon's Subcontracting Commitment
Women-Owned Business Enterprise	$15,923,238.64	$1,910,788.56 (12%)	$921,068 (5.8%/10.2%*)
Minority-Owned Business Enterprise	$15,923,238.64	$796,161.90 (5%)	$921,068 (5.8%/10.2%*)

* 5.8% is percentage of total contract value and 10.2% is percentage of total subcontract value.

Figure F-46. M/WBE Participation Summary – Raytheon is committed to achieving the M/WBE goals as specified by the Port Authority

PA 3749 B/ 08-07

THE PORT AUTHORITY OF NY & NJ
Office of Business and Job Opportunity

PROCUREMENT
M/WBE PARTICIPATION PLAN

PAGE 1 OF 1

NOTE: The Proposer/Bidder shall submit to the Manager, Line/Facility Dept. Form PA 3749 C MODIFIED PLAN for any changes to the original plan: i.e.; subcontractor, dollar amount or work performed.
If more than 1 page is used, complete totals on last page.

Purchase Order #: RFP No. 24997
Proposer/Bidder Name: Raytheon Company
Mailing Address: 1001 Boston Post Road
Telephone Number: 508-490-1000

Contract Description: Surface Management Systems Contractor
Contract Amount: $15,923,238.64
Contract Goals: MBE 12% WBE 5%

Name, Address, Phone Number of PA Certified M/WBE subcontractor (including name of contact person)	Indicate MBE or WBE	Description of Work, Services to be provided. Where applicable, specify, "supply" or "install or both "supply" and "install."	Anticipated date work will start and finish	Approximate $ amount of M/WBE Subcontract	M/WBE % of Total Contract Amount
Sterling Computers Sterling Computers 1508 Square Turn Boulevard Norfolk, NE 68701 Contract: Troy Jones	MWBE	Commercial off-the-shelf Hardware Supply Chain Management			12%/5%
			TOTAL:		

Signature of Contractor: Ellen K Kelley
Print Name: Ellen K. Kelley
Title: Manager, Contracts Date 8 August 2011

FOR OBJO USE ONLY
Contract Goals: ☐ Approved ☐ Waived ☐ Rejected
Reviewed by: _____
OBJO Business Development Representative
Print Name: _____ Date _____

Distribution: Original – OBJO; Copy 2 –Manager, Line/Facility Department; Copy 3 –Proposer/Bidder, Copy 4 – Procurement Dept – Award File

Figure F-47. M/WBE Plan – Potential M/WBE suppliers have been identified

Use or disclosure of data contained on this sheet is subject to the restriction on the title page of this proposal.

F.10 Subcontractors

Raytheon will team with Metron Aviation as the primary subcontractor to provide the SMS at JFK.

Metron Aviation is a world leader in Air Traffic Flow Management (ATFM) technology. They will provide their Harmony Product Suite as the basis of the surface management solution for JFK International Airport to improve the overall system efficiency and predictability of airport operations. Reference Section F.3 for a company overview, Section F.3.6 for staff roles and responsibilities, and Section F.1 for detailed technical information regarding our solution.

Raytheon's planned use of Minority Business Enterprises (MBEs) and Minority/Women Owned Business Enterprises (M/WBEs) are discussed in the M/WBE Subcontracting Plan shown in Section F.9.

F.11 Conflict of Interest

In connection with this RFP, Raytheon has determined that we do not have any interests to disclose that could either create a conflict of interest or give the appearance of a conflict of interest.

APPENDIX A. SAS-70 AUDIT REPORTS

A.1 SAS-70 Audit Report Summary

SAS 70 Type II

INTERNAP

The Ultimate Online Experience

Internap Network Services Corporation, a leading Internet solutions and data center services provider, has successfully completed a SAS 70 Type II audit of eight company-controlled data center facilities. A Type II SAS 70 report provides third-party verification that controls identified by a service organization, such as Internap, were adequately designed and operating effectively during the period of time under examination. With this certification, customers colocated with Internap can be confident that they are entrusting their business to a capable and qualified partner.

Each of the following locations underwent a thorough examination by an independent certified public accounting firm.

- **Atlanta**
  - 250 Williams Street, Atlanta, GA
- **Boston**
  - 70 Inner Belt, Somerville, MA
  - 50 Inner Belt, Somerville, MA
- **Houston**
  - 1301 Fannin Street, Houston, TX
- **New York**
  - 769th Avenue (111 8th Avenue), New York, NY
  - 75 Broad Street, New York, NY
- **Seattle**
  - 140 4th Avenue North, 2nd floor, Seattle, WA
  - 3355 S. 120th Place, Tukwila, WA

For each location, the following Internap control objectives and related activities were examined and validated:

- **Physical Security** - The audit focused on establishing that physical access to Internap facilities, computer equipment, media and documentation is limited to properly authorized individuals.

- **Facility and Environmental Protection** – The audit focused on providing reasonable assurance that the facilities are maintained properly and monitored for acceptable operating conditions including fire protection, cooling, humidity and electrical backup systems.

- **Control Environment** – The audit focused on corporate policies, processes and procedures outside the data center environments that directly impact the effective operation of the facilities and the user organization (i.e. hiring practices, training, and performance management)

Internap has dedicated significant time and resources to validate our commitment to maintaining a robust control framework and the well-designed processes required to deliver a secure, reliable data center services environment. Because a SAS 70 Report provides third-party attestation that selected control objectives effectively contribute to a service organization's integrity and operational excellence, Internap prospects can be confident with what our customers know: **Internap delivers on the commitments we make.**

For additional information about Internap's SAS 70 certification, contact us at gen_info@internap.com or 877.THE.PNAP (877.843.7627).

A.2 SAS-70 Audit Report (Boston, MA)

INTERNAP®

Report on the Controls Placed in Operation as of March 31, 2011
and Tests of Operating Effectiveness for the Period
October 1, 2010 through March 31, 2011
for the Internap BSN003 Data Center

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pwc

REPORT OF INDEPENDENT AUDITORS

To the Board of Directors of Internap Network Services:

We have examined the accompanying description of relevant general computer controls of control environment, physical security and environmental controls for the BSN003 data center, located at 50 Innerbelt Road, Somerville, Massachusetts, of Internap Network Services ("Internap" or "the Company"). Our examination included procedures to obtain reasonable assurance about whether (1) the accompanying description presents fairly, in all material respects, the aspects of Internap's controls that may be relevant to a user organization's internal control as it relates to an audit of financial statements; (2) the controls included in the description were suitably designed to achieve the control objectives specified in the description, if those controls were complied with satisfactorily and user organizations applied the controls contemplated in the design of Internap's controls; and (3) such controls had been placed in operation as of March 31, 2011. The control objectives were specified by the management of Internap. Our examination was performed in accordance with standards established by the American Institute of Certified Public Accountants and included those procedures we considered necessary in the circumstances to obtain a reasonable basis for rendering our opinion.

In our opinion, the accompanying description of the aforementioned controls presents fairly, in all material respects, the relevant aspects of Internap's controls that had been placed in operation as of March 31, 2011. Also, in our opinion, the controls, as described, are suitably designed to provide reasonable assurance that the specified control objectives would be achieved if the described controls were complied with satisfactorily, and user organizations applied the controls contemplated in the design of Internap's controls.

In addition to the procedures we considered necessary to render our opinion as expressed in the previous paragraph, we applied tests to specific controls to obtain evidence about their effectiveness in meeting the control objectives, during the period from October 1, 2010 to March 31, 2011. The specific control objectives and controls, and the nature, timing, extent, and results of the tests are listed in Section III. This information has been provided to user organizations of Internap and to their auditors to be taken into consideration, along with information about the internal control of user organizations, when making assessments of control risk for user organizations. In our opinion, the controls that were tested were operating with sufficient effectiveness to provide reasonable, but not absolute, assurance that the specified control objectives were achieved during the period from October 1, 2010 to March 31, 2011.

The relative effectiveness and significance of specific controls at Internap and their effect on assessments of control risk at user organizations are dependent on their interaction with the controls, and other factors present at individual user organizations. We have performed no procedures to evaluate the effectiveness of controls at individual user organizations.

The description of controls at Internap is as of March 31, 2011 and the information about tests of the operating effectiveness of specific controls covers the period from October 1, 2010 to March 31, 2011. Any projection of such information to the future is subject to the risk that, because of change, the description may no longer portray the controls in existence. The potential effectiveness of specific controls at Internap is subject to inherent limitations and accordingly, errors or fraud may occur and not be detected. Furthermore, the projection of any conclusions, based on our findings, to future periods is subject to the risk that changes made to the system or controls or the failure to make needed changes to the system or controls, may alter the validity of such conclusions.

pwc

This report is intended solely for use by the management of Internap, its users and the independent auditors of its users.

PricewaterhouseCoopers LLP

Atlanta, GA
April 25, 2011

Internap Network Services BSN003 Data Center
Description of Operations and Controls Provided by Internap

SECTION II: DESCRIPTION OF OPERATIONS AND CONTROLS PROVIDED BY INTERNAP

The scope of the report is limited to the Internap information technology general computer controls only. The specific business process functionality for the applications hosted on the Internap information technology control environment and BSN003 data center business process services provided are not included in the scope of this report. Thus, the accompanying description includes only those controls and related control objectives of Internap's information technology general computer controls. Refer to Section III for a description of the information technology general computer controls and control processes in scope for this report. This document was prepared according to the guidance contained in the American Institute of Certified Public Accountants ("AICPA") Statement on Auditing Standards No. 70, entitled Service Organizations, as amended.

A. Description of Operations

Company Background

Internap Network Services Corporation (NASDAQ: INAP) is an Internet solutions and data center company providing a suite of network optimization and delivery services and products that manage, deliver and distribute applications and content with a 100% availability service level agreement, as well as a global provider of secure and reliable data center services. Internap helps its customers innovate their business, improve service levels and lower the cost of information technology operations. Internap's services and products, combined with progressive and proactive technical support, enable their customers to migrate business-critical applications from private to public networks.

Internap operates in two business segments: IP services and data center services. The scope of this report is limited to Internap's data center, or colocation, services, which primarily include physical space for hosting customers' network and other equipment plus associated services such as redundant power and network connectivity, environmental controls and security.

Internap's data center services allow them to expand the reach of their high performance IP services to customers who wish to take advantage of locating their network and application assets in secure, high-performance facilities. Internap operates data centers where customers can host their applications directly on Internap's network to eliminate issues associated with the quality of local connections. Data center services also enable Internap to have a more flexible product offering, such as bundling its high performance IP connectivity and content delivery, along with hosting customers' applications. Internap's data center services provide a single source for network infrastructure, IP connectivity and security, all of which are designed to maximize solution performance while providing a more stable, dependable infrastructure, and are backed by guaranteed service levels and its team of dedicated support professionals.

Internap believes that its unique managed multi-network approach provides better performance, control and reliability compared to conventional Internet connectivity alternatives. Internap's service level agreements, or SLAs, guarantee performance across multiple networks and a broader segment of the Internet in the United States, excluding local connections, than providers of conventional Internet connectivity which typically only guarantee performance on their own network.

Internap uses a combination of facilities that are operated by Internap and by third parties, referred to as company-controlled facilities and partner sites, respectively. Internap offers a comprehensive solution, consisting of ten facilities for which SAS 70 examinations are performed and 28 partner sites. They charge monthly fees for data center services based on the amount of square footage and power that the customers use. This report is related to one of Internap's ten data center facilities for which a SAS 70 examination is performed.

Internap currently has approximately 2,700 customers across more than 28 metropolitan markets, serving a variety of industries, including entertainment and media, financial services, healthcare, travel, e-commerce, retail and technology.

Raytheon Competition Sensitive/Raytheon Proprietary
Export-Restricted Data
1106-1002

Use or disclosure of data contained on this sheet is subject to the restriction on the title page of this proposal.

Internap Network Services BSN003 Data Center
Description of Operations and Controls Provided by Internap

Customer Service and Support
The Senior Vice President of Operations and Customer Support is responsible for customer service at Internap. This individual is available for customers who wish to escalate pending technical issues or discuss overall operational concerns. Internap provides first level customer support through their on-site Technical Engineers. Technical Engineers are on-site and trained in various specialties and Internap data center operations. These individuals are on-site 24/7/365 and available to discuss customer issues specifically related to Internap data center operations.

New customers and new services are installed in Internap data centers according to agreed-upon specifications. Subsequent to consummation of an agreement, Internap provides ongoing operations and maintenance of critical infrastructure and physical security to the site. Internap's interactions with customers are treated as confidential and protected by non-disclosure agreements, and customer data is treated as confidential.

Internap's Sales organization and Customer Support work with the customer to build a quote acceptable to both Internap and the customer, including performance of appropriate legal reviews, service-level agreements, and specifically defined responsibilities of each party. Once the agreement has been signed, it becomes a legally binding contract and the customer then works with Internap's installation team for installation at the data center.

Raytheon Competition Sensitive/Raytheon Proprietary
Export-Restricted Data
1106-1002

Use or disclosure of data contained on this sheet is subject to the restriction on the title page of this proposal.

Internap Network Services BSN003 Data Center
Description of Operations and Controls Provided by Internap

B. Control Objective 1: Control Environment
Controls provide reasonable assurance that hiring practices, code of conduct, and performance and training programs are in place.

Integrity and Ethical Values
Adherence to standards of integrity and ethics are an integral part of Internap's day-to-day operations. Internap's Code of Conduct (hereafter, the Code) details the Company's commitment to the highest standards of ethical behavior and employee integrity. The Code formally communicates these standards to Internap's directors, management and employees.

The Code includes specific standards that govern relationships between those it governs (e.g. directors, officers, and employees) and customers, suppliers, shareowners, and others. Employees are required to review and acknowledge the Code upon hire and annually thereafter.

As a condition of the hiring process, Internap performs background checks on all employees. Likewise, computer use forms must be completed by each employee prior to receipt of a computer(s) and gaining access to company information, which includes the Company portal.

Commitment to Competence
Internap's commitment to competence includes management's determination of the levels of competence and expertise required for each position. Internap HR personnel prepare detailed job descriptions and organizational charts that capture and convey these requirements for each position. Internap also facilitates employee development through annual evaluations, on-site training, a company-wide tuition reimbursement program, and the allocation of funds for relevant off-site training.

Board of Directors Participation
Internap's board of directors is responsible for the oversight of company management, which includes oversight of the design and operation of company controls.

Management's Philosophy and Operating Style
Internap's management philosophy and operating style encompass a broad range of characteristics. Such characteristics include management's approach to taking and monitoring business risks and management's attitudes toward information processing, accounting functions and personnel. Periodic meetings are conducted to discuss operational issues.

Organizational Structure and Assignment of Authority and Responsibility
Internap has developed an organizational structure that adequately suits the nature and scope of its operations. The company has developed organizational charts that internally convey employee reporting relationships, operational responsibilities, and the overall organizational hierarchy.

Human Resource Policies and Practices
Internap's human resource department has policies and established practices that govern the hiring, termination, evaluation, promotion, counseling, and compensation of current and prospective company employees. A documented set of human resource, operational, and financial policies and procedures, along with a listing of internal controls are made available to applicable employees via the intranet. New hire policies include the requirement that background checks be performed on all new employees prior to commencing employment with Internap. Similarly, these same employees are required to read and acknowledge the Code before joining Internap, as well as annually thereafter during the performance review process. For terminated employees, Internap has a formal process for decommissioning access to company records and systems in a timely manner.

Risk Assessment
Internap utilizes various protocols to manage risks that could impact the Company's ability to deliver service to customers. Management also assesses risks that inherently arise from the expansion of the business, whether organically or inorganically. This may include managing risks that are rooted in changes in personnel, technology, or the Company's operating environment.

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Internap Network Services BSN003 Data Center
Description of Operations and Controls Provided by Internap

Information and Communication Systems
Internap's management team is responsible for the detailed design and effective operation of the company's internal controls. As part of this process, management communicates responsibilities and expectations to company personnel through both formal and informal means. Internal controls are evaluated by Internal Audit throughout the year as part of its annual Sarbanes-Oxley assessment procedures and other internal audit reviews. Testing results and exceptions identified during the audits are reported to management on a consistent basis. Management ensures that internal control deficiencies are addressed and communicates expected timelines for doing so. Internap does not record, process, summarize, or report the financial transactions of their user organizations.

Monitoring
Internap's management team, including support from its Internal Audit department, continuously monitors the effectiveness of the Company's system of internal control through the performance of periodic and annual audits of internal controls over financial reporting or specific testing procedures. Any deficiencies in the Company's system of internal control are reported to management, assessed, and addressed. Management's consistent oversight of internal controls helps the Company identify deficiencies in the system, ensuring the adequacy of the process.

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Internap Network Services BSN003 Data Center
Description of Operations and Controls Provided by Internap

C. Control Objective 2: Physical Security
Controls provide reasonable assurance that physical access to Internap facilities, computer equipment, media, and documentation is restricted to properly authorized individuals.

Security Staff
An outsourced security company employs and provides Internap's data center security resources. Such outsourcing ensures consistency of training, performance, metrics, and supervision. Responsibilities of security include, but are not limited to:

- Monitoring of Physical Security Systems (Internap is responsible for implementation)
- Monitoring of Physical Security Standards (Internap is responsible for implementation)
- Loss Prevention
- Internal Investigations (under the supervision of Internap)
- Security Policies and Procedures Compliance

Security Control Desk
All Internap data centers have a Security Control Desk to control access, monitor security alarms, monitor Closed-Circuit Television camera signals (CCTV), and support security-related operational activities 24/7/365. Security personnel are on-site 24/7/365.
The Security Control Desk possesses the following:

- Central ventilation, heating & air conditioning
- Real-time monitoring of data center door alarms
- Real-time monitoring of data center CCTV cameras
- Centralized security service and emergency dispatch communications for Security Staff, as well as for local fire departments, police departments, and other emergency response resources
- Electrical power support for continuous operation of communications, lighting, CCTV, intrusion detection, and alarm monitoring equipment in the event of utility power loss

Access Control
Internap employs a computerized access control system (ACS) to control physical access to its data centers that house customer equipment, media and documentation. The ACS utilizes proximity card readers and biometric technology to control access into perimeter doors, shipping & receiving areas, storerooms, and other critical areas. Customers and employees must follow formal access request and approval processes before physical access to data centers is granted. Additional access control features are as follows:

- Access to the data center and other restricted areas is specifically limited to Internap authorized individuals
- Internap access badges and a biometric fingerprint scan are required to gain entry
- Customers, Vendors, Contractors and other Visitors must be sponsored by an Internap-approved host to gain access, if not on the Customer-Approved List
- All Customers, Vendors, Contractors, and Visitors on the Customer-Approved List must check in with the Security Desk upon arrival with a government-issued photo identification
- Visitors and others not on the Customer-Approved List are escorted while in the data center and other critical areas
- Access for approved Contractors is limited to particular areas where work is being performed.
- Employees with access to the data center are limited to those with a specific business need or job function

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An automated security entrance system is utilized to control access in the data center. The systems employ the following key features:

- Monitored/Recorded by CCTV 24/7/365 by Security Control Desk
- 24/7 Intrusion/tampering alarm monitoring by Security Control Desk
- Integrated Card Access Control Systems limit access to authorized individuals

Access to add, modify and delete users in the ACS is restricted to appropriate personnel based on job roles and responsibilities and reviewed during the employee access review.

The alarm control system is also used to monitor, notify, and log security alarms. The system monitors:

- Perimeter/external doors
- Restricted area doors
- Data center doors
- Shipping/receiving doors

The alarm monitoring and reporting system is equipped and programmed to receive alarms for forced doors, propped doors, and denied card read attempts.

Visitor/Sales Tour Access
All Internap data center tours must be coordinated with an Internap representative. Tours of the data center and other restricted areas require an escort from an authorized Internap employee.

Customer Access
Each customer is permitted to designate individuals with access to data centers at Internap via the Network Operations Center (NOC). The customers make requests for access through the NOC via email, phone call, or the Customer Portal. The NOC manages customers' respective customer contact lists within the CST (Colo Space Tracker) application. Update access to CST customer contact lists is reviewed for appropriateness based on job responsibilities on an annual basis. Once a customer's keycard access information is updated, CST sends an automated email describing the change request to security, who will then carry out the request. The customer is responsible for requesting additions, modification, or deletions to access; the NOC is responsible for management of the Customer Access List. Upon notification of a customer employee termination or revocation of customer agreement, physical access to the data center is revoked.

Customer equipment is segregated via locked cages or locked cabinets to ensure that customers can only access their own equipment.

All entrants to Internap data centers are required to show a form of government-issued identification.

Customers must sign in at the security desk.

Customer and Employee Access Review
Internap data center (collocation) security personnel perform a quarterly audit to validate the appropriateness of all customers' physical access to the data centers, and a monthly audit to validate the appropriateness of all employees' physical access to the data centers. On a semi-annual basis, individuals with access to add, modify, and delete users in the key card access system are reviewed for appropriateness.

Data Center Check-In Process

1. Identify—upon request for access, the on-duty security officer will ascertain the type of requestor (Customer, Visitor, Contractor, and Internap employee without continuous access).
2. Verify— the security officer will reference the customer access list to ensure that the individual(s) requesting access is (are) authorized. If the individual(s) is (are) not on the listing, a ticket should be initiated by the Network Operations Center (NOC) requesting access to the data center. Authorization must be documented within the ticket before access is granted.

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Internap Network Services BSN003 Data Center
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3. Review—Security requires that each individual entering the data center (outside of authorized Internap employees and customers with continuous access) present a valid government-issued ID prior to gaining access.
4. Access—once the information is verified by security, an access card for the authorized areas will be programmed by security.

Employee Access to Data Center
Access to the data center is restricted to only those Internap employees with a legitimate business need. Access, if temporarily required for other employees whose job functions do not necessitate access to the data center on a day-to-day basis, is granted on a case-by-case basis by the data center manager, and these employees must be escorted by data center personnel. Upon notification of employee termination, physical access to the data center is revoked.

General Visitor Rules
1. All visitors must be escorted at all times by an authorized host or employee.
2. Internap data center regulations must be strictly followed at all times. Any individual (including Internap employees) not adhering to these rules are escorted from the data center by staff and/or security.

Surveillance and Monitoring
1. Internap data centers employ a CCTV (Closed Circuit Television) to record and facilitate monitoring of the data center. Cameras are positioned to provide views of critical areas, including perimeter doors, main entrances and exits, shipping & receiving, and other areas of importance.
2. Internap security desk personnel monitor the signals from the CCTV system. The desk is connected by secure cables to the cameras throughout the facility to permit both interior and exterior surveillance.
3. Cameras are recorded on site via digital video recorders 24/7/365. These visual records are retained for 30 days to provide details of activity at Internap data centers.
4. Internap provides dedicated 24/7/365 CPS (continuous power supply) and standby emergency power via generator to support security systems.

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Internap Network Services BSN003 Data Center
Description of Operations and Controls Provided by Internap

D. Control Objective 3: Facility and Environmental Protection
Controls provide reasonable assurance that facilities that house customer equipment have environmental controls in place, and environmental control devices are monitored by Internap and inspected by a third party.

Overview
The existing facility and environmental standards at Internap are designed to ensure that uptime is maximized by providing redundancy to key facility and environmental systems. These systems are designed to provide adequate redundancy to ensure that mechanical or electrical failures will not result in an outage. A minimum of N+1 redundancy is provided for all critical facility systems that provide cooling and power to the data center.

Monitoring Environmental Conditions
Data center environmental conditions are monitored and reported via the Alerton Envision for BACtalk system. Data center technicians and Internap's centralized Network Operations Center (NOC) personnel monitor a BACtalk console which reports the real-time status of power, HVAC, temperature, and fire detection/suppression conditions. If any issues or incidents with these environmental systems arise, the console displays an alert and e-mails on-site data center personnel.

Smoke/Fire Detection
The fire detection system includes a particulate sampling smoke detection system, a sampling system that detects smoke during the very early stages of combustion. This system is the first line of defense against fire in the facility, monitoring data center air for smoke at the micron level. When smoke is detected, an alarm is generated in the facility control room and the BACtalk system generates console and e-mail alerts.

The smoke detection system is inspected and serviced quarterly to ensure effective operation.

Fire Suppression
The fire suppression system consists of a pre-action dry pipe system. The pre-action dry pipe system is designed to keep water out of the sprinkler system plumbing in the data center areas during normal operations. If smoke and/or excessive heat is detected and a sprinkler fusible head melts as a result, water is pumped into the sprinkler systems for the affected zone(s) only. The Alerton BACtalk system continuously monitors and reports the status of the fire suppression system.

The fire suppression systems are inspected and serviced quarterly to ensure effective operation.

Clean agent fire extinguishers are also provided throughout the data center for accessibility in the event of a fire within the data center (or elsewhere in the building).

Fire extinguishers are inspected and serviced at least annually to ensure effective operation.

Heating, Ventilation, and Air Conditioning (HVAC)
Multiple HVAC units control both temperature and humidity within the data center, delivering 750 tons of redundant HVAC service. Temperature is maintained between 64 and 78 degrees, with humidity maintained between 30 and 70 percent. The HVAC units are monitored by the Alerton Envision for BACtalk system within the facility control room.

HVAC units are inspected and serviced quarterly to ensure effective operation.

Utility Power and Backup Power Systems
The data center is supplied by two separate 5 MW redundant AC power feeds from the servicing utility to support daily operations. The power feeds are channeled into redundant UPS systems, with total capacity of 1800 KW, which condition the power to be supplied to data center equipment. These redundant UPS units provide customers with redundant N+1 power feeds to their equipment.

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In the event of a utility power outage, the UPS systems automatically switch to backup power from a battery farm which supplies power for up to 20 minutes until three 2.0 MW generators power up. Internap maintains 9,600 gallons of on-site fuel which gives the generators capability to power the data center for at least 24 hours. Internap maintains contracts with fuel companies for the delivery of fuel as needed.

The UPS systems are inspected and serviced at least annually, and the generators are inspected and serviced semi-annually to ensure effective operation.

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Internap Network Services BSN003 Data Center
Description of Operations and Controls Provided by Internap

E. User Control Considerations

Internap's services are designed with the assumption that certain controls will be implemented by user organizations. In certain situations, the application of specified internal controls at user organizations is necessary to achieve certain control objectives included in this report. The list of user control considerations presented below is not a comprehensive list of all controls that should be employed by user organizations.

The following is a representative list of controls that are expected to be in operation at user organizations to complement the controls of Internap.

- User organizations are responsible for understanding and complying with their contractual obligations.
- User organizations are responsible for ensuring the supervision, management, and control of the use of Internap's services by their personnel.
- User organizations are responsible for designating authorized individuals for access requests to Internap's data center.
- User organizations are responsible for notifying Internap of terminated employees.
- User organizations are responsible for periodically reviewing their Customer Access Lists.
- User organizations are responsible for immediately notifying Internap of any actual or suspected information security breaches, including compromised user accounts.
- User organizations are responsible for notifying Internap of changes made to technical or administrative contact information.

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SECTION III: INTERNAP'S CONTROL OBJECTIVES AND CONTROL ACTIVITIES AND PRICEWATERHOUSECOOPERS LLP'S TESTS OF OPERATING EFFECTIVENESS

PricewaterhouseCoopers LLP ("PricewaterhouseCoopers") tested relevant aspects of Internap's control environment and the controls specified below. PricewaterhouseCoopers' tests covered only those controls provided by Internap and did not cover controls which may be specific to individual clients of Internap.

Tests of the controls included inquiry of appropriate management, supervisory and staff personnel, observation of Internap's activities and inspection of Internap's documents and records. The results of these tests were considered in planning the nature, timing and extent of testing of the controls designed to achieve the control objectives described on the following pages.

Internap Network Services BSN003 Data Center
Internap's Control Objectives and Control Activities and PricewaterhouseCoopers LLP's Tests of Operating Effectiveness

Control Environment

Control Objective 1
Controls provide reasonable assurance that hiring practices, code of conduct, and performance and training programs are in place.

#	Control Activity	Tests of Operating Effectiveness	Results of Tests
1.1	The Company has a written Code of Conduct that is available to all employees. The Code details the company's expectations regarding behavior, ethics, and business practices by which every employee must abide. New employees must acknowledge the Code of Conduct upon employment with Internap.	**Inspection** Inspected the Code of Conduct to determine whether the Code details the Company's expectations regarding behavior, ethics, and business practices. Inspected the acknowledgement of the Code of Conduct for a sample of employees hired during the examination period to determine whether employees acknowledged the Code of Conduct.	No relevant exceptions noted.
1.2	The Company maintains a documented set of human resource, operational, and financial policies and procedures, and internal controls which are made available to applicable employees.	**Inspection** Inspected the Company's policies, procedures, and controls documentation posted to the Company intranet to determine whether the Company maintains a documented set of human resource, operational, and financial policies and procedures, and internal controls which are made available to applicable employees.	No relevant exceptions noted.
1.3	Human Resources policies and procedures are maintained in the employee handbook, available to all employees via the intranet, and acknowledged by employees upon hire.	**Inspection** Inspected the employee handbook and Company's intranet site to determine whether Human Resources policies and procedures are maintained in the employee handbook and available to all employees via the intranet. Inspected the acknowledgements of the Human Resources policies and procedures for a sample of employees hired during the examination period.	No relevant exceptions noted.

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Internap Network Services BSN003 Data Center
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Control Environment

Control Objective 1
Controls provide reasonable assurance that hiring practices, code of conduct, and performance and training programs are in place.

#	Control Activity	Tests of Operating Effectiveness	Results of Tests
1.4	An employment pre-screening process is in place. It includes background, credit, and DMV checks (based on job requirements).	**Inspection** Inspected pre-screen results in the employee files for a sample of employees hired during the examination period to determine whether an employment pre-screening process is in place and includes background, credit and DMV checks where applicable based on job requirements.	No relevant exceptions noted.
1.5	An annual performance review process is in place. It gives managers and employees an opportunity to discuss performance, ethics, integrity and training needs. The review process also includes setting goals and objectives for the following year.	**Inspection** Inspected Annual Review document and acknowledgement in the HR system from the annual review process for a sample of employees to determine whether an annual review process is in place and operating.	No relevant exceptions noted.
1.6	The Company allows operating units to budget training for each employee to continue his education either virtually or locally, including maintenance of certifications. The Company also has a formal tuition reimbursement program.	**Inspection** Inspected the Employee Handbook and annual budget to determine whether the Company allows operating units to budget training for each employee to continue his education either virtually or locally, including maintenance of certifications and whether the Company also has a formal tuition reimbursement program.	No relevant exceptions noted.

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Internap Network Services BSN003 Data Center
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Control Environment

Control Objective 1
Controls provide reasonable assurance that hiring practices, code of conduct, and performance and training programs are in place.

#	Control Activity	Tests of Operating Effectiveness	Results of Tests
1.7	Organizational charts that detail the Company's employee direct reporting structure are maintained and updated.	**Inspection** Inspected the organizational charts for a sample of months to determine whether organizational charts that detail the Company's employee direct reporting structure are maintained and updated.	No relevant exceptions noted.

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Internap Network Services BSN003 Data Center
Internap's Control Objectives and Control Activities and PricewaterhouseCoopers LLP's Tests of Operating Effectiveness

Physical Security

Control Objective 2
Controls provide reasonable assurance that physical access to Internap facilities, computer equipment, media, and documentation is restricted to properly authorized individuals.

#	Control Activity	Tests of Operating Effectiveness	Results of Tests
2.1	Only authorized Internap employees and customers are granted physical access to the data center.	**Inspection** Inspected authorization evidence for a sample of employees and customers who were granted physical access to the data center during the examination period, to determine whether only authorized Internap employees and customers are granted physical access to the data center.	No relevant exceptions noted.
2.2	Physical access to the data center is revoked upon termination of Internap employees and upon revocation of customer agreements.	**Inspection** Inspected the active keycard listing for a sample of terminated employees, physical access revocation requests from the customers, and revoked customer agreements to determine whether physical access to the data center is revoked upon termination of Internap employees, requests from Internap's customers and revocation of customer agreements.	No relevant exceptions noted.
2.3	Customer equipment is segregated via locked cages or locked cabinets to ensure that customers can only access their own equipment.	**Inquiry** Inquired of data center management to determine whether customer equipment is segregated via locked cages or locked cabinets to ensure that customers can only access their own equipment. **Observation** Observed locked cages and locked cabinets to determine whether customer equipment is segregated via locked cages or locked cabinets such that customers can only access their own equipment.	No relevant exceptions noted.

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Physical Security

Control Objective 2
Controls provide reasonable assurance that physical access to Internap facilities, computer equipment, media, and documentation is restricted to properly authorized individuals.

#	Control Activity	Tests of Operating Effectiveness	Results of Tests
2.4	In order to gain physical access to Internap data centers, employees and customers must be validated via key card and biometric technology.	**Inquiry** Inquired of management to determine whether employees and customers must be validated via key card and biometric technology to gain physical access to the data center. **Observation** Observed successful and unsuccessful attempts to gain entry to the data center to determine whether employees and customers must be validated via key card and biometric technology.	No relevant exceptions noted.
2.5	Internap employs 24 hour video surveillance to monitor all entrances, exits, and other sensitive areas of its data centers.	**Inquiry** Inquired of data center management to determine whether Internap employs 24 hour video surveillance to monitor all entrances, exits, and other sensitive areas of its data centers. **Observation** Observed security personnel monitoring the video surveillance at entrances, exits, and other sensitive areas of data center and observed video recording parameters to determine whether Internap employs 24 hour video surveillance to monitor entrances, exits, and other sensitive areas of its data centers.	No relevant exceptions noted.

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Physical Security

Control Objective 2
Controls provide reasonable assurance that physical access to Internap facilities, computer equipment, media, and documentation is restricted to properly authorized individuals

#	Control Activity	Tests of Operating Effectiveness	Results of Tests
2.6	A manned security post controls entry into Internap data centers.	**Inquiry** Inquired of data center management to determine whether a manned security post controls entry into Internap data centers. **Observation** Observed the manned security post to determine whether a manned security post controls entry into Internap data centers.	No relevant exceptions noted.
2.7	Customer access to Internap data centers is logged at the security desk.	**Inspection** Inspected security logs for a sample of days to determine whether customer access to Internap data centers is logged at the security desk.	No relevant exceptions noted.
2.8	Internap collocation security personnel perform a quarterly audit to validate the appropriateness of all customers' physical access to the data centers, and a monthly audit to validate the appropriateness of all employees' physical access to the data centers. On a semi-annual basis, individuals with access to add, modify, and delete users in the key card access system are reviewed for appropriateness.	**Inspection** Inspected a sample of quarterly customer audits and monthly employee audits to determine whether Internap collocation security personnel perform a quarterly audit to validate the appropriateness of customers' physical access to the data centers and a monthly audit to validate the appropriateness of employees' physical access to the data centers. Inspected the semi-annual audit to determine whether Internap collocation security personnel perform a semi-annual audit to validate the appropriateness of individuals with access to add, modify, and delete users in the key card access system.	No relevant exceptions noted.

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Physical Security

Control Objective 2
Controls provide reasonable assurance that physical access to Internap facilities, computer equipment, media, and documentation is restricted to properly authorized individuals.

#	Control Activity	Tests of Operating Effectiveness	Results of Tests
2.9	Update access to CST customer contact lists is reviewed for appropriateness based on job responsibilities on an annual basis.	**Inquiry** Inquired of management to determine whether update access to CST customer contact lists is reviewed for appropriateness based on job responsibilities on an annual basis.	Not applicable. This control has not operated during the examination period due to its planned frequency.

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Internap Network Services BSN003 Data Center
Internap's Control Objectives and Control Activities and PricewaterhouseCoopers LLP's Tests of Operating Effectiveness

Facility and Environmental Protection

Control Objective 3
Controls provide reasonable assurance that facilities that house customer equipment have environmental controls in place, and environmental control devices are monitored by Internap and inspected by a third party.

#	Control Activity	Tests of Operating Effectiveness	Results of Tests
3.1	A particulate sampling smoke detection system is installed in the data center to detect and alert data center personnel to the presence of a fire at its very early stages.	**Observation** Observed particulate sampling smoke detection system in the data center to determine whether a smoke detection system is installed in the data center.	No relevant exceptions noted.
3.2	The particulate sampling smoke detection system is inspected and serviced quarterly to ensure effective operation.	**Inspection** Inspected a third-party vendor preventative maintenance and inspection report to determine whether the smoke detection system is inspected and serviced quarterly.	No relevant exceptions noted.
3.3	The data center is protected from the risk of fire by a pre-action, dry pipe sprinkler fire suppression system as well as fire extinguishers located throughout the data center.	**Observation** Observed sprinkler system and fire extinguishers throughout the data center to determine whether the data center is protected from the risk of fire by a pre-action, dry pipe sprinkler fire suppression system as well as fire extinguishers.	No relevant exceptions noted.
3.4	The pre-action, dry pipe sprinkler fire suppression system is inspected and serviced quarterly, and fire extinguishers are inspected and serviced at least annually, to ensure effective operation.	**Inspection** Inspected third-party vendor preventative maintenance and inspection reports to determine whether the sprinkler system is inspected quarterly and the fire extinguishers are inspected and serviced at least annually.	No relevant exceptions noted.

Internap Network Services BSN003 Data Center
Internap's Control Objectives and Control Activities and PricewaterhouseCoopers LLP's Tests of Operating Effectiveness

Facility and Environmental Protection

Control Objective 3
Controls provide reasonable assurance that facilities that house customer equipment have environmental controls in place, and environmental control devices are monitored by Internap and inspected by a third party.

#	Control Activity	Tests of Operating Effectiveness	Results of Tests
3.5	Multiple HVAC units control both temperature and humidity within the data center, delivering redundant HVAC service throughout the data center.	**Observation** Observed multiple HVAC units to determine whether HVAC units are designed to control both temperature and humidity within the data center, delivering redundant HVAC service throughout the data center.	No relevant exceptions noted.
3.6	HVAC units are inspected and serviced quarterly to ensure effective operation.	**Inspection** Inspected a sample of third-party vendor preventative maintenance and inspection reports to determine whether HVAC units are inspected and serviced quarterly.	No relevant exceptions noted.
3.7	Redundant UPS systems are in place to provide temporary power in the event of a power failure and to mitigate the risk of power surges impacting infrastructure in the data center.	**Observation** Observed UPS systems to determine whether redundant UPS systems are in place to provide temporary power in the event of a power failure and to mitigate the risk of power surges impacting infrastructure in the data center.	No relevant exceptions noted.
3.8	UPS systems are inspected and serviced at least annually to ensure effective operation	**Inspection** Inspected a third-party vendor preventative maintenance and inspection report to determine whether UPS systems are inspected and serviced at least annually.	No relevant exceptions noted.

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Internap Network Services BSN003 Data Center
Internap's Control Objectives and Control Activities and PricewaterhouseCoopers LLP's Tests of Operating Effectiveness

Facility and Environmental Protection

Control Objective 3
Controls provide reasonable assurance that facilities that house customer equipment have environmental **controls** in place, and environmental control devices are monitored by Internap and inspected by a third party.

#	Control Activity	Tests of Operating Effectiveness	Results of Tests
3.9	Multiple diesel generators are in place to provide backup power in the event of a power outage.	**Observation** Observed generators to determine whether multiple diesel generators are in place to provide backup power in the event of a power outage.	No relevant exceptions noted.
3.10	Generators are inspected and serviced semi-annually by third party vendors to ensure effective operation.	**Inspection** Inspected a sample of third-party vendor preventative maintenance and inspection reports to determine whether generators are inspected and serviced semi-annually by third party vendors.	No relevant exceptions noted.

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Facility and Environmental Protection

Control Objective 3
Controls provide reasonable assurance that facilities that house customer equipment have environmental controls in place, and environmental control devices are monitored by Internap and inspected by a third party.

#	Control Activity	Tests of Operating Effectiveness	Results of Tests
3.11	Data center environmental conditions are monitored and reported via the Alerton Envision for the BACtalk system. Data center technicians and Internap's centralized Network Operations Center (NOC) personnel monitor the BACtalk console which reports the real-time status of power, HVAC, temperature, and fire detection/suppression conditions.	**Inquiry** Inquired of data center management to determine whether data center environmental conditions are monitored and reported via the Alerton Envision for the BACtalk system and whether data center technicians and Internap's centralized Network Operations Center (NOC) personnel monitor BACtalk console which reports the real-time status of power, HVAC, temperature, and fire detection/suppression conditions. **Observation** Observed the local control room at the BSN003 data center and Internap's centralized Network Operations Center (NOC) to determine whether power, HVAC, temperature, and fire detection/suppression conditions are monitored and reported via the Alerton Envision for the BACtalk system. Observed data center technicians and Internap's centralized Network Operations Center (NOC) personnel monitor BACtalk console which reports the real-time status of power, HVAC, temperature, and fire detection/suppression conditions.	No relevant exceptions noted.

A.3 SAS-70 Audit Report (Atlanta, GA)

INTERNAP®

Report on the Controls Placed in Operation as of March 31, 2011
and Tests of Operating Effectiveness for the Period
October 1, 2010 through March 31, 2011
for the Internap ACS Data Center

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REPORT OF INDEPENDENT AUDITORS

To the Board of Directors of Internap Network Services:

We have examined the accompanying description of relevant general computer controls of control environment, physical security and environmental controls for the ACS data center, located on the bridge level of the American Cancer Society Center building at 250 Williams Street, Atlanta, Georgia, of Internap Network Services ("Internap" or "the Company"). Our examination included procedures to obtain reasonable assurance about whether (1) the accompanying description presents fairly, in all material respects, the aspects of Internap's controls that may be relevant to a user organization's internal control as it relates to an audit of financial statements; (2) the controls included in the description were suitably designed to achieve the control objectives specified in the description, if those controls were complied with satisfactorily and user organizations applied the controls contemplated in the design of Internap's controls; and (3) such controls had been placed in operation as of March 31, 2011. The control objectives were specified by the management of Internap. Our examination was performed in accordance with standards established by the American Institute of Certified Public Accountants and included those procedures we considered necessary in the circumstances to obtain a reasonable basis for rendering our opinion.

In our opinion, the accompanying description of the aforementioned controls presents fairly, in all material respects, the relevant aspects of Internap's controls that had been placed in operation as of March 31, 2011. Also, in our opinion, the controls, as described, are suitably designed to provide reasonable assurance that the specified control objectives would be achieved if the described controls were complied with satisfactorily, and user organizations applied the controls contemplated in the design of Internap's controls.

In addition to the procedures we considered necessary to render our opinion as expressed in the previous paragraph, we applied tests to specific controls to obtain evidence about their effectiveness in meeting the control objectives, during the period from October 1, 2010 to March 31, 2011. The specific control objectives and controls, and the nature, timing, extent, and results of the tests are listed in Section III. This information has been provided to user organizations of Internap and to their auditors to be taken into consideration, along with information about the internal control of user organizations, when making assessments of control risk for user organizations. In our opinion, the controls that were tested were operating with sufficient effectiveness to provide reasonable, but not absolute, assurance that the specified control objectives were achieved during the period from October 1, 2010 to March 31, 2011.

The relative effectiveness and significance of specific controls at Internap and their effect on assessments of control risk at user organizations are dependent on their interaction with the controls, and other factors present at individual user organizations. We have performed no procedures to evaluate the effectiveness of controls at individual user organizations.

The description of controls at Internap is as of March 31, 2011 and the information about tests of the operating effectiveness of specific controls covers the period from October 1, 2010 to March 31, 2011. Any projection of such information to the future is subject to the risk that, because of change, the description may no longer portray the controls in existence. The potential effectiveness of specific controls at Internap is subject to inherent limitations and accordingly, errors or fraud may occur and not be detected. Furthermore, the projection of any conclusions, based on our findings, to future periods is subject to the risk that changes made to the system or controls or the failure to make needed changes to the system or controls, may alter the validity of such conclusions.

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This report is intended solely for use by the management of Internap, its users and the independent auditors of its users.

PricewaterhouseCoopers LLP

Atlanta, GA
April 25, 2011

Internap Network Services ACS Data Center
Description of Operations and Controls Provided by Internap

SECTION II: DESCRIPTION OF OPERATIONS AND CONTROLS PROVIDED BY INTERNAP

The scope of the report is limited to the Internap information technology general computer controls only. The specific business process functionality for the applications hosted on the Internap information technology control environment and ACS data center business process services provided are not included in the scope of this report. Thus, the accompanying description includes only those controls and related control objectives of Internap's information technology general computer controls. Refer to Section III for a description of the information technology general computer controls and control processes in scope for this report. This document was prepared according to the guidance contained in the American Institute of Certified Public Accountants ("AICPA") Statement on Auditing Standards No. 70, entitled Service Organizations, as amended.

A. Description of Operations

Company Background
Internap Network Services Corporation (NASDAQ: INAP) is an Internet solutions and data center company providing a suite of network optimization and delivery services and products that manage, deliver and distribute applications and content with a 100% availability service level agreement, as well as a global provider of secure and reliable data center services. Internap helps its customers innovate their business, improve service levels and lower the cost of information technology operations. Internap's services and products, combined with progressive and proactive technical support, enable their customers to migrate business-critical applications from private to public networks.

Internap operates in two business segments: IP services and data center services. The scope of this report is limited to Internap's data center, or colocation, services, which primarily include physical space for hosting customers' network and other equipment plus associated services such as redundant power and network connectivity, environmental controls and security.

Internap's data center services allow them to expand the reach of their high performance IP services to customers who wish to take advantage of locating their network and application assets in secure, high-performance facilities. Internap operates data centers where customers can host their applications directly on Internap's network to eliminate issues associated with the quality of local connections. Data center services also enable Internap to have a more flexible product offering, such as bundling its high performance IP connectivity and content delivery, along with hosting customers' applications. Internap's data center services provide a single source for network infrastructure, IP connectivity and security, all of which are designed to maximize solution performance while providing a more stable, dependable infrastructure, and are backed by guaranteed service levels and its team of dedicated support professionals.

Internap believes that its unique managed multi-network approach provides better performance, control and reliability compared to conventional Internet connectivity alternatives. Internap's service level agreements, or SLAs, guarantee performance across multiple networks and a broader segment of the Internet in the United States, excluding local connections, than providers of conventional Internet connectivity which typically only guarantee performance on their own network.

Internap uses a combination of facilities that are operated by Internap and by third parties, referred to as company-controlled facilities and partner sites, respectively. Internap offers a comprehensive solution, consisting of ten facilities for which SAS 70 examinations are performed and 28 partner sites. They charge monthly fees for data center services based on the amount of square footage and power that the customers use. This report is related to one of Internap's ten data center facilities for which a SAS 70 examination is performed.

Internap currently has approximately 2,700 customers across more than 28 metropolitan markets, serving a variety of industries, including entertainment and media, financial services, healthcare, travel, e-commerce, retail and technology.

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Internap Network Services ACS Data Center
Description of Operations and Controls Provided by Internap

Customer Service and Support
The Senior Vice President of Operations and Customer Support is responsible for customer service at Internap. This individual is available for customers who wish to escalate pending technical issues or discuss overall operational concerns. Internap provides first level customer support through their on-site Technical Engineers. Technical Engineers are on-site and trained in various specialties and Internap data center operations. These individuals are on-site 24/7/365 and available to discuss customer issues specifically related to Internap data center operations.

New customers and new services are installed in Internap data centers according to agreed-upon specifications. Subsequent to consummation of an agreement, Internap provides ongoing operations and maintenance of critical infrastructure and physical security to the site. Internap's interactions with customers are treated as confidential and protected by non-disclosure agreements, and customer data is treated as confidential.

Internap's Sales organization and Customer Support work with the customer to build a quote acceptable to both Internap and the customer, including performance of appropriate legal reviews, service-level agreements, and specifically defined responsibilities of each party. Once the agreement has been signed, it becomes a legally binding contract and the customer then works with Internap's installation team for installation at the data center.

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Internap Network Services ACS Data Center
Description of Operations and Controls Provided by Internap

B. Control Objective 1: Control Environment
Controls provide reasonable assurance that hiring practices, code of conduct, and performance and training programs are in place.

Integrity and Ethical Values
Adherence to standards of integrity and ethics are an integral part of Internap's day-to-day operations. Internap's Code of Conduct (hereafter, the Code) details the Company's commitment to the highest standards of ethical behavior and employee integrity. The Code formally communicates these standards to Internap's directors, management and employees.

The Code includes specific standards that govern relationships between those it governs (e.g. directors, officers, and employees) and customers, suppliers, shareowners, and others. Employees are required to review and acknowledge the Code upon hire and annually thereafter.

As a condition of the hiring process, Internap performs background checks on all employees. Likewise, computer use forms must be completed by each employee prior to receipt of a computer(s) and gaining access to company information, which includes the Company portal.

Commitment to Competence
Internap's commitment to competence includes management's determination of the levels of competence and expertise required for each position. Internap HR personnel prepare detailed job descriptions and organizational charts that capture and convey these requirements for each position. Internap also facilitates employee development through annual evaluations, on-site training, a company-wide tuition reimbursement program, and the allocation of funds for relevant off-site training.

Board of Directors Participation
Internap's board of directors is responsible for the oversight of company management, which includes oversight of the design and operation of company controls.

Management's Philosophy and Operating Style
Internap's management philosophy and operating style encompass a broad range of characteristics. Such characteristics include management's approach to taking and monitoring business risks and management's attitudes toward information processing, accounting functions and personnel. Periodic meetings are conducted to discuss operational issues.

Organizational Structure and Assignment of Authority and Responsibility
Internap has developed an organizational structure that adequately suits the nature and scope of its operations. The Company has developed organizational charts that internally convey employee reporting relationships, operational responsibilities, and the overall organizational hierarchy.

Human Resource Policies and Practices
Internap's human resource department has policies and established practices that govern the hiring, termination, evaluation, promotion, counseling, and compensation of current and prospective company employees. A documented set of human resource, operational, and financial policies and procedures, along with a list of internal controls, are made available to applicable employees via the intranet. New hire policies include the requirement that background checks be performed on all new employees prior to commencing employment with Internap. Similarly, these same employees are required to read and acknowledge the Code before joining Internap, as well as annually thereafter during the performance review process. For terminated employees, Internap has a formal process for decommissioning access to company records and systems in a timely manner.

Risk Assessment
Internap utilizes various protocols to manage risks that could impact the Company's ability to deliver service to customers. Management also assesses risks that inherently arise from the expansion of the business, whether organically or inorganically. This may include managing risks that are rooted in changes in personnel, technology, or the Company's operating environment.

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Internap Network Services ACS Data Center
Description of Operations and Controls Provided by Internap

Information and Communication Systems
Internap's management team is responsible for the detailed design and effective operation of the Company's internal controls. As part of this process, management communicates responsibilities and expectations to company personnel through both formal and informal means. Internal controls are evaluated by Internal Audit throughout the year as part of its annual Sarbanes-Oxley assessment procedures and other internal audit reviews. Testing results and exceptions identified during the audits are reported to management on a consistent basis. Management ensures that internal control deficiencies are addressed and communicates expected timelines for doing so. Internap does not record, process, summarize, or report the financial transactions of their user organizations.

Monitoring
Internap's management team, including support from its Internal Audit department, continuously monitors the effectiveness of the Company's system of internal control through the performance of periodic and annual audits of internal controls over financial reporting or specific testing procedures. Any deficiencies in the Company's system of internal control are reported to management, assessed, and addressed. Management's consistent oversight of internal controls helps the Company identify deficiencies in the system, ensuring the adequacy of the process.

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Internap Network Services ACS Data Center
Description of Operations and Controls Provided by Internap

C. Control Objective 2: Physical Security
Controls provide reasonable assurance that physical access to Internap facilities, computer equipment, media, and documentation is restricted to properly authorized individuals.

Security Staff
An outsourced security company employs and provides Internap's data center security resources. Such outsourcing ensures consistency of training, performance, metrics, and supervision. Responsibilities of security include, but are not limited to:

- Monitoring of Physical Security Systems (Internap is responsible for implementation)
- Monitoring of Physical Security Standards (Internap is responsible for implementation)
- Loss Prevention
- Internal Investigations (under the supervision of Internap)
- Security Policies and Procedures Compliance

Security Control Desk
All Internap data centers have a Security Control Desk to control access, monitor security alarms, monitor Closed-Circuit Television camera signals (CCTV), and support security-related operational activities 24/7/365. Security personnel are on-site 17/7/365; the remainder of the time, the security control desk is monitored by an on-site technician.

The Security Control Desk possesses the following:

- Central ventilation, heating & air conditioning
- Real-time monitoring of data center door alarms
- Real-time monitoring of data center CCTV cameras
- Centralized security service and emergency dispatch communications for Security Staff, as well as for local fire departments, police departments, and other emergency response resources
- Electrical power support for continuous operation of communications, lighting, CCTV, intrusion detection, and alarm monitoring equipment in the event of utility power loss

Access Control
Internap employs a computerized access control system (ACS) to control physical access to its data centers that house customer equipment, media and documentation. The ACS utilizes proximity card readers and pin codes to control access into perimeter doors, shipping & receiving areas, storerooms, and other critical areas. Customers and employees must follow formal access request and approval processes before physical access to data centers is granted. Additional access control features are as follows:

- Access to the data center and other restricted areas is specifically limited to Internap authorized individuals
- Internap access badges and pin codes are required to gain entry
- Customers, Vendors, Contractors and other Visitors must be sponsored by an Internap-approved host to gain access, if not on the Customer-Approved List
- All Customers, Vendors, Contractors, and Visitors on the Customer-Approved List must check in with the Security Desk upon arrival with a government-issued photo identification
- All Customers, Vendors, Contractors, and Visitors are required to read and acknowledge, via their signature, "Datacenter Rules and Regulations" document, which is issued by Security upon their initial arrival to the site
- Visitors and others not on the Customer-Approved List are escorted while in the data center and other critical areas
- Access for approved Contractors is limited to particular areas where work is being performed
- Employees with access to the data center are limited to those with a specific business need or job function

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Internap Network Services ACS Data Center
Description of Operations and Controls Provided by Internap

An automated security entrance system is utilized to control access in the data center. The systems employ the following key features:

- Monitored/Recorded by CCTV 24/7/365 by Security Control Desk
- 24/7 Intrusion/tampering alarm monitoring by Security Control Desk
- Integrated Card Access Control Systems limit access to authorized individuals

Access to add, modify and delete users in the ACS is restricted to appropriate personnel based on job roles and responsibilities and reviewed during the employee access review.

The alarm control system is also used to monitor, notify, and log security alarms. The system monitors:

- Perimeter/external doors
- Restricted area doors
- Data center doors
- Shipping/receiving doors

The alarm monitoring and reporting system is equipped and programmed to receive alarms for forced doors, propped doors, and denied card read attempts.

Visitor/Sales Tour Access
All Internap data center tours must be coordinated with an Internap representative. Tours of the data center and other restricted areas require an escort from an authorized Internap employee.

Customer Access
Each customer is permitted to designate individuals with access to data centers at Internap via the Network Operations Center (NOC). The customers make requests for access through the NOC via email, phone call, or the Customer Portal. The NOC manages customers' respective customer contacts list within the CST (Colo Space Tracker) application. Update access to CST customer contact lists is reviewed for appropriateness based on job responsibilities on an annual basis. Once a customer's keycard access information is updated, CST sends an automated email describing the change request to security, who will then carry out the request. The customer is responsible for requesting additions, modification, or deletions to access; the NOC is responsible for management of the Customer Access List. Upon notification of a customer employee termination or revocation of customer agreement, physical access to the data center is revoked.

Customer equipment is segregated via locked cages or locked cabinets to ensure that customers can only access their own equipment.

All entrants to Internap data centers are required to show a form of government-issued identification.

Customers must sign in at the security desk.

Customer and Employee Access Review
Internap data center (colocation) security personnel perform a quarterly audit to validate the appropriateness of all customers' physical access to the data centers, and a monthly audit to validate the appropriateness of all employees' physical access to the data centers. On a semi-annual basis, individuals with access to add, modify, and delete users in the key card system are reviewed for appropriateness.

Data Center Check-In Process

1. Identify—upon request for access, the on-duty security officer (or technician, if between the hours of 12AM-7AM) will ascertain the type of requestor (Customer, Visitor, Contractor, Internap employee without continuous access).
2. Verify— the security officer will reference the customer contacts list to ensure that the individual(s) requesting access is (are) authorized. If the individual(s) is (are) not on the listing, a ticket should be initiated by the Network Operations Center (NOC) requesting access to the data center. Authorization must be documented within the ticket before access is granted.

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Internap Network Services ACS Data Center
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3. Review—Security requires that each individual entering the data center (outside of authorized Internap employees and customers with continuous access) present a valid government-issued ID prior to gaining access.
4. Access—once the information is verified by security, an access card for the authorized areas will be programmed by security.

Employee Access to Data Center
Access to the data center is restricted to only those Internap employees with a legitimate business need. Access, if temporarily required for other employees whose job functions do not necessitate access to the data center on a day-to-day basis, is granted on a case-by-case basis by the data center manager, and these employees must be escorted by data center personnel. Upon notification of employee termination, physical access to the data center is revoked.

General Visitor Rules
1. All visitors must be escorted at all times by an authorized host or employee.
2. Internap data center regulations must be strictly followed at all times. Any individual (including Internap employees) not adhering to these rules are escorted from the data center by staff and/or security.

Surveillance and Monitoring
1. Internap data centers employ a CCTV (Closed Circuit Television) to record and facilitate monitoring of the data center. Cameras are positioned to provide views of critical areas, including perimeter doors, main entrances and exits, shipping & receiving, and other areas of importance.
2. Internap security desk personnel monitor the signals from the CCTV system. The desk is connected by secure cables to the cameras throughout the facility to permit both interior and exterior surveillance.
3. Cameras are recorded on site via digital video recorders 24/7/365. These visual records are retained for 30 days to provide details of activity at Internap data centers.
4. Internap provides dedicated 24/7/365 CPS (continuous power supply) and standby emergency power via generator to support security systems.

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Internap Network Services ACS Data Center
Description of Operations and Controls Provided by Internap

D. Control Objective 3: Facility and Environmental Protection
Controls provide reasonable assurance that facilities that house customer equipment have environmental controls in place, and environmental control devices are monitored by Internap and inspected by a third party.

Overview
The existing facility and environmental standards at the data center are designed to ensure that uptime is maximized by providing redundancy to key facility and environmental systems. These systems are designed to provide adequate redundancy to ensure that mechanical or electrical failures will not result in an outage. A minimum of N+1 redundancy is provided for all critical facility systems that provide cooling and power to the data center.

Monitoring Environmental Conditions
Data center environmental conditions are monitored and reported via the Alerton Envision for BACtalk system. Data center technicians and Internap's centralized Network Operations Center (NOC) personnel monitor a BACtalk console which reports the real-time status of power, HVAC, temperature, and fire detection/suppression conditions. If any issues or incidents with these environmental systems arise, the console displays an alert and e-mails on-site data center personnel.

Smoke/Fire Detection
The fire detection system includes a zoned very early smoke detection system (VESDA), a sampling system that detects smoke during the very early stages of combustion. The VESDA warning system is the first line of defense against fire in the facility, monitoring return air and ceiling space for smoke at the micron level. When smoke is detected by the VESDA system, an alarm is generated in the facility control room and the BACtalk system generates console and e-mail alerts.

The VESDA smoke detection system is inspected and serviced at least annually to ensure effective operation.

Fire Suppression
The fire suppression system consists of a pre-action dry pipe system. The pre-action dry pipe system is designed to keep water out of the sprinkler system plumbing in the data center areas during normal operations. If smoke and/or excessive heat is detected, and a sprinkler fusible head melts as a result, water is pumped into the sprinkler systems for the affected zone(s) only. The Alerton BACtalk system continuously monitors and reports the status of the fire suppression system.

The fire suppression systems are inspected and serviced at least annually to ensure effective operation. Clean agent fire extinguishers are also provided throughout the data center for accessibility in the event of a fire within the data center (or elsewhere in the building).

Fire extinguishers are inspected and serviced at least annually to ensure effective operation.

Heating, Ventilation, and Air Conditioning (HVAC)
Multiple HVAC units control both temperature and humidity within the data center, delivering 420 tons of redundant HVAC service. Temperature is maintained between 64 and 78 degrees, with humidity maintained between 30 and 70 percent. The HVAC units are monitored by the Alerton Envision for BACtalk system within the facility control room.

HVAC units are inspected and serviced quarterly to ensure effective operation.

Utility Power and Backup Power Systems
The data center is supplied by a 3,000 KVA power feed from the servicing utility to support daily operations. The power feed is channeled into redundant UPS systems which condition the power to be supplied to data center equipment. These redundant UPS units, with a capacity of 600 KW, provide customers redundant N+1 power feeds to their equipment.

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Internap Network Services ACS Data Center
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In the event of a utility power outage, the UPS systems automatically switch to backup power from a battery farm which supplies power for up to 20 minutes until two 1.5 MW generators power up. Internap maintains between 12,000-18,000 gallons of on-site fuel which gives the generators capability to power the data center for a period between 52-174 hours. Internap maintains contracts with fuel companies for the delivery of fuel as needed.

The UPS systems are inspected and serviced at least annually to ensure effective operation. The generators are inspected and serviced quarterly to ensure effective operation.

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Internap Network Services ACS Data Center
Description of Operations and Controls Provided by Internap

E. User Control Considerations

Internap's services are designed with the assumption that certain controls will be implemented by user organizations. In certain situations, the application of specified internal controls at user organizations is necessary to achieve certain control objectives included in this report. The list of user control considerations presented below is not a comprehensive list of all controls that should be employed by user organizations.

The following is a representative list of controls that are expected to be in operation at user organizations to complement the controls of Internap.

- User organizations are responsible for understanding and complying with their contractual obligations.
- User organizations are responsible for ensuring the supervision, management, and control of the use of Internap's services by their personnel.
- User organizations are responsible for designating authorized individuals for access requests to Internap's data center.
- User organizations are responsible for notifying Internap of terminated employees.
- User organizations are responsible for periodically reviewing their Customer Access Lists.
- User organizations are responsible for immediately notifying Internap of any actual or suspected information security breaches, including compromised user accounts.
- User organizations are responsible for notifying Internap of changes made to technical or administrative contact information.

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Internap Network Services ACS Data Center
Internap's Control Objectives and Control Activities and PricewaterhouseCoopers LLP's Tests of Operating Effectiveness

SECTION III: INTERNAP'S CONTROL OBJECTIVES AND CONTROL ACTIVITIES AND PRICEWATERHOUSECOOPERS LLP'S TESTS OF OPERATING EFFECTIVENESS

PricewaterhouseCoopers LLP ("PricewaterhouseCoopers") tested relevant aspects of Internap's control environment and the controls specified below. PricewaterhouseCoopers' tests covered only those controls provided by Internap and did not cover controls which may be specific to individual clients of Internap.

Tests of the controls included inquiry of appropriate management, supervisory and staff personnel, observation of Internap's activities and inspection of Internap's documents and records. The results of these tests were considered in planning the nature, timing and extent of testing of the controls designed to achieve the control objectives described on the following pages.

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Internap Network Services ACS Data Center
Internap's Control Objectives and Control Activities and PricewaterhouseCoopers LLP's Tests of Operating Effectiveness

Control Environment

Control Objective 1
Controls provide reasonable assurance that hiring practices, code of conduct, and performance and training programs are in place.

#	Control Activity	Tests of Operating Effectiveness	Results of Tests
1.1	The Company has a written Code of Conduct that is available to all employees. The Code details the company's expectations regarding behavior, ethics, and business practices by which every employee must abide. New employees must acknowledge the Code of Conduct upon employment with Internap.	**Inspection** Inspected the Code of Conduct to determine whether the Code details the Company's expectations regarding behavior, ethics, and business practices. Inspected the acknowledgement of the Code of Conduct for a sample of employees hired during the examination period to determine whether employees acknowledged the Code of Conduct.	No relevant exceptions noted.
1.2	The Company maintains a documented set of human resource, operational, and financial policies and procedures, and internal controls which are made available to applicable employees.	**Inspection** Inspected the Company's policies, procedures, and controls documentation posted to the Company intranet to determine whether the Company maintains a documented set of human resource, operational, and financial policies and procedures, and internal controls which are made available to applicable employees.	No relevant exceptions noted.
1.3	Human Resources policies and procedures are maintained in the employee handbook, available to all employees via the intranet, and acknowledged by employees upon hire.	**Inspection** Inspected the employee handbook and Company's intranet site to determine whether Human Resources policies and procedures are maintained in the employee handbook and available to all employees via the intranet. Inspected the acknowledgements of the Human Resources policies and procedures for a sample of employees hired during the examination period.	No relevant exceptions noted.

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Internap Network Services ACS Data Center
Internap's Control Objectives and Control Activities and PricewaterhouseCoopers LLP's Tests of Operating Effectiveness

Control Environment

Control Objective 1
Controls provide reasonable assurance that hiring practices, code of conduct, and performance and training programs are in place.

#	Control Activity	Tests of Operating Effectiveness	Results of Tests
1.4	An employment pre-screening process is in place. It includes background, credit, and DMV checks (based on job requirements).	**Inspection** Inspected pre-screen results in the employee files for a sample of employees hired during the examination period to determine whether an employment pre-screening process is in place and includes background, credit and DMV checks where applicable based on job requirements.	No relevant exceptions noted.
1.5	An annual performance review process is in place. It gives managers and employees an opportunity to discuss performance, ethics, integrity and training needs. The review process also includes setting goals and objectives for the following year.	**Inspection** Inspected Annual Review document and acknowledgement in the HR system from the annual review process for a sample of employees to determine whether an annual review process is in place and operating.	No relevant exceptions noted.
1.6	The Company allows operating units to budget training for each employee to continue his education either virtually or locally, including maintenance of certifications. The Company also has a formal tuition reimbursement program.	**Inspection** Inspected the Employee Handbook and annual budget to determine whether the Company allows operating units to budget training for each employee to continue his education either virtually or locally, including maintenance of certifications and whether the Company also has a formal tuition reimbursement program.	No relevant exceptions noted.

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Internap Network Services ACS Data Center
Internap's Control Objectives and Control Activities and PricewaterhouseCoopers LLP's Tests of Operating Effectiveness

Control Environment

Control Objective 1
Controls provide reasonable assurance that hiring practices, code of conduct, and performance and training programs are in place.

#	Control Activity	Tests of Operating Effectiveness	Results of Tests
1.7	Organizational charts that detail the Company's employee direct reporting structure are maintained and updated.	**Inspection** Inspected the organizational charts for a sample of months to determine whether organizational charts that detail the Company's employee direct reporting structure are maintained and updated.	No relevant exceptions noted.

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Internap Network Services ACS Data Center
Internap's Control Objectives and Control Activities and PricewaterhouseCoopers LLP's Tests of Operating Effectiveness

Physical Security

Control Objective 2
Controls provide reasonable assurance that physical access to Internap facilities, computer equipment, media, and documentation is restricted to properly authorized individuals.

#	Control Activity	Tests of Operating Effectiveness	Results of Tests
2.1	Only authorized Internap employees and customers are granted physical access to the data center.	**Inspection** Inspected authorization evidence for a sample of employees and customers who were granted physical access to the data center during the examination period, to determine whether only authorized Internap employees and customers are granted physical access to the data center.	No relevant exceptions noted.
2.2	Physical access to the data center is revoked upon termination of Internap employees and upon revocation of customer agreements.	**Inspection** Inspected the active keycard listing for a sample of terminated employees, physical access revocation requests from the customers, and revoked customer agreements to determine whether physical access to the data center is revoked upon termination of Internap employees, requests from Internap's customers and revocation of customer agreements.	No relevant exceptions noted.
2.3	Customer equipment is segregated via locked cages or locked cabinets to ensure that customers can only access their own equipment.	**Inquiry** Inquired of data center management to determine whether customer equipment is segregated via locked cages or locked cabinets to ensure that customers can only access their own equipment. **Observation** Observed locked cages and locked cabinets to determine whether customer equipment is segregated via locked cages or locked cabinets such that customers can only access their own equipment.	No relevant exceptions noted.

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Internap Network Services ACS Data Center
Internap's Control Objectives and Control Activities and PricewaterhouseCoopers LLP's Tests of Operating Effectiveness

Physical Security

Control Objective 2
Controls provide reasonable assurance that physical access to Internap facilities, computer equipment, media, and documentation is restricted to properly authorized individuals.

#	Control Activity	Tests of Operating Effectiveness	Results of Tests
2.4	In order to gain physical access to Internap data centers, employees and customers must be validated via a combination of key card technology and pin codes.	**Inquiry** Inquired of management to determine whether employees and customers must be validated via a combination of key card technology and pin codes to gain physical access to the data center. **Observation** Observed successful and unsuccessful attempts to gain entry to the data center to determine whether employees and customers must be validated via a combination of key card technology and pin codes.	No relevant exceptions noted.
2.5	Internap employs 24 hour video surveillance to monitor all entrances, exits, and other sensitive areas of its data centers.	**Inquiry** Inquired of data center management to determine whether Internap employs 24 hour video surveillance to monitor all entrances, exits, and other sensitive areas of its data centers. **Observation** Observed security personnel monitoring the video surveillance at entrances, exits, and other sensitive areas of data center and observed video recording parameters to determine whether Internap employs 24 hour video surveillance to monitor entrances, exits, and other sensitive areas of its data centers.	No relevant exceptions noted.

Internap Network Services ACS Data Center
Internap's Control Objectives and Control Activities and PricewaterhouseCoopers LLP's Tests of Operating Effectiveness

Physical Security

Control Objective 2
Controls provide reasonable assurance that physical access to Internap facilities, computer equipment, media, and documentation is restricted to properly authorized individuals.

#	Control Activity	Tests of Operating Effectiveness	Results of Tests
2.6	A manned security post controls entry into Internap data centers.	**Inquiry** Inquired of data center management to determine whether a manned security post controls entry into Internap data centers. **Observation** Observed the manned security post to determine whether a manned security post controls entry into Internap data centers.	No relevant exceptions noted.
2.7	Customer access to Internap data centers is logged at the security desk.	**Inspection** Inspected security logs for a sample of days to determine whether customer access to Internap data centers is logged at the security desk.	No relevant exceptions noted.
2.8	Internap collocation security personnel perform a quarterly audit to validate the appropriateness of all customers' physical access to the data centers, and a monthly audit to validate the appropriateness of all employees' physical access to the data centers. On a semi-annual basis, individuals with access to add, modify, and delete users in the key card access system are reviewed for appropriateness.	**Inspection** Inspected a sample of quarterly customer audits and monthly employee audits to determine whether Internap collocation security personnel perform a quarterly audit to validate the appropriateness of customers' physical access to the data centers and a monthly audit to validate the appropriateness of employees' physical access to the data centers. Inspected the semi-annual audit to determine whether Internap collocation security personnel perform a semi-annual audit to validate the appropriateness of individuals with access to add, modify, and delete users in the key card access system.	No relevant exceptions noted.

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Physical Security

Control Objective 2
Controls provide reasonable assurance that physical access to Internap facilities, computer equipment, media, and documentation is restricted to properly authorized individuals.

#	Control Activity	Tests of Operating Effectiveness	Results of Tests
2.9	Update access to CST customer contact lists is reviewed for appropriateness based on job responsibilities on an annual basis.	**Inquiry** Inquired of management to determine whether update access to CST customer contact lists is reviewed for appropriateness based on job responsibilities on an annual basis.	Not applicable. This control has not operated during the examination period due to its planned frequency.

Internap Network Services ACS Data Center
Internap's Control Objectives and Control Activities and PricewaterhouseCoopers LLP's Tests of Operating Effectiveness

Facility and Environmental Protection

Control Objective 3
Controls provide reasonable assurance that facilities that house customer equipment have environmental controls in place, and environmental control devices are monitored by Internap and inspected by a third party.

#	Control Activity	Tests of Operating Effectiveness	Results of Tests
3.1	A zoned very early smoke detection system (VESDA) is installed in the data center to detect and alert data center personnel to the presence of a fire at its very early stages.	**Observation** Observed VESDA smoke detection system in the data center to determine whether a smoke detection system is installed in the data center.	No relevant exceptions noted.
3.2	The VESDA smoke detection system is inspected and serviced at least annually to ensure effective operation.	**Inquiry** Inquired of data center management to determine whether the smoke detection system is inspected and serviced at least annually.	Not applicable. This control has not operated during the examination period due to its planned frequency.
3.3	The data center is protected from the risk of fire by a pre-action, dry pipe sprinkler fire suppression system as well as fire extinguishers located throughout the data center.	**Observation** Observed sprinkler system and fire extinguishers throughout the data center to determine whether the data center is protected from the risk of fire by a pre-action, dry pipe sprinkler fire suppression system as well as fire extinguishers.	No relevant exceptions noted.

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Internap Network Services ACS Data Center
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Facility and Environmental Protection

Control Objective 3
Controls provide reasonable assurance that facilities that house customer equipment have environmental controls in place, and environmental control devices are monitored by Internap and inspected by a third party.

#	Control Activity	Tests of Operating Effectiveness	Results of Tests
3.4	The pre-action, dry pipe sprinkler fire suppression system and fire extinguishers are inspected and serviced at least annually, to ensure effective operation.	**Inquiry** Inquired of data center management to determine whether the pre-action, dry pipe sprinkler fire suppression system and fire extinguishers are inspected and serviced at least annually, to ensure effective operation. **Inspection** Inspected a third-party vendor preventative maintenance and inspection report to determine whether the fire extinguishers are inspected and serviced at least annually.	Fire suppression system- Not applicable. This control has not operated during the examination period due to its planned frequency. Fire extinguishers- No exceptions noted.
3.5	Multiple HVAC units control both temperature and humidity within the data center, delivering redundant HVAC service throughout the data center.	**Observation** Observed multiple HVAC units to determine whether HVAC units are designed to control both temperature and humidity within the data center, delivering redundant HVAC service throughout the data center.	No relevant exceptions noted.
3.6	HVAC units are inspected and serviced quarterly to ensure effective operation.	**Inspection** Inspected a sample of third-party vendor preventative maintenance and inspection reports to determine whether HVAC units are inspected and serviced quarterly.	No relevant exceptions noted.

Internap Network Services ACS Data Center
Internap's Control Objectives and Control Activities and PricewaterhouseCoopers LLP's Tests of Operating Effectiveness

Facility and Environmental Protection

Control Objective 3
Controls provide reasonable assurance that facilities that house customer equipment have environmental controls in place, and environmental control devices are monitored by Internap and inspected by a third party.

#	Control Activity	Tests of Operating Effectiveness	Results of Tests
3.7	Redundant UPS systems are in place to provide temporary power in the event of a power failure and to mitigate the risk of power surges impacting infrastructure in the data center.	**Observation** Observed UPS systems to determine whether redundant UPS systems are in place to provide temporary power in the event of a power failure and to mitigate the risk of power surges impacting infrastructure in the data center.	No relevant exceptions noted.
3.8	UPS systems are inspected and serviced at least annually to ensure effective operation.	**Inspection** Inspected a third-party vendor preventative maintenance and inspection report to determine whether UPS systems are inspected and serviced at least annually to ensure effective operation.	No relevant exceptions noted.
3.9	Multiple diesel generators are in place to provide backup power in the event of a power outage.	**Observation** Observed generators to determine whether multiple diesel generators are in place to provide backup power in the event of a power outage.	No relevant exceptions noted.
3.10	Generators are inspected and serviced quarterly by third party vendors to ensure effective operation.	**Inspection** Inspected a sample of third-party vendor preventative maintenance and inspection reports to determine whether generators are inspected and serviced quarterly by third party vendors.	No relevant exceptions noted.

Internap Network Services ACS Data Center
Internap's Control Objectives and Control Activities and PricewaterhouseCoopers LLP's Tests of Operating Effectiveness

Facility and Environmental Protection

Control Objective 3
Controls provide reasonable assurance that facilities that house customer equipment have environmental controls in place, and environmental control devices are monitored by Internap and inspected by a third party.

#	Control Activity	Tests of Operating Effectiveness	Results of Tests
3.11	Data center environmental conditions are monitored and reported via the Alerton Envision for the BACtalk system. Data center technicians and Internap's centralized Network Operations Center (NOC) personnel monitor the BACtalk console which reports the real-time status of power, HVAC, temperature, and fire detection/suppression conditions.	**Inquiry** Inquired of data center management to determine whether data center environmental conditions are monitored and reported via the Alerton Envision for the BACtalk system and whether data center technicians and Internap's centralized Network Operations Center (NOC) personnel monitor BACtalk console which reports the real-time status of power, HVAC, temperature, and fire detection/suppression conditions. **Observation** Observed the local control room at the ACS data center and Internap's centralized Network Operations Center (NOC) to determine whether power, HVAC, temperature, and fire detection/suppression conditions are monitored and reported via the Alerton Envision for the BACtalk system. Observed data center technicians and Internap's centralized Network Operations Center (NOC) personnel monitor BACtalk console which reports the real-time status of power, HVAC, temperature, and fire detection/suppression conditions.	No relevant exceptions noted.

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APPENDIX B. RAYTHEON EMPLOYMENT POLICIES

B.1 Raytheon Alternative Dispute Resolution (ADR) Policy

Raytheon		**Document Number:**	000000049-RP
Company Policy		**Effective Date:**	October 15, 2008
Hard Copies Uncontrolled - Verify Effective Date Prior to Use		**Function:**	Human Resources
Title:	Raytheon Alternative Dispute Resolution (ADR)	**Authorized By:**	Senior Vice President – Human Resources

1. **Status**

1.1 Supersedes Raytheon policy 000000049-RP, Raytheon Alternative Dispute Resolution (ADR), dated January 11, 2006.

1.2 Policy revised as follows:

1.2.1 Various sections have been revised to coincide with the ADR policy change to make mediation voluntary and subject to mutual consent of the parties, and to make arbitration subject to mutual consent of the parties unless mediation is requested by an employee and declined by the Company.

1.2.2 Various sections have been revised to reflect the elimination of the Corporate ADR Director position.

1.2.3 The process sections of the policy have been removed and converted to a process workbook which is incorporated into this policy by reference.

2. **Purpose**

2.1 This policy establishes a uniform conflict management process for U.S.-based, self-represented employees, built on foundational elements of fair and timely complaint review, "due process" for all participants, and alignment with Raytheon's people values.

2.2 Benefits provided by the ADR process

2.2.1 The ADR process benefits both employees and Raytheon for a number of reasons:

2.2.2 Accessibility – ADR begins at the local level where most workplace disputes can be resolved, and does not require the employee to hire a lawyer to resolve his or her workplace dispute;

2.2.3 Timely Resolution of Disputes – ADR encourages quick and mutually agreeable resolution of issues / concerns;

2.2.4 Neutral Mediator – ADR provides for parties to reach a confidential, negotiated agreement using a neutral third-party mediator;

2.2.5 Neutral Arbitrator – ADR provides for parties to arbitrate employment disputes by a neutral arbitrator. If the parties proceed to arbitration, the arbitrator is selected from an independent service provider. After conducting a hearing, the arbitrator will render an award and decision which is binding on both parties;

2.2.6 Full Remedies – ADR provides that the arbitrator can award the same remedies as a court;

2.2.7 Economical – ADR should, in most cases, allow all parties concerned to avoid excessive legal fees and court costs;

2.2.8 Flexibility – ADR provides employees with an alternative process to litigation to resolve many controversies arising in the workplace. Employees may still pursue available legal redress if they wish, as long as they have not initiated the process to proceed to arbitration by submitting a Request For Arbitration Form.

3. **Applicability**

3.1 The Raytheon ADR process applies to all U.S.-based employees. Former Raytheon employees are eligible only to the extent they have "Eligible Claims" as defined in Section 6.2.1 of this policy.

3.2 Independent contractors, third-party contractors, contingent workers, leased workers, and employees working under the terms of a collective bargaining agreement are not covered by, and are not eligible to participate in, the Raytheon ADR Process, as a party or representative.

3.3 Claims eligible under ADR are defined in Section 6.2.1 of this policy.

4. **Policy**

4.1 Employees are encouraged to continue to resolve workplace disputes using Raytheon's existing open door practices. Raytheon has, however, created additional steps as part of the ADR process:

4.1.1 The opportunity to file a formal complaint;

4.1.2 Mediation with an outside neutral mediator if mutually agreed to by the parties;

4.1.3 Arbitration with an outside neutral arbitrator if mutually agreed to by the parties, or by employee request if an employee's unilateral request for mediation had been declined by the Company.

4.2 In order to proceed to any given step of the ADR process, the employee must have already sought resolution at each prior step, except if an employee's unilateral request for mediation had been declined by the Company, in which case the Company must accept arbitration if requested.

4.3 In the event a dispute progresses to the Arbitration step, the arbitrator's award and decision shall be binding upon Raytheon and the employee or any other party.

4.4 In order to reach Mediation and / or Arbitration, a claim must meet the "Eligible Claim" criteria as defined in Section 6.2.1 of this policy. The decision to mediate is by mutual consent of the parties, as is arbitration unless mediation was unilaterally requested by an employee and declined by the Company.

5. **Responsibilities**

5.1 Employees

5.1.1 Informal Step – Clearly communicate the nature of his / her concern (to his / her immediate supervisor, department manager or human resources representative) and the resolution he / she seeks. Participate in the discussion and provide the necessary facts to help resolve the concern / issue.

5.1.2 Formal Step – Reduce the concern and the resolution to writing by means of a formal complaint filed with the designated ADR Point of Contact (POC). Cooperate with the investigation. Meet with higher levels of local management and a Human Resources representative to receive the management response and discuss opportunities to resolve the concern.

5.1.3 Mediation – Actively participate in the mediation process in an effort to mutually resolve their concern.

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5.1.4 Arbitration – Present their case with or without a lawyer to an arbitrator.

5.2 Human Resources

5.2.1 At all stages, exercise confidentiality by restricting case information to the following: individuals from whom it is necessary to gather relevant case facts, Raytheon management for case decisions, Corporate ADR Office, Business ADR Leads, Business ADR Points of Contacts (POC's), Human Resource representatives for case assistance and program evaluation, and Company and / or outside attorneys for case assistance or presentation.

5.2.2 Informal Step – Listens to employee concern / issue and acts as a facilitator between the employee and supervisor to attempt a mutual resolution of the issue prior to the formal steps of the ADR. May investigate or fact-find in order to resolve the employee concern. Provides the employee and management information concerning the ADR process.

5.2.3 Formal Step – Works with the Business ADR POC and case investigator as appropriate to ensure the facts of the investigation are documented and timely. Notifies the appropriate level of the employee's management that a formal complaint has been filed. May act as a facilitator between the employee and management to resolve the employee concern. Using the facts of the investigation may recommend a resolution to management. Responsible for involving the appropriate level of management before the matter is referred to mediation.

5.2.4 Mediation – Works closely with the Business ADR Lead and Business Legal on all aspects of the mediation step, including the decision to proceed to mediation, preparation and coordination.

5.2.5 Arbitration – Works closely with the Business ADR Lead and Business Legal on all aspects of the arbitration step, including the decision to proceed to arbitration, preparation and coordination.

5.3 Management

5.3.1 At all stages, exercises confidentiality by restricting case information to the following: parties necessary to gather relevant case facts, Raytheon management for case decisions, Corporate ADR Office, Business ADR Leads, Business ADR Points of Contacts (POC's), and Human Resource representatives for case assistance and program evaluation.

5.3.2 Informal Step – Meets with the employee to listen to his / her concern and, when necessary, conducts fact-finding. Notifies Human Resources for assistance when necessary and works to resolve the employee concern.

5.3.3 Formal Step – Business manager responder reviews formal investigation results with the Business ADR POC, meets with Human Resources or other members of management and helps craft a written management response. Business manager responder meets with the employee where practical and delivers the management response. This flexibility is intended for responding managers who are not located at the same physical location as the Complainant.

5.3.4 Mediation – Local management will participate as required by Human Resources or Legal.

5.3.5 Arbitration – Business management will participate as requested by Human Resources or Legal.

5.4 Senior Vice President - Human Resources or Designee

5.4.1 Provides a uniform Alternative Dispute Resolution process for U.S.-based, self-represented employees, built on foundational elements of fair and timely complaint review, "due process" for all participants, and alignment with Raytheon's people values.

5.4.2 Manages the provisions of this policy.

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5.4.3 Provides process oversight for the Corporation.

5.4.4 Remains current with ADR developments on the national and regional levels.

5.4.5 Promotes ADR skill development across the Corporation.

5.4.6 Evaluates ADR program effectiveness and recommends improvements as appropriate.

5.4.7 Collects enterprise ADR data for monthly reports to improve performance.

5.4.8 Promotes institutionalization of the ADR process.

5.5 Business Human Resources Vice President

5.5.1 Provides leadership support and resources to institutionalize the ADR process.

5.5.2 Supports the Business Leader's obligation to cultivate working environments that encourage employees to raise issues and concerns without fear of retaliation.

5.5.3 Regularly reviews the effectiveness of the program within their Business.

5.6 Business ADR Lead

5.6.1 Oversees the process for Business Human Resources Vice President and the Corporation.

5.6.2 Regularly reviews ADR case activity and ensures Business cases are administered within scope of published guidelines and goals.

5.6.3 Manages the Case Management System and provides technical coaching to Business ADR POC's.

5.6.4 Remains current with ADR developments.

5.6.5 Promotes development of dispute resolution skills within their Business.

5.6.6 Provides input relating to Business POC's effectiveness to relevant manager.

5.6.7 Participates in ADR Community of Practice.

5.6.8 Institutionalizes dispute resolution skills and the ADR process within the Business.

5.6.9 Provides case management review and tracks Business ADR data.

5.6.10 Coordinates the review of case documentation and Management Response for all Step III and Step IV claims with designated Legal Counsel.

5.6.11 Manages the mediation and arbitration processes.

5.6.12 Provides training on ADR and investigation techniques.

5.7 Designated ADR POC

5.7.1 Manages ADR cases for assigned area of responsibility.

5.7.2 Assesses initial complaint and initial interview with Complainant.

5.7.3 Manages Step II cycle time.

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5.7.4 Selects case investigator and provides initial case investigative guidance.

5.7.5 Communicates throughout Step II with Complainant.

5.7.6 Ensures thoroughness of fact-finding process and high quality investigative report writing.

5.7.7 Responsible for timely and accurate Case Management administration.

5.8 Investigator

5.8.1 Completes Raytheon course on Conducting Effective Internal Investigations.

5.8.2 Conducts and fully documents a complete, neutral, fact-based inquiry into all allegations by a Complainant using written Raytheon guidance on "Conducting Effective Internal Investigations."

5.8.3 Prepares a written Investigation Notebook for all Step II cases.

5.8.4 Coordinates the review of Step III and Step IV eligible investigations with designated ADR POC and designated Legal Counsel.

5.9 Legal Counsel

5.9.1 Reviews and provides guidance regarding all Step II, III and IV Eligible Investigation Notebooks.

5.9.2 Reviews and provides guidance regarding all Step II, III and IV Eligible Management Responses.

6. Procedure

6.1 The Raytheon ADR policy outlines a four-step program to resolve employee-related concerns / issues. The four steps are:

6.1.1 Step I: Open Door / Informal (all claims);

6.1.2 Step II: Formal Complaint and Management Response (all claims);

6.1.3 Step III: Mediation of "Eligible Claims" if mutually agreed to by the parties;

6.1.4 Step IV: Arbitration of "Eligible Claims" if mutually agreed to by the parties, or by employee request if an employee's unilateral request for mediation had been declined by the Company.

6.2 Eligibility

6.2.1 Claims Eligible for All Steps of ADR

a. Employees may submit any employment-related dispute at Step I and proceed to Step II. Employees may only submit "Eligible Claims" to Steps III and IV. "Eligible Claims" are employment-related claims against Raytheon and / or its individual managers or agents regarding any alleged violation of state or federal statutes or other matters that would be subject to resolution before an administrative agency or in court. For example:

(1) Employment discrimination and harassment claims, including discrimination in promotion and termination, based on age, race, sex, religion, national origin, veteran status, citizenship, sexual orientation, gender identity and expression, and disability;

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(2) Retaliation claims for legally protected activity such as reporting discrimination, harassment or whistle blowing;

(3) Tort claims arising out of employment, such as negligence, defamation, invasion of privacy, infliction of emotional distress, or wrongful discharge;

(4) Claims of violation of public policy;

(5) Any other legally recognized claim involving the employee's employment with Raytheon, which does not fall into any of the exclusionary categories in Section 6.2.3 of this policy.

6.2.2 Claims Eligible for Steps I and II only

a. Claims of violation of Raytheon's policies and / or procedures.

6.2.3 Claims Not Eligible for Raytheon ADR

a. The following claims are excluded from Raytheon ADR:

(1) Claims for compensation and / or benefits under Raytheon Programs for which an internal or external appeal process exists;

(2) Claims for workers' compensation, unemployment compensation benefits, or disabilities program (or disability programs) sponsored by the Company for which an internal or external appeals process exists;

(3) Claims involving issues regulated by the Federal National Labor Relations Act or the Occupational Safety and Health Act;

(4) Claims solely involving allegations of violation of Raytheon's ethics policies, but disciplinary action taken by management based on Ethics investigation and recommendation is subject to ADR review;

(5) Claims seeking only injunctive relief.

b. For further information, see the discussion of "Timely Filing" in Section 6.2.5 of this policy.

c. If there is a dispute as to whether or not a claim is an Eligible Claim, the employee may take this dispute to Arbitration. If the Arbitrator rules that the claim is an Eligible Claim, the employee resumes the ADR process at Step II.

6.2.4 Effective Date

a. The Raytheon ADR process is in effect as of April 7, 2003 (the "Effective Date").

6.2.5 Timely Filing

a. In order for an "Eligible Claim" to be timely and appropriate for processing through Steps III and IV of the ADR process, the claim must be raised at Step I within one hundred and eighty (180) days from the date the dispute arose or before the expiration of the applicable statute of limitations for filing the claim, whichever is longer. If an Eligible Claim is timely under applicable law when it is submitted to Step I, the applicable limitations period are tolled while the Eligible Claim is being processed pursuant to the terms of the ADR process. Raytheon reserves the right, and in its discretion, to disregard the untimeliness of

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an employee's Eligible Claim and thus allow the dispute to proceed through the ADR process.

6.2.6 Who is Covered

a. Except as otherwise noted below, the term "employee," as used in the Raytheon ADR process, includes all current full-time, part-time, salaried and seasonal employees (including paid interns), both management and non-management. Former employees of Raytheon who have claims eligible for Step III and IV, which arose prior to, or because of, their separation from Raytheon may also pursue such claims through the Raytheon ADR process as long as such claims arose on or after April 7, 2003. Independent contractors, third party contractors, contingent workers, leased workers, and employees working under the terms of a collective bargaining agreement are not covered by Raytheon ADR.

6.3 Administration

6.3.1 Administrative Charges

a. Nothing in this policy statement is intended to discourage or interfere with the legally protected rights of individuals to file administrative claims or charges with government agencies. Such agencies include, but are not limited to, the Equal Employment Opportunity Commission ("EEOC"), the Office of Federal Contract Compliance Programs ("OFCCP") and related state fair employment agencies. However, if an employee files a charge with such agency or agencies as, including without limitation, the EEOC, OFCCP or a state fair employment agency, Raytheon may request the agency to defer its processing of the charge until the employee and Raytheon have completed the Raytheon ADR process. Charges brought to an outside agency which are being processed for determination, or have been brought to a conclusion by the agency, are not subject to the Raytheon ADR process.

6.3.2 Reservation of Rights

a. Raytheon reserves the right to modify or terminate this ADR policy. Any Claims eligible for Steps III and IV that arose prior to the effective date of such modification or termination shall be governed by the Raytheon ADR process in effect at such time.

6.3.3 Retaliation Prohibited

a. All forms of retaliation against any employee because of the employee's participation in the ADR process either as a complainant, witness, or otherwise are prohibited.

6.3.4 Independent Service Providers

a. Mediators – The Company will furnish a list of available and qualified Mediators from an Independent Service Provider from which the parties will select a neutral Mediator to facilitate the mediation. The parties alternate in striking names from the list until a single mediator is remaining - this mediator will facilitate the mediation. A coin flip will determine which party decides the order of striking. For terminated employees, the complainant may elect which party strikes the first name.

b. Arbitrators – The Company will furnish a list of available and qualified Arbitrators from an Independent Service Provider from which the parties will select a neutral Arbitrator to facilitate the arbitration. The parties alternate in striking names from the list until a single arbitrator is remaining - this arbitrator will facilitate the arbitration. A coin flip will determine which party decides the order of striking. For terminated employees, the complainant may elect which party strikes the first name.

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6.3.5 Severability

a. If any provision of the Raytheon ADR process is determined by a court to be invalid or unenforceable, the validity, legality and enforceability of the remaining provisions are not affected by the determination, and each provision of the Raytheon ADR process is valid, legal and enforceable to the fullest extent permitted by law.

6.3.6 Federal Arbitration Act

a. The Raytheon ADR process incorporates an agreement to arbitrate pursuant to the Federal Arbitration Act, 9 U.S.C. Sections 1-14, or if that Act is held to be inapplicable for any reason, the arbitration law in the state in which the arbitration hearing is held in cases where the parties have mutually agreed to use arbitration to resolve the dispute.

6.4 Rules for Resolution of Employment Disputes

6.4.1 Applicability of Rules – These rules govern the conduct of Mediation under Step III of Raytheon ADR and Arbitration under Step IV. To the extent that these rules are silent on a particular issue, the rules applicable to the Mediation or Arbitration of employment disputes of the selected Service Provider, as such rules and procedures are then in effect, shall apply.

6.4.2 Making a Request – To make a request for Mediation or Arbitration under Raytheon ADR, an employee or Raytheon must submit the proper written request form to the designated ADR POC Refer to Section 7.1 of this policy for access information to the Request for Mediation and Request for Arbitration forms.

6.4.3 Time Period for Making Request – A Request for Mediation Form must be filed within thirty (30) days of the date of Raytheon's Formal Response pursuant to Step II. A Request for Arbitration Form must be submitted within thirty (30) days of the date on which either party gives written notice to the other that the dispute cannot be resolved through Mediation. If no mediation was held either party can request arbitration within 30 days of the decision not to mediate. If the employee or Raytheon does not submit the relevant form within the required period, he or she or Raytheon will forfeit any further right to make use of the Raytheon ADR process. Employees with questions about the applicable filing period or statutes of limitations may contact their attorneys or the Human Resources department.

6.4.4 Representation by Counsel – An Employee as well as Raytheon has the right to be represented by counsel at Mediation or Arbitration. Each is responsible for paying the fees and disbursements of their own counsel, provided that in the case of an Arbitration, the Arbitrator has the authority to award attorney's fees as provided by applicable law, including that related to the allocation of the burden of proof and remedies for violations of such law, if any, as well as all points of substantive law. He or she will have no authority either to abridge or to enlarge substantive rights available under existing law or to alter mutual agreements regarding legal fees entered into by the parties before the arbitration begins.

6.4.5 Mediator and Arbitrator – These are neutral and impartial service professionals. All Arbitrators are experienced in employment law. The Company will provide a roster of available and qualified Mediators / Arbitrators from which the parties will select a neutral to facilitate the mediation or decide the arbitration.

6.4.6 Expenses – There are various expenses associated with a Mediation or Arbitration, such as the Service Provider's fees and the Mediator's or Arbitrator's daily fees and travel expenses. In the case of Mediation, Raytheon bears all costs associated with the mediator, Service Provider, and meeting space. An employee who chooses to be represented by an attorney is solely responsible for his or her attorney's fee. In the case of Arbitration, the issue of attorney fees for employee representation will be part of the mutual agreement to proceed to arbitration. Such mutual agreement on attorney fees

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will be binding on the arbitrator. In the case of Arbitration initiated by an employee in respect of an Eligible Claim asserted by him or her, Raytheon bears all expenses due to the Service Provider, Arbitrator and for the meeting space. The employee is responsible for paying Raytheon a $125 arbitration filing fee for the proceeding. Such payment shall be in the form of a Cashier's Check, Money Order or Bank Check payable to Raytheon Company. Raytheon also reserves the right in its sole discretion to waive the filing fee, resulting in no cost to the employee. In the event that Raytheon initiates the process by asserting an Eligible Claim, it covers the initial filing fee as well.

6.4.7 Location of a Mediation or Arbitration – Any Mediation or Arbitration is held in the location where the complaint of action(s) took place. Unless otherwise mutually agreed, if a proceeding initiated by an employee in respect of an Eligible Claim takes place somewhere other than in the location of the unit where the employee presently works, Raytheon reimburses the reasonable expenses of the employee, as well as any witnesses produced by him or her in an Arbitration, incurred in connection with traveling to the site of the proceeding. In extreme circumstances, e.g. disputing employees in remote locations or sites with very small populations, management reserves the right to arrange alternative locations or methodologies to support mediation, e.g., audio, video, or electronic dispute resolution. However, utilization of such steps are intended to be infrequent exceptions.

6.4.8 Confidentiality – In the case of Arbitration, the Arbitrator has the authority to make appropriate rulings to protect confidentiality. Any Mediation or Arbitration is held in confidence by the parties, the Arbitrator, the Mediator, and the selected Service Provider.

6.4.9 Pre-Hearing Discovery – In the case of an Arbitration, both the employee and Raytheon are entitled to the following pre-hearing discovery:

a. Names of witnesses and titles of documents – On a hearing schedule set forth by the Arbitrator, both parties submit to the other the names and addresses of the witnesses they intend to call and the documents they intend to present;

b. Depositions and written discovery – The Arbitrator has the discretion to determine the amount and frequency of the pre-hearing discovery, bearing in mind the desired efficiency of the arbitration process, the discovery requested by the parties and applicable law.

6.4.10 Interim Measures – In the case of an Arbitration and at the request of either party, the Arbitrator may take whatever interim measures he or she deems appropriate or necessary to avoid irreparable injury or preserve the status quo with respect to the dispute.

6.4.11 Evidence – In the case of an Arbitration, the following procedures apply to the submission and consideration of evidence.

a. The Arbitrator is the sole judge of the materiality, admissibility, and relevancy of any evidence offered, consistent with the values of truthfulness, relevance, and efficient resolution of the dispute. The Arbitrator is not bound by the legal rules of evidence.

b. The Arbitrator may subpoena witnesses or documents at the request of a party.

c. It is within the Arbitrator's discretion to consider the evidence of witnesses by affidavit or declaration, but he or she gives it only such weight as he or she deems appropriate after consideration of any objection made to its admission, and consistent with the values of truthfulness, relevance, and efficient resolution of the dispute.

d. Witnesses for each party submit to direct and cross examination as approved by the Arbitrator.

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6.4.12 Arbitration in the Absence of a Party – The Arbitrator has the authority to proceed in the absence of parties or their representatives who fail, after due notice, to be present or obtain a postponement. An award, however, is made on the evidence presented at the proceeding, and not made solely on the basis of a party's or a representative's failure to appear.

6.4.13 Settlement – In the case of a successful Mediation, the Mediator sets down the terms of the parties' settlement in a written document to be signed by both parties. Absent an agreement to the contrary, all parties to the Mediation must appear in person, and a Raytheon representative must be a manager with the authority to resolve the matter at issue. In the case of Arbitration, the parties may settle their dispute at any point before the Arbitrator issues an award, in which event the Arbitrator sets out the terms of the settlement in a consent award.

6.4.14 Closing of Proceedings – In the case of an Arbitration, the Arbitrator declares the proceedings closed when he or she is satisfied that the record is complete and that both parties have had a full and fair opportunity to present their evidence.

6.4.15 Choice of Law – For eligible claims involving state laws, the Arbitrator will apply the law of the state in which the Arbitration proceeding occurs.

6.4.16 Authority of Arbitrator – In the case of arbitration, the Arbitrator's authority is limited to the resolution of legal disputes between the employee and Raytheon. He or she is bound by and is required to apply all applicable law, including that relating to the allocation of the burden of proof and remedies for violations of such law, if any, as well as all points of substantive law. He or she has no authority either to abridge or to enlarge substantive rights available under existing law, or to alter any specific provision of the parties contained in the agreement to arbitrate. This section should not, however, be construed as altering the standard of judicial review of arbitration awards under applicable law.

6.4.17 Arbitrator's Award and Decision – The Arbitrator is required to render a written, signed, and dated award and decision that identifies the parties, summarizes the issues in controversy, and sets forth the decision of the arbitrator and the factual and legal basis for the decision. This award and decision are made promptly by the Arbitrator and - unless agreed to otherwise by the parties – no later than thirty (30) days from the date of the closing of the arbitration proceedings. The employee and Raytheon are bound by the Arbitrator's award and decision in Step IV with limited exclusion, subject only to the right to seek judicial review of the award and decision in accordance with applicable law.

7 Related Information

7.1 Forms

Form Number	Title
10-3724PC	Formal Complaint - Raytheon Alternate Dispute Resolution Process
10-3725PC	Request for Mediation - Raytheon Alternate Dispute Resolution Process
10-3726PC	Agreement to Mediate - Raytheon Alternate Dispute Resolution Process
10-3727PC	Request for Arbitration - Raytheon Alternate Dispute Resolution Process

7.2 ADR website

7.3 ADR Process Workbook

End of Document

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B.2 Sexual Harassment Policy

Raytheon		**Document Number:**	000000150-RP
Company Policy		**Effective Date:**	September 22, 2005
Hard Copies Uncontrolled - Verify Effective Date Prior to Use		**Function:**	Human Resources
Title:	Sexual Harassment	**Authorized By:**	Senior Vice President - Human Resources

1. **Status**

   1.1 Supercedes Raytheon policy 32-9070-110, Sexual Harassment, dated November 1, 1996.

   1.2 Policy revised to reflect the current operating structure of the Company and to make other minor revisions.

2. **Purpose**

   2.1 Establishes company-wide guidelines regarding the prevention and investigation of sexual harassment, defines what constitutes sexual harassment, and reaffirms that such behavior is strictly prohibited.

3. **Applicability**

   3.1 This policy applies to all organizations within Raytheon Company and to all persons working in support of Raytheon activities including employees, contractors, vendors, and consultants.

4. **Definitions**

   4.1 Sexual Harassment – Behavior of a sexual nature which is unwelcome, offensive and / or creates an intimidating or hostile work environment. Sexual harassment is a form of employee misconduct which undermines a person's ability to perform his / her job duties.

   4.1.1 Sexual harassment includes but is not limited to:

   a. Unwelcome sexual advances;

   b. Requests for sexual favors; and / or,

   c. Other unwelcome verbal or physical acts of a sexual-based nature, provided that:

   (1) Submission to such conduct is made a term and condition of employment, either explicitly or implicitly;

   (2) An employment decision is based on acceptance or rejection of such conduct;

   (3) Such conduct unreasonably interferes with an employee's work performance; or

   (4) Such conduct creates an intimidating, hostile or offensive work environment.

   4.1.2 Examples of sexual harassment include:

   a. Sexually oriented statements, sexual gestures, whistles, jokes or comments about a person's sexual experience or physical characteristics;

   b. Pressure for sexual activity or sexual favors;

c. Sexual innuendo, suggestive comments, sexually oriented "kidding," or "teasing," or "practical jokes";

d. Physical conduct of a sexual nature such as touching, pinching or brushing against another person's body, hair or clothing, or blocking someone's path to force contact;

e. Implied or overt promises of preferential treatment or threats concerning an individual's employment status related to sexual advances or sexual conduct;

f. Posting, displaying, or distributing sexually oriented materials inappropriate to the workplace, such as suggestive, demeaning or sexually explicit posters, objects or graffiti.

4.1.3 Sexual harassment is not limited to supervisor / subordinate relationships. It also may occur between fellow employees or between employees and non-employees (contractors, visitors, customers, suppliers, etc.) of the same or opposite sex.

4.1.4 Whether behavior is sexual harassment does not necessarily depend on the intent of the person engaging in the conduct. Rather, it depends on the perceptions of and impact on the employee who perceives the conduct. If a reasonable person would perceive the conduct as creating a hostile or intimidating environment or as interfering with his / her ability to perform his / her job, the conduct is harassment, even if the harasser did not so intend or might not view it as such.

5. Policy

5.1 Sexual harassment is a violation of various federal and state laws and may subject both the Company and the individual employee engaging in such behavior to substantial liability. Sexual harassment is contrary to the Company's policy of providing a safe, supportive and productive work environment which treats each employee with dignity and respect.

5.2 It is the policy of the Company that sexual harassment is prohibited. Observed and reported instances will be promptly investigated. Retaliation and reprisal against an individual raising a concern of sexual harassment, or participating in an investigation regarding sexual harassment is prohibited.

5.3 Where it is determined sexual harassment has occurred, appropriate corrective action must be taken and documented. Such corrective action must be sufficient to discontinue the prohibited conduct and may include discipline of the violating person. Disciplinary action may range from counseling and oral warning to pay reduction, change in classification, job reassignment, suspension or discharge.

5.4 The Company will continue to prevent sexual harassment through communication and training programs to assure that all Company employees understand what sexual harassment is, how it can be reported and that sexual harassment is strictly prohibited.

6. Responsibilities

6.1 The Senior Vice President – Human Resources and the Director - Compliance Management have primary responsibility for this policy.

6.2 General Responsibilities

6.2.1 All employees are responsible for refraining from sexual harassment of their fellow employees or others, such as customers, vendors, suppliers, subcontractor employees.

6.2.2 All employees involved in any investigation into an incident of alleged sexual harassment must treat all information obtained as confidential within a need-to-know context, consistent with conducting a full and thorough investigation.

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6.2.3 Any person who perceives himself / herself as being sexually harassed should promptly report the incident to his / her immediate supervisor so the incident can be appropriately addressed. Alternatively, the incident may be reported to the next level of supervision or management, to a Human Resources Representative, to the Director - Compliance Management, to the Corporate Ethics Office or to a person specifically designated by the employee's business or site to investigate allegations of sexual harassment.

6.2.4 Anyone who has observed sexual harassment or retaliation should report it to his or her supervisor or to the Human Resources Manager. A complaint need not be limited to someone who was the target of the harassment or retaliation.

6.3 Management

6.3.1 Managers and supervisors are responsible for assuring that employees in their area are aware of this policy.

6.3.2 Managers and supervisors, in conjunction with Human Resources, are responsible to investigate all reports or incidents of sexual harassment that involve employees under their direct supervision and to keep contemporaneous documentation of their investigation and conclusions.

6.3.3 Where an incident of sexual harassment has been deemed to have occurred, managers and supervisors are responsible for ensuring the appropriate corrective action is implemented.

6.4 Human Resources

6.4.1 Local Human Resources Managers are responsible for ensuring compliance with local statutory requirements regarding notification to employees of the Company's policy prohibiting sexual harassment.

6.4.2 At each facility, Human Resources is responsible for posting the name, address and telephone number of the Human Resources Representative, Director - Compliance Management, the Corporate Ethics Office and other Company representative designated to investigate harassment allegations at each facility.

6.4.3 Human Resources, in conjunction with line managers and supervisors, is responsible for investigating all reports or incidents of sexual harassment brought to their attention.

6.4.4 Human Resources is responsible for advising line managers and supervisors as to the appropriate corrective action where incidents of sexual harassment have occurred.

End of Document

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B.3 Violence in the Workplace Policy

File Code:	32-9075-110
Page:	1 of 9
Revises Issue Dated:	
Effective Date:	May 1, 1998
Function:	Human Resources
Authorized By:	Senior Vice President - Human Resources

General Policies and Procedures

Subject: Violence In The Workplace

1. PURPOSE

1.1 The purpose of this policy and procedure is to:

1.1.1 Ensure that Raytheon Company and its subsidiaries develop and maintain a Workplace Violence (WPV) Plan in accordance with this policy.

1.1.2 Establish WPV Teams to deal with any situation that either has the potential or has developed into an act of workplace violence.

2. POLICY

The preservation and protection of all persons, employees and visitors on Company premises is Raytheon's foremost consideration. Raytheon maintains a no tolerance policy for any conduct that is harassing or violent in the workplace. Threats of any nature are strictly prohibited in the workplace. It is the responsibility of management and all employees to report any occurrence that appears to be a threat against any employee or any person on Company premises. All incidents and/or threats of violence will be immediately investigated.

3. APPLICABILITY

This Policy and Procedure applies to all Operating units of the Company.

4. RESPONSIBILITIES

4.1 The Senior Vice President - Human Resources is responsible for ensuring that uniform WPV Plans, in accordance with Exhibit A, and WPV Teams are established at the business unit level and flow to all entities. In addition, the Senior Vice President - Human Resources will ensure that provisions are made at the business unit level to implement and operate the WPV Plans and WPV Teams at a regional level when more than one business unit is located within the same geographical region.

4.2 The Business Unit Human Resources Manager is responsible for ensuring that teams and plans are in place and are functional at the appropriate organizational levels and at regional levels where appropriate.

4.3 The Manager at each location is responsible for the establishment of a Workplace Violence Plan (Exhibit A) and for taking the necessary action to ensure that a WPV Team is in place, and that a "Workplace Violence Team Member Profile," Form 10-3587PC (Exhibit B) on each team member has been completed and is on file with the Business Unit Human Resources Manager.

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File Code:	32-9075-110	**General Policies and Procedures**
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5. PROCEDURE

5.1 The WPV team will be comprised of representatives from Human Resources, Employee Assistance Program/Medical, Legal, Security and Management. At the manager's discretion, one of these members can double as the team leader. The manager of each facility may appoint others as deemed necessary. All appointments will be in writing including formal provisions for alternates and submitted to the Business Unit Human Resources Manager on Form 10-3587PC (Exhibit B).

5.2 Violence in the workplace ranges from threats, intimidation, coercion, harassment, assault, hostages, suicide or homicide. These violent or potentially violent situations may develop internally among the existing workforce or externally, i.e., former employees, spouses, associates, civil unrest, terrorists, etc. Recognizing indicators of potentially violent behavior or situations will be a part of every manager's and supervisor's core training. Ideally, potentially violent individuals or volatile conditions will be recognized, defused or contained before the situation escalates. The WPV Team's responsibility is to ensure these situations are recognized, reported, and to the extent possible defused, contained or brought under immediate control, and all infrastructure is in place to deal with situations that may develop.

5.3 Verbal threats, coercion and harassment by employees are covered by existing employee work rules and are handled under existing workplace procedures. However, if there is an apparent high probability of escalation to violence, the WPV Team shall be activated. Threats to life and/or property which constitutes imminent danger and involves such things as weapons, hostage taking or physical violence fall within the scope of the WPV Team. This policy provides the framework for managing such situations, establishes the WPV Team, identifies their responsibilities and sets up a system for recognizing and dealing with these issues through a WPV Management Plan.

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WORKPLACE VIOLENCE PLAN

I. PURPOSE

To establish uniform procedures for dealing with violence in the workplace and to outline the responsibilities of the Workplace Violence Team (WPV Team).

II. GENERAL

The most effective way to prevent potential workplace violence is through preparation, communication and training. Senior management from Business Units, Operating Locations and other entities should be given a detailed orientation on what workplace violence is, its effects, how to recognize it, how to prevent or control it, and the necessity of establishing a WPV Team. Detailed training should be made available to the WPV Team, covering recognition, incident prevention, incident reaction/control, etc. and courses for management/supervisors should cover the day-to-day workforce and how to recognize potential WPV symptoms, report it, react to it, and system support activity as appropriate. These are particularly crucial in the following areas:

A. Interview Processes

1. Applicants—must serve the purpose of determining whether or not a candidate has the required competency to perform the job requirements.

2. RIF/Discharge—must serve two purposes, give notice of job loss and provide honest reasons for actions.

B. Investigative Processes

1. New hires' past employment must be validated as to performance, behavior and honesty.

2. Improper acts or suspected improper acts under the scope of this policy/plan must be immediately, and if necessary, confidentially communicated; then quickly and thoroughly investigated and resolved.

C. Awareness/Identification Processes

1. Expand every effort to identify individuals who may be potentially violent.

2. Provide management with the appropriate techniques of how and what to look for in the workplace, i.e., social behavior, work habits, honesty, etc.

III. RESPONSIBILITY

Primary responsibility for investigating alleged threats or reported incidents of violence rests with the Workplace Violence (WPV) Team. Safety of the workforce is the primary consideration in making the assessment. This team assesses and responds to threats against employees, facilities and non-employees in a company facility. After the

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threat assessment is completed, corrective action is recommended regarding the individual(s) alleged to have made the threat.

IV. TEAM MEMBERSHIP

A. The WPV Team has two components:

1. The Core Team (permanent WPV Team) - a team leader and members from Human Resources, Employee Assistance Program, Security, Legal, Management, and if appropriate, Operational Management. The core team is convened to assess and respond to allegations of threats or violent behavior.

2. The Core Team plus Internal/External Communication and External Consultants This team is convened to control the release of information externally and internally relative to an incident of violence. External consultants are used to provide additional assessment, advice and counsel as determined by the WPV Team.

B. Each member of the WPV Team will have specific roles in relation to an incident for which the team has been convened. Specific responsibilities of each member of the WPV Team are outlined as follows:

1. Team Leader
   a) Provide team leadership
   b) Coordinate assessment process
   c) Facilitate consensus decision of action to be taken, make decisions in absence of consensus
   d) Facilitate case review
   e) Establish liaisons with involved parties
   f) Communicate case status as required to non-team members
   g) Ensure documentation of team process
   h) Ensure required follow-up after review is complete
   i) Maintain summary of all cases to ensure consistency of actions and lessons learned
   j) Ensure training of team members
   k) Maintain and update Plan as necessary

2. Human Resources
   a) Notify management of person making threat and person receiving threat
   b) Coordinate with other business units (BU's) if their employee(s) are involved
   c) Initiate and coordinate interviews and investigations, including review of all files and supporting documentation
   d) Prepare written report, including specifics of threats(s) and any pertinent information from files or documentation
   e) Recommend corrective action to team, if warranted - assuring consistency with past practices
   f) Ensure appropriate people are present at meeting with employee and that appropriate safety precautions are taken

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g) Ensure that all benefits issues are attended to and resolved prior to any disciplinary suspension or termination
h) Ensure there is follow-up plan, when appropriate, for monitoring behavior of employee when she/he returns to work
i) Coordinate and lead organizational debrief on event

3. Employee Assistance Program/Medical
   a) Provide initial psychological assessment of the threatening employee, assess whether or not she/he needs to be absent from the workplace
   b) Focus on immediate treatment and support services for the threatening employee and other affected employees
   c) Advise and assist in reintegration back into the workplace with appropriate ongoing case monitoring
   d) Advise whether the threatening employee is cooperating with recommended treatment
   e) Provide assessment, referral, and follow-up services to those affected by the threat
   f) Maintain confidentiality of employee assistance data by controlling release on a need-to-know basis

4. Legal
   a) Provide direction to conduct investigations under legal privilege
   b) Advise on area of the law that impact threat assessment (i.e. rights of privacy, wrongful discharge, etc.)
   c) Determine appropriate legal action, if necessary (i.e., restraining order)
   d) Maintain liaison with other attorneys, both internal and external

5. Security
   a) Act as the principal investigative lead for non HR issues
   b) Search investigative database(s) or appropriate public records for prior similar incidents
   c) Advise all persons involved in order to maximize their safety
   d) Evaluate the need to increase physical security at the facility and other potentially affected sites, and implement changes
   e) Issue stop orders and be informed of restraining orders
   f) Provide escort service(s) on Company property
   g) Alert/Notify other business unit security elements and appropriate law enforcement entities
   h) Develop a response plan for security should the event require or escalate to a level requiring response
   I) Develop intelligence internally and externally
   j) Maintain active liaison with local, state and federal law enforcement agencies

6. Management
   a) Notify Security or Human Resources of all incidents of workplace violence including threats
   b) Provide detailed documentation of any incident and background information
   c) Make decisions regarding appropriate disciplinary options or corrective action

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d) Monitor environment during and after assessment
e) Protect employees reporting threats against retaliation

C. Convening the Team - Any member of the WPV Team can convene the team, as well as any manager requiring an assessment of a threat situation. A decision to convene the team requires judgment about whether or not the event is strictly an employee relations matter or includes the necessity for a more extensive assessment. For instance, an argument between two employees may generate some "threatening" language on the part of both the participants, but whether or not this is an issue for the team is clearly a judgment call.

D. Team Actions - The WPV Team members will exercise their specific roles and responsibilities with the team meeting as often as necessary to bring a case to conclusion. The team will normally accomplish the following as a corporate body:

1. Review the report of the individual bringing the incident to light and/or assign someone to conduct additional interviews, etc., as necessary
2. Determine whether or not the event requires further investigation and review
3. Direct a team member to interview the person allegedly making the threat, interview witnesses, review all documentation and files concerning the threatening individual, and notify management, as appropriate, via the Team Leader
4. Determine when a threat is accurate and that immediate steps must be taken before all information and interviews are collected and evaluated. For example, emergency involvement of local law enforcement
5. Ensure that all proper steps of the documentation process are completed within 24 hours, if possible
6. Once the review is completed, the team determines the seriousness of the reported threat or actual violence and the continuing for the potential individual to commit other acts and initiates corrective action.

E. Documentation - Documentation ensures continuity between different people working on tasks, provides protection against legal liability, and maintains accurate and accessible accounts of all events related to a case. Documentation should include the following:

1. Records of all interviews and conversations
2. Investigative reports
3. Minutes of all WPV Team meetings

F. Confidentiality - Confidentiality must be maintained throughout the entire team process (including interview, documentation review, etc.). Information cannot be shared with anyone except team members, management or others who have a "need to know." Anyone inquiring about a specific case without an obvious need to know should be reported to the team. Confidentiality, including the disposition of the case, should be maintained once the case is closed. If there is any doubt, the Legal staff should be consulted.

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G. Rapid Response Team (RRT) - The senior Human Resources Manager of each major business unit will designate a WPV Team to function as a Rapid Response Team. This team will be capable of immediately responding to any situation of violence and will primarily be deployed to a site when directed or when requested by the local WPV Team - normally in response to a prolonged incident where there are high profile issues, i.e. hostage situation, homicides, riots, civil disturbances, etc. The RRT will normally be comprised of senior level employees representing the disciplines as identified previously in Section IV and will assume command authority over the local WPV Team, unless otherwise directed.

H. Regional/Multi-site Support - In areas where operating entities from different business units are either co-located or within the same geographic region, the Human Resources Department of the business unit, with largest holdings, will assume the leadership role in supporting this plan. This does not relieve the individual operating entity from having a WPV Team and Plan, unless there is host/tenant situation, in that case the host will assume this responsibility.

I. Coordination of Dual Site Involvement - When a threat involves more than one site or organization, the team leaders of those site WPV Teams should immediately agree upon the following:

1. Who will take the lead?
2. Who will conduct the interview(s) and make the assessment?
3. Who will keep the documentation?
4. Who will decide the corrective action to be taken?

Except as discussed above, the site WPV Team of the individual(s) making the threat will take the lead on the assessment process and coordinate that process with other site(s) that may have affected employees. The site WPV Team of the threatening individual may interview that person(s), review all records and documentation, but may request the interview(s) of the individual(s) receiving the threat be conducted by their site WPV Team.

J. Training - The Executive Offices Senior Vice President - Human Resources will designate a special training team to visit the senior management team at each business unit and major operating entity in order to provide orientation training in support of this plan. This training/orientation will be designed to accomplish the following:

1. WPV Team establishment
2. WPV Plan implementation
3. General overview of Workplace Violence issues/history
4. Risk Management - Workplace Violence
5. Threat Analysis and Triggers
6. Overview of Management/Supervisory training recommendations

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Management/Supervisory Training - A Core Management/Supervisory Course will be developed at the Executive Office for appropriate distribution throughout the Company and cover the following areas:

1. Workplace Violence - What is it...?
2. Why and How does it happen
3. Anatomy of Workplace Violence
4. Profile of the Potentially Violent Employee
5. Warning Signs - What to look for...
6. Situations that can "trigger" violence
7. Prevention Guidelines
8. Defusing Techniques
9. Support availability, i.e., Human Resources, Security, etc.
10. Reporting

In addition to the Management/Supervisory training outlined above, the WPV Team will receive additional training as required in the following areas:

1. Interview Processes
2. Investigative Processes
3. Awareness/Identification Process
4. Defusing and containment techniques
5. Up Channel Reporting
6. Media Interface
7. Documentation

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Click here to download Form 10-3587PC Microsoft Word for PC's

EXHIBIT B

| VERTICAL LINE, IF APPLICABLE, INDICATES ADDITION OR REVISION

B.4 Alcohol/Drug Use and Abuse Policy

Raytheon		**Document Number:**	000000099-RP
Company Policy		**Effective Date:**	May 25, 2004
Hard Copies Uncontrolled - Verify Effective Date Prior to Use		**Function:**	Human Resources
Title:	Alcohol / Drug Use and Abuse	**Authorized By:**	Senior Vice President - Human Resources

1. **Status**

   1.1 Supersedes Raytheon policy 37-1002-110, Alcohol / Drug Use and Abuse, dated November 24, 1999.

   1.2 Policy updated to reflect current practices and nomenclature.

2. **Purpose**

   2.1 This policy sets forth the Company's philosophy with respect to alcohol / drug use and abuse. It is not intended to describe in specific detail the requirements of various government agencies relating to drugs and alcohol testing. Those facilities which are subject to the drug testing requirements of the Federal Aviation Administration, the Department of Transportation, or other agency should adhere to the specific requirements of the applicable regulations. To the extent such regulations may conflict with statements in this general policy, the regulations should be followed.

3. **Applicability**

   3.1 This policy applies to all organizations within Raytheon Company except Canadian operations.

4. **Policy**

   4.1 In order to maintain a work environment that is safe and healthful for employees, clients and the general public; and which provides efficient and stable working conditions, the following rules will be enforced uniformly for all employees:

   4.1.1 Employees are prohibited from arriving to work under the influence of alcohol or illegal drugs;

   4.1.2 Employees are prohibited from using, possessing, distributing, or manufacturing illegal drugs on Company property or while performing Company business;

   4.1.3 Employees may not bring or consume alcoholic beverages on Company property except in connection with Company-authorized events;

   4.1.4 Employees being treated with a drug or controlled substance that might adversely affect their ability to perform their work must provide a written statement from the prescribing physician to the Company's Medical Department. Some adjustment in the employee's job assignment may be required for the duration of the prescribed treatment. Only the person for whom a prescription drug is issued can bring that medication on Company property;

   4.1.5 Employees convicted of violating a criminal drug statute in the workplace must notify the Company within five (5) days of the conviction.

   4.2 Any other use, possession, or sale of alcohol or drugs, including but not limited to narcotics, hallucinogens, depressants, stimulants, marijuana or other controlled substances by an employee that may adversely affect the employee's job performance, or conditions of the work place, or that may reflect unfavorably upon public confidence in the manner in which the Company carries out its responsibilities is also prohibited.

4.3 Employees undergoing physician-prescribed medical treatment with a drug, which may or does impair their physical or mental ability must provide written verification from the prescribing physician to the Company's Medical Department. Some adjustment in the employee's job assignment may be required for the duration of the prescribed treatment.

4.4 As a condition of employment, and to assure compliance with the Drug-Free Workplace Act of 1988, all employees are required to comply with this policy. In addition, any employee convicted under a criminal drug statute must notify the Company of that conviction within five (5) days of that conviction.

5. **Procedure**

5.1 Employees violating this policy will be subject to disciplinary action up to and including termination.

5.2 Employees with drug or alcohol problems are encouraged to request assistance by contacting the Company's Employee Assistance Program (EAP). Refer to Raytheon Policy 000000100-RP, Employee Assistance Plan. Voluntary requests for assistance will be treated on a confidential basis, meaning that no information regarding an individual's participation in the EAP will be disclosed except in the following circumstances:

5.2.1 The EAP participant consents in writing;

5.2.2 The law requires disclosure; or

5.2.3 It is believed that life or safety are threatened by failure to disclose.

5.3 Voluntary participation in a formal drug or alcohol rehabilitation program does not relieve an employee of his or her obligation to comply with this policy.

5.4 Alcohol and Drug Testing

5.4.1 The Company uses drug testing to help administer this policy. All drug testing procedures conform with federal and state laws. Drug testing is conducted under the following conditions:

a. Pre-employment drug tests are performed on all applicants;

b. Reasonable suspicion tests are administered when a supervisor has reason to believe an employee might be under the influence of alcohol or drugs. Symptoms suggesting drug or alcohol use include visible needle marks, red eyes, liquor smell on breath or clothing, sudden changes in work performance, inappropriate behavior, and unexplained and / or frequent absenteeism;

c. Random tests are performed on employees who occupy safety or health-sensitive positions, including transportation positions;

d. Where the employee is involved in an accident, a near-miss or an unsafe practice;

e. Return-to-work testing is performed on employees returning from a lengthy job absence.

5.4.2 All alcohol and drug testing will be performed in accordance with applicable federal and state laws. Specimen collection will be conducted in accordance with the Code of Federal Regulations, Title 49, Department of Transportation procedures. Employees who refuse to submit to drug / alcohol testing and / or medical screening may be terminated as deemed appropriate by the Company.

5.4.3 Employees who refuse to submit to drug testing are referred to the EAP or may be terminated, depending on the circumstances, at the Company's discretion.

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5.5 Employees Who Test Positive

5.5.1 Employees who test positive or screen positive shall be subject to disciplinary action, up to and including termination of employment; however, in certain instances, as deemed appropriate by the Company, first-time offenders who test or screen positive may be given a suspension. While suspended, the affected employee is expected to examine his / her continued working relationship with the Company and seek appropriate rehabilitative assistance through the Company's Employee Assistance Program. Some of the medical expenses for any rehabilitation required may be covered by the Company's group insurance policies.

a. After the suspension period has ended, and the employee is in compliance of a required rehabilitation program (if applicable), the employee must be retested prior to being considered for possible return to work. Failure to test negative will result in termination.

b. Employees who test positive for the first time and complete their period of suspension and rehabilitation (if required), and subsequently test negative, shall be offered an opportunity to return to work in a position to be determined by the Company, if any such position is available. These employees must execute Form 10-3697PC, Last Chance Agreement, and will be subject to regular testing during the two (2) calendar years following their return to work. After the successful completion of this two-year testing period, the basic provisions of Section 5.4 of this policy apply.

c. In accordance with our contractual and legal obligations, any employee holding or in process for a personnel security clearance who tests positive or screens positive must be reported to the cognizant U.S. Government agency.

(1) The Human Resources Manager (or designee) will inform the local Security Manager of any employees who test positive or screen positive if the employee holds, or is in the process for, a Personnel Security Clearance.

(2) The local Security Manager will be responsible for submitting a report of the facts to the Cognizant Security Agency.

5.5.2 At the discretion of management, where appropriate, a location can establish a policy of discharging first-time offenders. However, under such circumstances, discipline must be applied uniformly, and all persons found to have tested or screened positive must be terminated, unless, of course, it is determined that the test was defective in a manner which would affect the result of a test.

5.5.3 Employees subject to unscheduled random testing who test positive will be discharged and terminated from the payroll.

5.6 Searches

5.6.1 The Company can require employees to submit to a personal search and / or search of any personal article within the employee's work area based on suspicion or evidence of sale, possession, or use of controlled substances. Employees also must submit to searches of their vehicles brought on company property.

5.7 Alcohol and Drug Testing

5.7.1 Management, supervisory and other personnel on Federal contracts, or when required by statute, or by specific project / client policy or procedure shall undergo a training program that targets the identification of illegal drug use by employees, the procedures dealing with such use and the analysis of performance factors which suggest a problem area.

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5.8 Employee Assistance Program

5.8.1 The Company's Employee Assistance Program is available to provide confidential, professional assistance for a broad range of personal and / or work-related problems. Employees are encouraged to seek such assistance on a self-referral basis at the earliest possible point. The Employee Assistance Program emphasizes confidential assessment and referral services, short-term counseling, training, and follow-up.

5.9 Self-Referrals

5.9.1 Self-Referrals to the EAP are kept confidential. Employees who agree to take part in a drug treatment program will not have their employment affected unless they fail to complete the required course of treatment or continue to use drugs.

5.10 Employee Certification

5.10.1 Employees who are required either as a condition of work on a specific contract or by federal or state statute to execute a certificate relating to the drug and alcohol program shall, as a condition of continued employment, execute Form 10-3602PC, Drug and Alcohol Abuse Policy Certification.

End of Document

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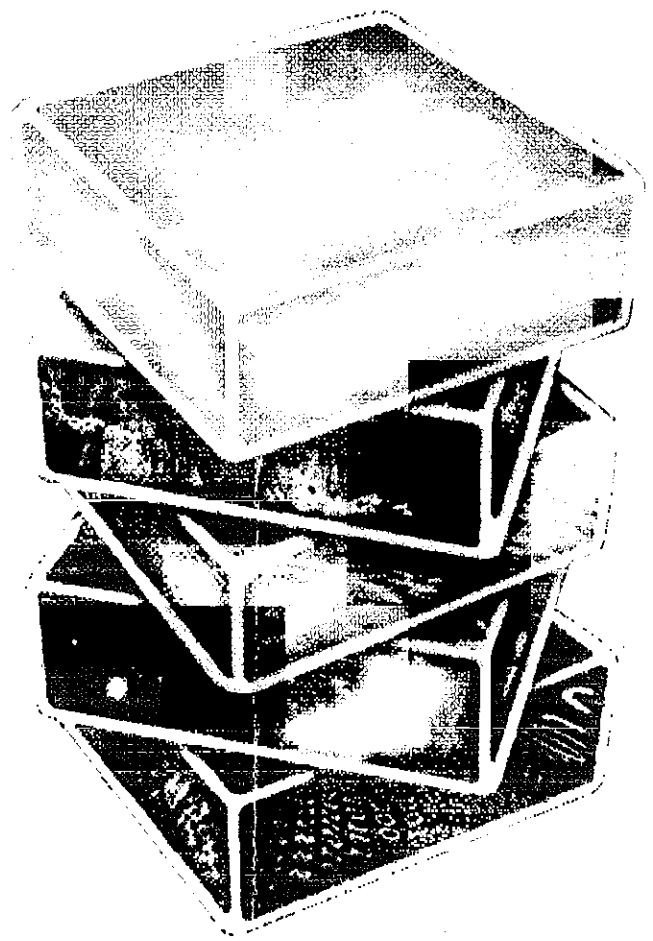
APPENDIX C. RAYTHEON 2010 ANNUAL REPORT

INNOVATION IN ALL DOMAINS



AIR | SPACE | SEA | SPACE

RAYTHEON INNOVATION STAYS ALL DOMAINS, DELIVERING PROVEN SUCCESS FOR CUSTOMERS AROUND THE WORLD. SCAN THE QR CODE TO THE LEFT WITH YOUR SMARTPHONE TO SEE MORE.

DEAR FELLOW SHAREHOLDERS,

Raytheon delivered strong operating performance in 2010.

We continued executing well and delivered solid bottom-line results in a challenging environment. This was a result of our focus on program execution and productivity initiatives driven by Raytheon Six Sigma™ and operational improvements. We have a strong balance sheet, a diverse portfolio of innovative technologies both in depth and breadth, as well as strong demand for our solutions domestically and internationally.

The year had some headwinds including program delays, U.S. government budget uncertainty and a difficult economy. However, our strategies prepared us well for these conditions and allowed us to leverage our capabilities, cost competitiveness, solid program performance and strong customer alignment to achieve one of the highest competitive win rates in the company's history. In short, we created opportunities from challenges.

During 2010, our adjusted earnings per share rose to $5.58, up 15 percent from 2009 to 2010, primarily due to our operational improvements and capital deployment actions. We also generated strong operating cash flow of $1.9 billion for the year, after making a fourth quarter $750 million discretionary contribution to our pension plans. For the full year, Raytheon had a 14.6 percent return on invested capital and continued to have strong operating margins. The company ended the year with a net debt of near zero.

Raytheon demonstrated its balanced approach to capital deployment with a number of actions in 2010 as we continued our focus on creating value for our customers and our shareholders. The company repurchased 29 million shares of common stock for about $1.5 billion during 2010. This, coupled with our sixth consecutive year of dividend increases, and the discretionary pension contribution, underscored our approach.

We increased long-term value generation in 2010 through strategic acquisition activity. We acquired Technology Associates, Trusted Computer Solutions and substantially all the assets of an Australian company, Compucat Research Pty. Ltd. These transactions bring new and complementary capabilities to our company and customers. In December, we announced the Applied Signal Technology acquisition which closed in January 2011. AST brings world-class technologies, and its talent aligns with Raytheon's strong Intelligence, Surveillance and Reconnaissance solutions. This combination of strengths along with our complementary cultures of innovation will provide capabilities to address our customers' current and future challenges.

2010 was a great year for competitive wins, including programs such as Small Diameter Bomb, Global Positioning System (GPS) Advanced Control Segment, Air and Missile Defense Radar for the U.S. Navy, and the Standard Terminal Automation Replacement System for air traffic control, among others. These wins position us well for future competitions.

A PORTFOLIO WITH DEPTH AND BREADTH

One of Raytheon's strengths is the depth and breadth of our portfolio of technologies, products, systems and capabilities. We believe they are well aligned with our customers' needs to address important threats. One could argue that these threats have increased in our global environment.

Nowhere was this more evident than in the cyberdomain. Insider threats were headline news in 2010, and this is an area where we have built world-class capabilities. Our customers are increasingly relying on our award-winning SureView™ information protection solution, as well as our other Cybersecurity technologies that close the cyberthreat.

Our Homeland Security capabilities were strengthened with the introduction of our Clear View™ security solutions. It is a comprehensive security management system for critical infrastructure, border security and other security needs.

An uncertain world increases the demand for our Intelligence, Surveillance and Reconnaissance capabilities. Raytheon is uniquely capable of providing full-spectrum ISR solutions that address Secretary Gates' mandate to provide additional tactical ISR capability to our forces deployed in combat.

In Missile Defense, we had several key tests and intercepts that prove the system is ready and ready to be further developed to meet all future missile defense requirements. Most notably, our Standard Missile-3 is the cornerstone of the U.S. Phased Adaptive Approach, and demand continues to grow for our Patriot Air and Missile Defense System.

Our more than 70 years' expertise in radars serves as a cornerstone for Missile Defense, and is used in scores of other applications on land, sea, air and space – from tactical fighters outfitted with our active electronically scanned array Raytheon Advanced Combat Radars, to radar design for the U.S. Air Force's Space Fence for tracking and detecting space objects.

We continue to grow our position in the training market. Raytheon performs some of the world's largest military and commercial training contracts, and we've been recognized as No. 1 in HRO Today magazine's "Baker's Dozen in Learning" for three years in a row.

Our portfolio is increasingly international in scope, and the international market remains a key area of growth for the company. In 2010, 23 percent of our sales were to international customers, and our international revenues grew by 10 percent.

INNOVATION IN TECHNOLOGY AND PROCESSES

As a technology leader, Raytheon needs to be at the forefront of innovation. Our contract research and development (CRAD) bookings were up in 2010 by 28 percent, while sales on these programs increased by 13 percent. This provides much of the funding for the next generation of Raytheon technologies, and keeps us at the cutting edge of technology development in areas directly in line with our customers' needs.

At the same time, our common business, IT and operations processes allow us to leverage the power of our 72,000 people, and make us flexible, adaptable and faster going forward. With an eye toward continuous improvement, we will remain focused on driving our systems and processes to even greater levels of efficiency.

CORPORATE RESPONSIBILITY

Raytheon's results related to corporate responsibility are also important to measure. Here too, we have much to be proud of.

We have long been a strong supporter of science, technology, engineering and math education, since it is critically important for us to inspire today's students to develop and sustain an interest in math and science. This commitment only grew in 2010. Raytheon celebrated the fifth anniversary of its signature MathMovesU® program with a multifaceted launch including a new MathMovesU website and a variety of local community activities. The program has now touched the lives of more than 1 million students, teachers and parents. All these efforts were bolstered by Raytheon employee volunteers, who doubled their volunteer hours over the previous year.

Additionally, Raytheon joined the launch of the "Change the Equation" initiative supporting President Obama's "Educate to Innovate" campaign and sponsored NBC's "Education Nation" in September. We are continuing as the title sponsor of the MATHCOUNTS® National Competition through 2014, and I had the privilege of serving as the honorary chair of National Engineers Week.

We are proud of our commitment to ethics and to maintaining the highest ethical standards in all that we do. Raytheon's ethics program is reinforced each year with comprehensive ethics education, since our success is dependent on each individual's commitment.

We continue to position ourselves as best in class with regard to environmental, health and safety programs. To that end, we became a *Save Energy Now*® LEADER with the U.S. Department of Energy and committed to a 25-percent reduction in energy intensity over 10 years. In early 2011 we were awarded the U.S. Environmental Protection Agency's ENERGY STAR® Sustained Excellence Award for the fourth year in a row.

We are making progress on our goal of an injury-free workplace to protect our greatest resource – our people. We achieved the lowest employee injury rate in our industry and received the Aerospace Industries Association Worker Safety Excellence Award in the Aerospace Components Category.

KEEPING US ON TRACK: OUR VISION, STRATEGY, GOALS AND VALUES

When I reflect on our accomplishments during the year, I see a company that excels at what it sets out to do. That's good for our customers, it's good for our shareholders, and it's good for our employees.

As we continue creating opportunities from challenges, we cannot lose sight of the rock-solid foundation formed by Raytheon's Vision, Strategy, Goals and Values. In this environment, they are as important as ever. They are a compass – keeping our 72,000 people aligned and pointed on a true course. They show we are ready as a company.

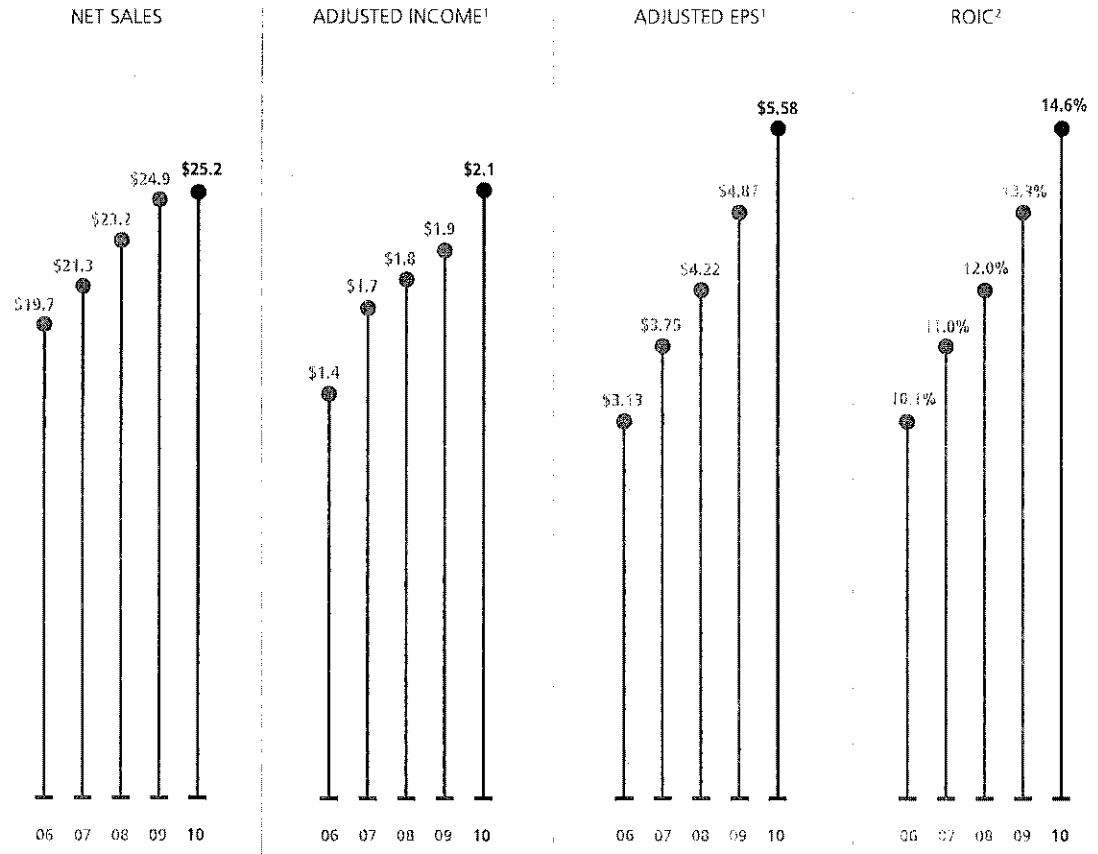
A proud member of the Raytheon team for 39 years,

William H. Swanson
Chairman and Chief Executive Officer

March 2011

RAYTHEON 2010
FINANCIAL HIGHLIGHTS

In billions, except per share amounts and percentages



YEARS ENDED DECEMBER 31 In millions, except per share amounts and percentages	2008	2009	2010
Net Sales	$23,174	$24,881	$25,183
Operating Income	2,620	3,042	2,607
Adjusted Income[1]	1,799	1,928	2,105
Adjusted EPS[1]	4.22	4.87	5.58
Operating Cash Flow from Continuing Operations	2,036	2,745	1,931
Dividends Declared per Share	1.12	1.24	1.50
Debt to Capital	20.1%	19.0%	26.7%
Return on Invested Capital (ROIC)[2]	12.0%	13.3%	14.6%

(1) Adjusted Income is income from continuing operations attributable to Raytheon Company common stockholders and Adjusted EPS is EPS from continuing operations attributable to Raytheon Company common stockholders excluding, in both cases, the impact of the FAS/CAS pension adjustment and, from time to time, certain other items. Adjusted Income and EPS are non-GAAP financial measures. Please see the page that precedes the back cover of this report for information on the excluded items, a reconciliation of these measures to GAAP and a discussion of why the company is presenting this information.

(2) ROIC has been calculated using the company's revised ROIC definition. ROIC is a non-GAAP financial measure. Please see the page that precedes the back cover of this report for information on the revised definition and the company's use of ROIC.

2010 FORM 10-K

UNITED STATES
SECURITIES AND EXCHANGE COMMISSION
WASHINGTON, D.C. 20549

FORM 10-K

☒ ANNUAL REPORT PURSUANT TO SECTION 13 OR 15(d) OF THE SECURITIES EXCHANGE ACT OF 1934

For the fiscal year ended December 31, 2010.

☐ TRANSITION REPORT PURSUANT TO SECTION 13 OR 15(d) OF THE SECURITIES EXCHANGE ACT OF 1934

For the transition period from to

Commission File Number 1-13699

RAYTHEON COMPANY

(Exact Name of Registrant as Specified in its Charter)

Delaware	95-1778500
(State or Other Jurisdiction of Incorporation or Organization)	(I.R.S. Employer Identification No.)

870 Winter Street, Waltham, Massachusetts 02451
(Address of Principal Executive Offices) (Zip Code)

(781) 522-3000
(Registrant's telephone number, including area code)

Securities registered pursuant to Section 12(b) of the Act:

Title of Each Class	Name of Each Exchange on Which Registered
Common Stock, $.01 par value	New York Stock Exchange

Securities registered pursuant to Section 12(g) of the Act:
None

Indicate by check mark if the registrant is a well-known seasoned issuer, as defined in Rule 405 of the Securities Act. Yes ☒ No ☐

Indicate by check mark if the registrant is not required to file reports pursuant to Section 13 or Section 15(d) of the Act. Yes ☐ No ☒

Indicate by check mark whether the registrant (1) has filed all reports required to be filed by Section 13 or 15(d) of the Securities Exchange Act of 1934 during the preceding 12 months (or for such shorter period that the Registrant was required to file such reports), and (2) has been subject to such filing requirements for the past 90 days. Yes ☒ No ☐

Indicate by check mark whether the registrant has submitted electronically and posted on its corporate Web site, if any, every Interactive Data File required to be submitted and posted pursuant to Rule 405 of Regulation S-T (§ 232.405 of this chapter) during the preceding 12 months (or for such shorter period that the registrant was required to submit and post such files). Yes ☒ No ☐

Indicate by check mark if disclosure of delinquent filers pursuant to Item 405 of Regulation S-K is not contained herein, and will not be contained, to the best of registrant's knowledge, in definitive proxy or information statements incorporated by reference in Part III of this Form 10-K or any amendment to this Form 10-K. ☒

Indicate by check mark whether the registrant is a large accelerated filer, an accelerated filer, a non-accelerated filer, or a smaller reporting company. See the definitions of "large accelerated filer," "accelerated filer" and "smaller reporting company" in Rule 12b-2 of the Exchange Act.

Large accelerated filer ☒ Accelerated filer ☐ Non-accelerated filer ☐ Smaller reporting company ☐

Indicate by check mark whether the registrant is a shell company (as defined in Rule 12b-2 of the Exchange Act). Yes ☐ No ☒

The aggregate market value of the voting stock held by non-affiliates of the Registrant as of June 27, 2010, was approximately $18.7 billion.

The number of shares of Common Stock outstanding as of February 11, 2011 was 359,694,000.

Documents incorporated by reference and made a part of this Form 10-K:

Portions of the Registrant's Definitive Proxy Statement for its 2011 Annual Meeting of Stockholders are incorporated by reference in Part III of this Form 10-K.

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PART I

ITEM 1. BUSINESS

General

Raytheon Company, together with its subsidiaries, is a technology and innovation leader specializing in defense, homeland security and other government markets throughout the world. We provide state-of-the-art electronics, mission systems integration and other capabilities in the areas of sensing, effects, and command, control, communications and intelligence systems (C3I), as well as a wide range of mission support services. We serve both domestic and international customers, principally as a prime contractor on a broad portfolio of defense and related programs for government customers.

We were founded in 1922 and have grown internally and through a number of acquisitions. We are incorporated in the state of Delaware. Our principal executive offices are located at 870 Winter Street, Waltham, Massachusetts 02451.

In this section, we describe our business, including our business segments, product lines, customers, operations and other considerations.

Business Segments

We operate in six business segments:
- Integrated Defense Systems;
- Intelligence and Information Systems;
- Missile Systems;
- Network Centric Systems;
- Space and Airborne Systems; and
- Technical Services.

The following is a description of each of our business segments. As part of the description, we include a discussion of some of the segment's notable initiatives and achievements in 2010, such as certain key contract awards, new product introductions and acquisitions. For a discussion of the financial performance of our business segments and other financial information, see pages 46-59 of this Form 10-K.

Integrated Defense Systems (IDS)—IDS, headquartered in Tewksbury, Massachusetts, is a leader in global capabilities integration, providing affordable, integrated solutions to a broad international and domestic customer base. IDS leverages its core domain knowledge and capabilities in sensors, command, control and communication (C3), persistent surveillance/intelligence, surveillance and reconnaissance (ISR), effects and mission support, to provide integrated naval, air and missile defense and civil security response solutions. Key customers include the U.S. Navy, Army and Air Force, and the U.S. Missile Defense Agency (MDA), and numerous international customers.

In 2010, IDS, as the prime contractor for the Patriot Air & Missile Defense System, a long-range, high-altitude system designed to defeat advanced threats, provided Patriot Configuration 3 upgrades to the U.S. Army as well as Patriot System upgrades to international customers. IDS also continued to serve as the prime mission systems integrator for all electronic and combat systems of the Zumwalt Class Destroyer program (DDG 1000), the development of mission critical software and the continued delivery of elements of mission systems equipment to the U.S. Navy. IDS was also awarded a contract to construct, integrate and test an Army/Navy Transportable Radar Surveillance (AN/TPY-2) radar to meet warfighter urgent needs.

IDS has the following principal product lines:

Patriot Programs (PP)—PP, as the prime contractor, designs, develops and produces the Patriot Air & Missile Defense System for the U.S. Army, which serves as the foundation of the U.S. Army's integrated air and missile defense against the escalating tactical ballistic missile threat. PP also provides the Patriot System to key international customers

including Germany, Greece, Spain, and The Netherlands in Europe; Israel, Kuwait, Saudi Arabia, and the United Arab Emirates (UAE) in the Middle East; and Japan, South Korea and Taiwan in the Far East. In addition, PP provides the HAWK XXI system, an advanced air defense system against low- to medium-altitude air threats with advanced fire control and battle management, to international and coalition partners.

National and Theater Security Programs (NTSP)—NTSP provides integrated whole-life air and missile defense systems for the U.S. Army, Navy, Air Force, MDA, Inter-agencies and international partners which enable warfighters to sense, detect and engage threats through air and ground-based sensors and command and control systems as well as joint system solutions and intelligence support for air and ballistic missile defense. NTSP produces systems and solutions such as the Joint Land Attack Cruise Missile Defense Elevated Netted Sensor (JLENS), a theater-based, advanced sensor system that provides long-endurance, over-the-horizon detection and tracking capabilities required to defeat the threat of cruise missiles; Early Warning Radars, including the X-band Family-of-Radars, such as the Transportable Radar Surveillance (TPY-2) radar, which enable threat detection, precision tracking, discrimination and classification of ballistic missile threats. NTSP also provides integrated capabilities in persistent surveillance, multi-domain awareness, decision support, information fusion and space situational awareness through a broad range of solutions to detect, identify, track and disseminate actionable information, as well as warfare robotics development through Raytheon Sarcos.

Seapower Capability Systems (SCS)—SCS is a provider and integrator of submarine and surface ship combat management, anti-submarine, mine warfare and integrated ship systems, as well as sensors and torpedoes for U.S. and international navies. SCS is a leader in the U.S. Navy's Open Architecture initiatives for surface combatants, serving as the prime contractor of mission systems for the Navy's DDG 1000, Zumwalt class combat system and providing Ship Self Defense System (SSDS), an open, distributed combat management system for U.S. Navy carriers and amphibious ships. For the DDG 1000, SCS designs and produces mission systems equipment, which includes the Total Ship Computing Environment (TSCE), radar, sonar, associated electronics systems and the software and hardware for these systems. These capabilities are planned to be leveraged across the U.S. Navy's family of ships. SCS is also developing the Dual Band Radar (DBR) which will be the first dual frequency radar produced for the U.S. Navy as the primary sensor for CVN 78 Ford class carriers. SCS is also prime contractor for the Cobra Judy Replacement (CJR) mission system and equipment.

Intelligence and Information Systems (IIS)—IIS, headquartered in Garland, Texas, is a leader in intelligence, surveillance and reconnaissance (ISR), advanced cyber solutions, weather and environmental solutions, and information-based solutions for law enforcement and homeland security. Approximately half of its business is for classified customers. Other key customers include the U.S. Intelligence Community, U.S. Department of Defense (DoD) agencies, the Federal Bureau of Investigations (FBI), and the National Oceanographic and Atmospheric Association (NOAA).

In 2010, IIS was awarded the initial $886 million contract to develop the first two development deliverables of the advanced control segment (OCX) of the Global Positioning System (GPS). Also in 2010, the Company acquired Trusted Computer Solutions Inc. and Technology Associates Inc., both headquartered in Northern Virginia, as well as Compucat Research Pty, based in Belconnen, Australia to support and strengthen IIS' ability to deliver end-to-end cyber capabilities by adding a host of new solutions including cross-domain information sharing, data extraction and analysis, digital media intercept and exploitation and embedded system programming. In 2010, IIS was negatively impacted by the UK Border Agency Program termination as described under "Commitments and Contingencies" on page 64.

IIS has the following principal product lines:

Defense and Civil Mission Solutions (DCMS)—DCMS provides multi-INT ground systems, unmanned systems technology, environmental information management systems and satellite command and control. Additionally, DCMS provides large-scale information processing, information integration and visualization systems for intelligence, satellite and space-based programs for commercial and DoD customers. Key programs include advanced ground solutions for strategic and tactical ISR missions, including Global Hawk, U-2, and the U.S. Air Force's Distributed Common Ground System (DCGS), a network-centric system for the U.S. armed forces designed to enable real-time information sharing. DCMS also provides ground stations for the Joint Polar Satellite System (JPSS) weather observation system, the Global Positioning System (GPS-OCX) and the NASA earth-observing research mission.

Ground Enterprise Solutions (GES)—GES primarily supports classified programs in support of the U.S. Intelligence Community. GES capabilities include ground systems for Geospatial Intelligence (GEOINT) and Signals Intelligence (SIGINT) systems, large-scale data processing and exploitation, storage architectures and high performance data handling and processing systems.

Mission Operations Solutions (MOS)—MOS provides integrated mission support and systems engineering for civil, intelligence and defense agencies, as well as international governments. Its scalable, secure and integrated business systems are focused on delivering enterprise-wide performance improvement and reliable results. Core competencies include business excellence, mission critical operations, mission systems engineering, enterprise solutions and infrastructure services.

Operational Technologies and Solutions (OTS)—OTS provides cutting-edge management and dissemination of massive volumes of intelligence data, as well as intelligence operations support capabilities for Human Intelligence (HUMINT), Open Source Intelligence (OSINT), wireless and close access collection for intelligence, law enforcement and other government agencies. OTS also has strong capabilities in geospatial, geologic and technical analysis and support.

Information Security Solutions (ISS)—ISS is focused on providing information security solutions and services to government and Fortune 500 customers worldwide. Through ISS, Raytheon combines its legacy information assurance solutions with a number of products from recent key acquisitions to provide leading cybersecurity offerings, including Active Defense—protecting mission critical systems against a wide range of internal and external threats. ISS capabilities are used to counter sophisticated and dangerous advanced persistent threats in the world. In addition to expanding in information assurance and cyber-operations areas, Raytheon is leveraging and incorporating the cyber-capabilities within ISS broadly across the company, embedding information assurance technologies and know-how into many of its core solutions and products. ISS provides high-level cyber security support to the Defense Intelligence Systems Agency on the Insider Threat Focused Observation Tool program and manages information assurance for the National Geospatial Intelligence Agency.

Advanced Programs (AP)—AP is focused on providing innovative solutions for a new generation of special missions. It applies advanced technology to address complex problems for U.S. intelligence and operational commands.

Missile Systems (MS)—MS, headquartered in Tucson, Arizona is a premier developer and producer of missile systems for the armed forces of the U.S. and other allied nations. Leveraging its key capabilities in advanced airframes, guidance and navigation systems, high-resolution sensors, targeting, and netted systems, MS develops and supports a broad range of cutting-edge weapon systems, including missiles, smart munitions, close-in weapon systems, projectiles, kinetic kill vehicles and directed energy effectors. Key customers include the U.S. Navy, Army, Air Force and Marine Corps, the MDA and the armed forces of more than 40 allied nations.

In 2010, MS continued to demonstrate its missile systems capabilities with several key contract awards and significant test successes. MS won a $450 million contract to launch development of the Small Diameter Bomb Increment II (SDB II) for the U.S. Air Force and Navy. The U.S. Army selected MS as the winner for the next phase of the Excalibur Ib program: the next-generation, 155 mm, precision-guided projectile. MS continued to gain key contract awards from a broad international customer base, including more than $600 million in international awards for the Paveway™ program and more than $250 million for the Advanced Medium-Range Air-to-Air Missile (AMRAAM) program. In addition, the Standard Missile-3 (SM-3) program had another successful flight test. SM-3 is a key element of the U.S. Government's missile defense strategy. MS also completed the risk reduction phase of the Joint Air-to-Ground Missile (JAGM) with several key flight test successes demonstrating the tri-mode seeker. MS and Boeing are partnering on the JAGM program, which will be a competitively awarded program intended to replace Hellfire, Maverick and air-launched TOW missiles.

MS has the following principal product lines:

Air Warfare Systems (AWS)—AWS products and services enable the U.S. armed forces and international customers to attack, suppress and destroy air- and ground-based targets. Products include the AMRAAM, a state-of-the-art, highly dependable and battle-proven air-to-air missile that also has a surface-to-air launch application; the Tomahawk cruise missile, an advanced surface- or submarine-launched cruise missile with loitering and network

communication capability; the SDB II, a 250 lb. class air-to-ground glide weapon with a tri-mode seeker and dual-band data link; the Joint Standoff Weapon (JSOW), a family of air-to-ground weapons that employ an integrated GPS/inertial navigation system that guides the weapon to the target; the Paveway™ family of laser- and GPS-guided smart bombs; the AIM-9X Sidewinder short-range air-to-air missile; the Miniature Air-Launched Decoy (MALD™); the High-Speed Anti-Radiation Missile (HARM) and the HARM Targeting System; and the Maverick precision strike missile.

Air & Missile Defense Systems (AMDS)—AMDS designs, develops, produces and supports air defense and ballistic missile defense interceptor systems. AMDS' primary customers are the MDA, the U.S. Navy and various international navies around the world. AMDS develops, manufactures and supports the Standard Missile family of weapons with capabilities ranging from anti-air warfare to ballistic missile defense. AMDS is responsible for the first line of ship defense weapons, the Standard Missile-2 (SM-2) and Standard Missile-6 (SM-6). AMDS is also responsible for the SM-3, which is a core element of the MDA's phased adaptive approach to global missile defense. AMDS builds and supports the Exoatmospheric Kill Vehicle (EKV), which is part of the U.S. ground-based midcourse defense system that defends our nation against ballistic missile attack. AMDS is also involved in a number of advanced missile defense concepts that seek to pace the evolving ballistic missile threat.

Naval Weapon Systems (NWS)—NWS products and services provide layered defense capability and naval surface fire support for the navies of more than 30 countries, providing highly effective ship defense across multiple platforms to counter the anti-ship threats of today and tomorrow. NWS leverages its capabilities to provide forward-operating base defense for the U.S. Army, Air Force and Marine Corps. NWS produces the Phalanx Close-In Weapon System (afloat and ashore), RAM, SeaRAM and the Evolved Sea Sparrow/Sparrow family of missiles for ship self-defense against air and surface threats. Additionally, NWS continues to expand its commitment to international cooperative endeavors with international partners and to evolve its products and technologies to encompass the full spectrum of threats, including the protection of land bases and high-value infrastructure sites to counter terrorist threats.

Land Combat—Land Combat provides precision missiles and projectiles to the U.S. Army and Marine Corps and more than 40 U.S. allied nations, and focuses on accelerating the deployment of precision munitions capability to land combat forces and on expanding its mission support capabilities. Land Combat provides the Stinger weapon system for air defense; the Tube-launched, Optically-tracked, Wireless-guided (TOW) weapon system, a long-range precision anti-armor/anti-fortification/anti-amphibious-landing weapon system; the Javelin, a shoulder-fired, fire-and-forget anti-tank weapon; and Excalibur, a GPS-guided artillery round designed to provide organic indirect precision fire for ground forces. Land Combat is also developing two new products: Laser-Guided Rocket (LGR), a low-cost, lightweight, rapidly deployable and lethal weapon for helicopters and fixed-wing aircraft; and the Shoulder-Launched Multipurpose Assault Weapon (SMAW II) for the U.S. Marine Corps.

Other MS product lines include Advanced Missiles and Unmanned Systems and Advanced Security and Directed Energy Systems (AS&DES). Advanced Missiles and Unmanned Systems focuses on the development and early introduction of next-generation, end-to-end system solutions supporting the AWS, NWS and Land Combat product lines, and leading our entry into unmanned systems. AS&DES pursues opportunities in the directed energy and adjacent markets, including the development of force protection solutions, information operations/information assurance (IO/IA), high-power microwave, high-energy laser systems, space applications, and counterterrorism solutions.

Network Centric Systems (NCS)—NCS, headquartered in McKinney, Texas, is a leading provider of net-centric mission solutions for federal, state and local government and civil customers. NCS leverages its capabilities in networking, sensors, command and control, and communications to develop and produce solutions for customers in key markets such as U.S. Army modernization, international and domestic homeland security, civil communications, and transportation solutions. NCS customers include the DoD and other U.S. Government customers, as well as numerous international customers.

In 2010, NCS' Standard Terminal Automation Replacement System (STARS) was selected by the Federal Aviation Agency (FAA) to upgrade 11 existing regional Air Traffic Control (ATC) systems. NCS is continuing to expand its entry in civil communications markets and was selected as the integrator of mobile systems for the Los Angeles Sheriff's department. NCS was also awarded production for U.S. Navy Multi-band Terminal (NMT), a single terminal for the U.S. Navy's next generation satellite communications which is designed to expand high capacity critical satellite communications to

multiple naval platforms. In addition, Raytheon BBN Technologies was chosen to support the National Cyber Range and continued to provide innovative solutions with its further development of multi-lingual automatic translation capabilities.

NCS has the following principal product lines:

Integrated Communications Systems (ICS)—ICS offers wireless, high-bandwidth and transformational communication solutions for every DoD agency, and for civil and international customers. These solutions enable connectivity for Net-centric Operations (NCO) and the Global Information Grid (GIG) and provide mission assurance to customers with satellite, point-to-point and networked communications services that are effective on land, sea, undersea, air and space. Solutions include MAINGATE, an interoperable communications platform for battlefield communications that provides a broadband gateway between separate radio systems, the Enhanced Position Location Reporting System (EPLRS), an integrated networking system that provides robust, high-speed battlefield communications for warfighters; the Secure Mobile Anti-Jam Reliable Tactical Terminal (SMART-T), a low-cost, extremely high frequency (EHF) satellite terminal that provides robust, low probability-of-detection, jam-resistant, multi-channel communications in support of the field commander; and the U.S. Navy Multi-band Terminal (NMT). ICS also includes Raytheon BBN Technologies and its advanced networking and cybersecurity technologies and capabilities.

Command and Control Systems (C2S)—C2S develops, delivers and supports domestic and international military and civil customers, including the FAA, Department of Transportation and DoD, with integrated networked command and control (C2) systems encompassing ground, air, space and security systems. Command and control systems are designed to securely capture, present and tailor actionable knowledge in real-time to the needs of decision makers (i.e. military commander, air traffic controller, border patrol, and others) to minimize information overload and enable rapid decisions. C2S ground, air and space capabilities include integrated communications, navigation, surveillance, air traffic management, and open road tolling systems. C2S products include the U.S. Army's Advanced Field Artillery Tactical Data System (AFATDS) and Joint Automated Deep Operations Coordination System (JADOCS), which provide for the command and control of battlefield weapons, effects and operations. C2S also is continuing to develop advanced airspace management capabilities with the FAA-certified Wide Area Augmentation System (WAAS), Japan's Multifunction Transport Satellite-based Augmentation System (MSAS) and India's Geosynchronous Augmented Navigation System (GAGAN) to improve airspace design flexibility and efficiency by removing route dependency on ground-based navigational aids. C2S also is developing open road tolling systems, the Perimeter Intrusion Detection System (PIDS) at four airports under the Port Authority of New York and New Jersey, and is deploying ClearView, a comprehensive yet scalable security C2 capability for critical infrastructure.

Combat Systems (CS)—CS provides integrated ground-based surveillance and target engagement solutions designed to provide a significant advantage to the U.S. Army and Marine Corps warfighters. CS develops advanced ground sensor capabilities for the U.S. Army's Brigade Combat Team (BCT) Modernization program such as the Mast Mounted Sensor (MMS) and the Multi-Function Radio Frequency System (MFRFS). CS also developed the Active Protection System (APS) which destroys rocket-propelled grenades or anti-tank missiles targeting combat vehicles. In addition, CS provides the Long Range Advanced Scout Surveillance System (LRAS3), a long-range multi-sensor system which provides the ability to detect, identify and geo-locate distant targets, and is now networked to enable multi-sensor improved accuracy. Other CS products include the Integrated Target Acquisition System (ITAS) for the Tube launched Optically tracked Wire guided (TOW) missile which increases target detection, acquisition, recognition and engagement ranges; the HTI 2nd Generation FLIR (Horizontal Technology Integration Forward Looking Infrared) systems which provide the host vehicle the capability to detect, recognize, acquire, and engage targets at extended ranges; and Thermal Weapon Sights (TWS) for individual and crew served soldier weapons.

Operations and Precision Components (OPC)—OPC provides a broad range of imaging capabilities, including next-generation X-ray, visible, infrared, and millimeter wave focal plane arrays for thermal imaging, earth remote sensing and astronomy applications. Precision optical and electronic solutions, electronic hardware and software products that enhance the interoperability of communications systems are provided through its Raytheon Vision Systems and ELCAN products. OPC also designs and manufactures strategic precision mechanical and electronic components and provides related services through its Raytheon Precision Manufacturing products. Customers include the DoD, NASA, and international customers.

Thales-Raytheon Systems, LLC (TRS LLC)—TRS LLC is the U.S. operating subsidiary of the Thales-Raytheon joint venture (TRS) and is part of NCS. TRS is a leader in complex information systems, command and control, communications systems including terrestrial, satellite and voice communications, as well as long range air defense radars, tactical short to medium range air defense radars and weapon locating radars. TRS LLC solutions include the Sentinel air defense and Firefinder weapon locating radar systems used by the U.S. Army and Marine Corps and over 20 allied nations; the Battle Command System (BCS) air command and control system used by the U.S. Air Force and Canada; and the ACCS NATO air command and control system.

Space and Airborne Systems (SAS)—SAS, headquartered in El Segundo, California, is a leader in the design and development of integrated systems and solutions for advanced missions, including traditional and non-traditional intelligence, surveillance and reconnaissance (ISR), precision engagement, unmanned aerial operations and space. Leveraging advanced concepts, state-of-the-art technologies and mission systems knowledge, SAS provides electro-optical/infrared sensors, airborne radars for surveillance and fire control applications, lasers, precision guidance systems, processors, electronic warfare systems and space-qualified systems for civil and military applications. Key customers include the U.S. Navy, Air Force and Army, as well as classified and international customers.

In 2010, SAS delivered the first APG-82(V)1 Active Electronically Scanned Array (AESA) radar for the U.S. Air Force's F-15E radar modernization program. SAS also completed a feasibility study and won a follow-on contract from the U.S. Navy to mature the technology for key elements of a Next Generation Jammer capability, a replacement for the current ALQ-99 jamming system on the EA-18G Growler. SAS' Multi-Spectral Targeting System achieved a major milestone by completing its one millionth operational flight hour and having 1,000 systems fielded both domestically and internationally. In the international market, SAS was selected to provide an Advanced Countermeasures Electronic System with self-protection capabilities for F-16 aircraft. SAS also won a major surveillance radar program as part of the India P-8I Maritime Surveillance Aircraft. In space, SAS was selected to provide the Visible Infrared Imager Radiometer Suite (VIIRS) sensor to the restructured NASA/NOAA Joint Polar Satellite System (JPSS) and U.S. Air Force Defense Weather Satellite System (DWSS) programs. VIIRS flight unit one was delivered as part of the National Polar-orbiting Operational Environmental Satellite System preparatory project program, a precursor to the JPSS and DWSS programs. Additionally, Space Systems supported the transition of ARTEMIS, a sophisticated hyperspectral imaging sensor, from AFRL to the U.S. Air Force Space Command, as an operational system. On January 31, 2011, the Company completed its acquisition of Applied Signal Technology, Inc. (AST). AST will be integrated into SAS and is expected to enhance SAS's capabilities across the full spectrum of integrated sensor solutions for classified and other government customers.

SAS has the following principal product lines:

Intelligence, Surveillance and Reconnaissance Systems (ISRS)—ISRS designs and manufactures sensor, surveillance and targeting solutions that enable actionable information for strike, persistent surveillance and special mission applications. ISRS provides maritime and overland surveillance radars, terrain following/terrain avoidance radars and electro-optical/infrared sensors to customers including every branch in the DoD, the Department of Homeland Security (DHS) and international governments. The ISRS portfolio includes the APY-10 radar on the U.S. Navy's P-8A Poseidon, the SeaVue radar on the Predator Guardian unmanned aerial system (UAS), the AAS-44(V) forward looking infrared sensor on the U.S. Navy's H-60 helicopters, the Multi-spectral Targeting System on the U.S. Air Force's Reaper and Predator UAS, the DAS-2 on the Army's Gray Eagle UAS, and the ASQ-228 ATFLIR targeting pod on the F/A-18 Hornet and Super Hornets. ISRS also provides the Enhanced Integrated Sensor Suite for the Global Hawk UAS, which enables the Global Hawk to scan large geographic areas and produce outstanding high-resolution reconnaissance imagery. In addition, ISRS provides integrated solutions for all tiers of airborne intelligence, surveillance and reconnaissance systems, including the dual mode Synthetic Aperture Radar/Moving Target Indicator sensor for the ASTOR program for the U.K. Ministry of Defence, which enables high-resolution images and the monitoring of hostile forces.

Tactical Airborne Systems (TAS)—TAS designs and manufactures cost-effective, high-performance integrated sensor solutions for tactical and strategic platforms, delivering trusted, actionable information and mission assurance. TAS provides sensors and integrated sensor systems with advanced fire control radars, electronic warfare and processor technologies to customers including the U.S. Navy, Marine Corps, and Air Force and international governments. TAS produces radars using AESA antennas for the U.S. Air Force's F-15 and B-2 aircraft, the U.S. Navy and Royal Australian

Air Forces' F/A-18, and the U.S. Navy's EA-18G. TAS also provides electronic warfare systems for large body and tactical aircraft, helicopters and surface ships. The TAS electronic warfare portfolio includes towed decoys, radar warning receivers, jammers, missile warning systems and integrated electronic warfare suites. In addition, TAS' advanced airborne processors form the basis of the secure mission computer/signal processing systems on the F-16, F-22 and F-35 aircraft.

Space Systems (SS)—SS designs and manufactures space and space-qualified sensor payloads for large national programs and develops innovative solutions for emerging intelligence, defense and civil space applications. SS provides electro-optical, infrared, radio frequency and laser space-based sensors to customers including branches of the DoD, MDA, NASA, classified customers and international governments. Its major non-classified program is VIIRS, an advanced imaging and radiometric sensor for future NASA/NOAA (JPSS) and U.S. Air Force (DWSS) weather/environmental monitoring programs.

Other SAS product lines include Advanced Concepts and Technologies (ACT) and Integrated Technology Programs (ITP). ACT conducts internal research and development for SAS and contract research and development for customers, including the U.S. Air Force Research Laboratory (ARFL) and Defense Advanced Research Projects Agency (DARPA). ITP provides a wide range of state-of-the-art product families and engineering services in support of the DoD's recent efforts to transform the capabilities and structure of the U.S. Armed Forces, including a variety of sophisticated GPS systems and anti-jam solutions for many customers, including the U.S. Air Force and Navy.

Technical Services (TS)—TS, headquartered in Dulles, Virginia, provides a full spectrum of technical, scientific and professional services to defense, federal, international and commercial customers worldwide. It specializes in training, logistics, engineering services and solutions, product support and operational support services. TS provides solutions for mission support, homeland security, space, civil aviation, counterproliferation and counterterrorism markets. Key customers include all branches of the U.S. Armed Forces, as well as the DHS, NASA, FAA, Department of Energy, Defense Threat Reduction Agency (DTRA) and international governments.

In 2010, TS continued to expand its training, logistics and engineering solutions capabilities and offerings domestically and internationally. The TS-led Air Traffic Control Optimum Training Solution (ATCOTS) program trained more than 4,000 FAA air traffic controllers. In support of customer engineering upgrades and transformation, TS won two contracts to support F-16 aircraft with a revolutionary helmet-mounted display system and an upgraded Center Display Unit. TS also won a contract to engineer and manufacture an advanced Multi-Purpose Bomb Rack for the U.S. Navy. In addition, the TS-led Warfighter Field Operations Customer Support (FOCUS) activities have been providing integrated training and training support, primarily to the U.S. Army, at numerous locations around the world for nearly three years.

TS has the following principal product lines:

Warfighter Support Services (WSS)—WSS provides training solutions, logistics and engineering support throughout the world. Within WSS, the TS-led Warrior Training Alliance (WTA) operates activities in support of the U.S. Army's Warfighter FOCUS contract, conducting integrated operational training with the U.S. Army, as well as U.S. Air Force and Marine Corps among other customers. TS is leading a team of subcontractors on this ten year program which is composed of various contracts for education, live, virtual and constructive training, including operational training for domestic and foreign locations. Work performed includes: support for live, virtual and constructive training exercises and operations; maintenance for all training and range systems; curriculum development and instruction; management oversight and administration for contractor activities; and supply support for all government-owned property and material.

Mission Support Operations (MSO)—MSO supports systems and products from design to deployment, providing services to the mission support, civil aviation, homeland security and threat reduction markets. MSO offers a range of capabilities including engineering services and solutions, field support, integrated logistics support, training, maintenance, installation and integration services for U.S. and international government customers and contractors. MSO provides support to NASA's Neutral Buoyancy Lab and Space Vehicle Mockup Facility at the Johnson Space Center and also works with DTRA on international counterproliferation and counterterrorism programs in the former Soviet Union.

Customized Engineering & Depot Support (CEDS)—CEDS provides a broad spectrum of engineering and limited-production services, including Capability Maturity Model Integration for Development (CMMI-DEV®) Maturity

Level 3 capability for all engineering functions. CEDS also provides full life-cycle support for air, sea and land-based electronics and weapons. For the V-22 Osprey aircraft program, CEDS manages the Systems Integration Lab, leads the software support activity, performs updates to operational flight profile software and provides mission planning software and training devices. CEDS also provides integration and field support for the Shared Reconnaissance Pod, which enables real-time, high-resolution imaging for F/A-18E/F air crews and air operation commanders. CEDS provides upgrades and integration services to a number of air platforms, including the A-10, the HH-60, the B-52 and the F-16, and ground-based platforms, including radars and tanks. CEDS also provides Mission Support to Canada's military across numerous platforms, including the Phalanx Close-In Weapon System, the SPS-49 Air Defense Radar and the APG-73 Radar.

Raytheon Professional Services (RPS)—RPS designs, implements and manages highly complex training solutions that align an organization's employees, customers and partners. Using systems engineering practices, RPS applies commercial solutions, processes, tools and training experts to make its training programs available anytime, anywhere. This enables RPS clients to scale competencies and resources to meet the geographic, cultural and regulatory demands of their distributed enterprise. RPS helps leading companies in numerous countries rethink the way training is delivered internally. RPS clients include General Motors Corporation, NASA and the FAA.

Raytheon Polar Services—Raytheon Polar Services is the prime operations and logistics contractor to the National Science Foundation to support scientific research and maintain a geopolitical presence in Antarctica. It provides core business applications, information security processes and oversight in accordance with stringent federal guidelines.

International Subsidiaries—We conduct the operations and activities of our business segments in certain countries through international subsidiaries, including Raytheon Systems Limited (RSL) for the U.K., Raytheon Australia and Raytheon Canada Limited (RCL). RSL designs, develops and manufactures advanced systems for network-enabled operations, safety critical control functions and precision systems for the U.K. Ministry of Defence and commercial air traffic control organizations. Programs include the Airborne Standoff Radar (ASTOR), a world-class ground surveillance capability (with SAS) and the Joint Effects Tactical Targeting System (JETTS) (with NCS). Raytheon Australia is a Mission Support and mission systems integration provider to the Australian Government. Programs include the Air Warfare Destroyer contract to design, develop and procure the combat system for the new Hobart Class destroyers (with IDS). Raytheon Australia also manages the entire operations and maintenance requirements of the Canberra Deep Space Communication Complex and provides design, integration and lifecycle operations and maintenance services for the Royal Australian Defense Force's aerospace capability (with TS). RCL provides persistent surveillance radar for air traffic management systems (primarily with NCS).

Sales to the U.S. Government

Our total net sales to the U.S. Government were $22.3 billion in 2010, $22.0 billion in 2009 and $20.2 billion in 2008, representing 88% of total net sales in 2010 and 2009 and 87% of total net sales in 2008. Included in U.S. Government sales were foreign military sales through the U.S. Government of $3.3 billion, $2.8 billion and $1.8 billion in 2010, 2009 and 2008, respectively. Our principal U.S. Government customer is the DoD; other U.S. Government customers include the Departments of Homeland Security, Justice, State and Energy, Intelligence Community agencies, NASA and the FAA.

U.S. Government Contracts and Regulation

We act as a prime contractor or major subcontractor for numerous U.S. Government programs. As a result, we are subject to extensive regulations and requirements of the U.S. Government agencies and entities which govern these programs, including with respect to the award, administration and performance of contracts under such programs. We are also subject to certain unique business risks associated with U.S. Government program funding and appropriations and government contracts and with supplying technologically-advanced, cutting edge defense-related products and services to the U.S. Government.

U.S. Government contracts generally are subject to the Federal Acquisition Regulation (FAR), which sets forth policies, procedures and requirements for the acquisition of goods and services by the U.S. Government, department-specific regulations that implement or supplement FAR, such as the DoD's Defense Federal Acquisition Regulation Supplement (DFARS) and other applicable laws and regulations. These regulations impose a broad range of requirements, many of which are unique to government contracting, including various procurement, import and export, security, contract

pricing and cost, contract termination and adjustment, and audit requirements. A contractor's failure to comply with these regulations and requirements could result in reductions to the value of contracts, contract modifications or termination, and the assessment of penalties and fines and lead to suspension or debarment, for cause, from government contracting or subcontracting for a period of time. In addition, government contractors are also subject to routine audits and investigations by U.S. Government agencies such as the Defense Contract Audit Agency (DCAA) and Defense Contract Management Agency (DCMA). These agencies review a contractor's performance under its contracts, cost structure and compliance with applicable laws, regulations and standards. The DCAA also reviews the adequacy of and a contractor's compliance with its internal control systems and policies, including the contractor's purchasing, property, estimating, compensation and management information systems. For a discussion of certain risks associated with compliance with U.S. Government contract regulations and requirements, see Item 1A "Risk Factors" of this Form 10-K.

U.S. Government contracts include both cost reimbursement and fixed-price contracts. Cost reimbursement contracts, subject to a contract-ceiling amount in certain cases, provide for the reimbursement of allowable costs plus the payment of a fee. These contracts fall into three basic types: (i) cost plus fixed fee contracts which provide for the payment of a fixed fee irrespective of the final cost of performance, (ii) cost plus incentive fee contracts which provide for increases or decreases in the fee, within specified limits, based upon actual cost results compared to contractual cost targets, and (iii) cost plus award fee contracts which provide for the payment of an award fee determined at the discretion of the customer based upon the performance of the contractor against pre-established criteria. Under cost reimbursement type contracts, the contractor is reimbursed periodically for allowable costs and is paid a portion of the fee based on contract progress. Some costs incident to performing contracts have been made partially or wholly unallowable for reimbursement by statute, FAR or other regulation. Examples of such costs include charitable contributions, certain merger and acquisition costs, lobbying costs, interest expense and certain litigation defense costs.

Fixed-price contracts are either firm fixed-price contracts or fixed-price incentive contracts. Under firm fixed-price contracts, the contractor agrees to perform a specific scope of work for a fixed price and as a result, benefits from cost savings and carries the burden of cost overruns. Under fixed-price incentive contracts, the contractor shares with the government savings accrued from contracts performed for less than target costs and costs incurred in excess of targets up to a negotiated ceiling price (which is higher than the target cost) and carries the entire burden of costs exceeding the negotiated ceiling price. Accordingly, under such incentive contracts, the contractor's profit may also be adjusted up or down depending upon whether specified performance objectives are met. Under firm fixed-price and fixed-price incentive type contracts, the contractor usually receives either milestone payments equaling up to 90% of the contract price or monthly progress payments from the government generally in amounts equaling 80% of costs incurred under government contracts. The remaining amount, including profits or incentive fees, is billed upon delivery and acceptance of end items under the contract. For a discussion of certain risks associated with fixed price and cost reimbursement contracts, see Item 1A "Risk Factors" of this Form 10-K.

U.S. Government contracts generally also permit the government to terminate the contract, in whole or in part, without prior notice, at the government's convenience or for default based on performance. If a contract is terminated for convenience, the contractor is generally entitled to payments for its allowable costs and will receive some allowance for profit on the work performed. If a contract is terminated for default, the contractor is generally entitled to payments for its work that has been accepted by the government. The U.S. Government's right to terminate its contracts has not had a material adverse effect upon our operations or financial condition. For a discussion of the risks associated with the U.S. Government's right to terminate its contracts, see Item 1A "Risk Factors" of this Form 10-K.

U.S. Government programs generally are implemented by the award of individual contracts and subcontracts. Congress generally appropriates funds on a fiscal year basis even though a program may extend across several fiscal years. Consequently, programs are often only partially funded initially and additional funds are committed only as Congress makes further appropriations. The contracts and subcontracts under a program generally are subject to termination for convenience or adjustment if appropriations for such programs are not available or change. The U.S. Government is required to equitably adjust a contract price for additions or reductions in scope or other changes ordered by it. For a discussion of the risks associated with program funding and appropriations, see Item 1A "Risk Factors" and "Overview" within Item 7 of this Form 10-K. In addition, because we are engaged in supplying technologically-advanced, cutting edge defense-related products and services to the U.S. Government, we are subject to certain business risks, some of which are

specific to our industry. These risks include: the cost of obtaining and retaining trained and skilled employees; the uncertainty and instability of prices for raw materials and supplies; the problems associated with advanced designs, which may result in unforeseen technological difficulties and cost overruns; and the intense competition and the constant necessity for improvement in facilities and personnel training. Our sales to the U.S. Government may be affected by changes in procurement policies, budget considerations, changing concepts of national defense, political developments abroad and other factors. See Item 1A "Risk Factors" and "Overview" within Item 7 of this Form 10-K for a more detailed discussion of these and other related risks.

We are also involved in U.S. Government programs, principally through our IIS and SAS business segments, which are classified by the U.S. Government and cannot be specifically described in this Form 10-K. The operating results of these classified programs are included in our consolidated financial statements. The business risks and considerations associated with these and our international classified programs generally do not differ materially from those of our other programs and products. Total classified sales were 14%, 13% and 12% of total net sales in 2010, 2009 and 2008, respectively.

We are subject to government regulations and contract requirements which may differ from U.S. Government regulation with respect to our sales to non-U.S. customers. See "International Sales" below for more information regarding our sales outside of the U.S. and Item 1A "Risk Factors" for a discussion of the risks associated with international sales.

See "Sales to the U.S. Government" on page 8 of this Form 10-K for information regarding the percentage of our revenues generated from sales to the U.S. Government.

International Sales

Our sales to customers outside the U.S. were $5.8 billion or 23% of total net sales in 2010, $5.3 billion or 21% of total net sales in 2009, and $4.6 billion or 20% of total net sales in 2008. In 2010, international sales were negatively impacted by the UK Border Agency Program termination as described in "Commitments and Contingencies" on page 64. Included in sales to customers outside the U.S. were foreign military sales through the U.S. Government of $3.3 billion, $2.8 billion and $1.8 billion, in 2010, 2009 and 2008, respectively. International sales were principally in the fields of air defense systems, missile systems, airborne radars, naval systems, air traffic control systems, missile defense systems, electronic equipment, computer software and systems, homeland security solutions, personnel training, equipment maintenance and microwave communication and other products and services permitted under the International Traffic in Arms Regulations (ITAR). Generally, we finance our foreign subsidiary working capital requirements in the applicable countries. Sales and income from international operations and investments are subject to U.S. Government laws, regulations and policies, including the ITAR and the Foreign Corrupt Practices Act and the export laws and regulations described below, as well as foreign government laws, regulations and procurement policies and practices, which may differ from U.S. Government regulation, including import-export control, investments, exchange controls, repatriation of earnings and requirements to expend a portion of program funds in-country. In addition, embargoes, international hostilities and changes in currency values can also impact our international sales. Exchange restrictions imposed by various countries could restrict the transfer of funds between countries and between Raytheon and its subsidiaries. We have acted to protect ourselves against most undue risks through insurance, foreign exchange contracts, contract provisions, government guarantees and/or progress payments. See revenues derived from external customers and long-lived assets by geographical area set forth in "Note 16: Business Segment Reporting" within Item 8 of this Form 10-K.

In connection with certain foreign sales, we utilize the services of sales representatives who are paid commissions in return for services rendered.

The export from the U.S. of many of our products may require the issuance of a license by either the U.S. Department of State under the Arms Export Control Act of 1976 (formerly the Foreign Military Sales Act) and its implementing regulations under the ITAR, the U.S. Department of Commerce under the Export Administration Act and its implementing regulations as kept in force by the International Emergency Economic Powers Act of 1977 (IEEPA), and/or the U.S. Department of the Treasury under IEEPA or the Trading with the Enemy Act of 1917. Such licenses may be denied for reasons of U.S. national security or foreign policy. In the case of certain exports of defense equipment and services, the Department of State must notify Congress at least 15-60 days (depending on the identity of the importing country that will utilize the equipment and services) prior to authorizing such exports. During that time, Congress may take action to block or delay a proposed export by joint resolution which is subject to Presidential veto.

Additional information regarding the risks associated with our international business is contained in Item 1A "Risk Factors" of this Form 10-K.

Backlog

Our total backlog of orders was $34.6 billion at December 31, 2010 and $36.9 billion at December 31, 2009. Included in total backlog was $28.5 billion and $30.3 billion from the U.S. Government at December 31, 2010 and 2009, respectively. Included in U.S. Government backlog was foreign military sales backlog of $5.6 billion and $7.2 billion at December 31, 2010 and 2009, respectively. Also included in total backlog was direct foreign government backlog and non-government foreign backlog of $5.3 billion and $0.4 billion at December 31, 2010 and $5.6 billion and $0.6 billion at December 31, 2009, respectively. Also, included in total backlog was $0.2 billion and $0.4 billion of non-U.S. government domestic backlog at December 31, 2010 and 2009, respectively. Total international backlog including foreign military sales backlog was $11.3 billion or 33% of total backlog at the end of 2010 compared with $13.4 billion or 36% of total backlog at the end of 2009. Approximately $16.0 billion of the 2010 year-end backlog is not expected to be filled during the following twelve months. These amounts include both funded backlog (unfilled orders for which funding is authorized, appropriated and contractually obligated by the customer) and unfunded backlog (firm orders for which funding has not been appropriated or obligated to us). For additional information related to backlog figures, see "Segment Results" within Item 7 of this Form 10-K.

Research and Development

We conduct extensive research and development activities to continually enhance our existing products and services and develop new products and services to meet our customers' changing needs and requirements and address new market opportunities. During 2010, we expended $625 million on research and development efforts compared with $565 million in 2009 and $517 million in 2008. These expenditures principally have been for product development for the U.S. Government, including bid and proposal efforts related to U.S. Government programs. We also conduct funded research and development activities under U.S. Government contracts which are included in net sales. For additional information related to our research and development activities, see "Note 1: Summary of Significant Accounting Policies" within Item 8 of this Form 10-K.

Raw Materials, Suppliers and Seasonality

We are dependent upon the delivery of materials by suppliers and the assembly of major components and subsystems by subcontractors used in our products. Some products require relatively scarce raw materials. In addition, we must comply with specific procurement requirements which may, in effect, limit the suppliers and subcontractors we may utilize. In some instances, for a variety of reasons, we are dependent on sole-source suppliers. We enter into long-term or volume purchase agreements with certain suppliers and take other actions to ensure the availability of needed materials, components and subsystems. We generally have not experienced material difficulties in procuring the necessary raw materials, components and other supplies for our products.

In recent years, our revenues in the second half of the year have generally exceeded revenues in the first half. The timing of U.S. Government awards, the availability of U.S. Government funding and product deliveries are among the factors affecting the periods in which revenues are recorded. We expect this trend to continue in 2011.

Competition

We directly participate in most major areas of development in the defense and government electronics, space, information technology and technical services and support markets. Technical superiority, reputation, price, past performance, delivery schedules, financing and reliability are among the principal competitive factors considered by customers in these markets. We compete worldwide with a number of U.S. and international companies in these markets, some of which may have more extensive or more specialized engineering, manufacturing and marketing capabilities than we do in some areas. The on-going consolidation of the U.S. and global defense, space and aerospace industries continues to intensify competition and has reduced the number of principal prime contractors in the U.S. As a result of this consolidation, we frequently partner on various programs with our major suppliers, some of whom are, from time to time, competitors on other programs. In addition, U.S. defense spending levels in the near future are increasingly difficult to predict. Changes in U.S. defense spending may potentially limit certain future market opportunities. See Item 1A "Risk Factors" and "Overview" within Item 7 of this Form 10-K for a more detailed discussion of these and other related risks.

Patents and Licenses

We own an intellectual property portfolio which includes many United States and foreign patents, as well as unpatented know-how, data, software, trademarks and copyrights, all of which contribute to the preservation of our competitive

position in the market. In certain instances, we have augmented our technology base by licensing the proprietary intellectual property of others. We also license our intellectual property to others. While our intellectual property rights in the aggregate are important to the operation of Raytheon, we do not believe that any existing patent, license or other intellectual property right is of such importance that its loss or termination would have a material adverse effect on our business, taken as a whole.

Employment

As of December 31, 2010, we had approximately 72,000 employees. Approximately 8% of our employees are unionized. We consider our union-management relationships to be generally satisfactory.

Environmental Regulation

Our operations are subject to and affected by a variety of international, federal, state and local environmental protection laws and regulations. We have provided for the estimated cost to complete remediation where we have determined that it is probable that we will incur such costs in the future to address the environmental impact at current or formerly owned operating facilities or at sites where we have been named a Potentially Responsible Party (PRP) by the Environmental Protection Agency (EPA) or similarly designated by other environmental agencies. It is difficult to estimate the timing and ultimate amount of environmental cleanup costs to be incurred in the future due to the uncertainties regarding the extent of the required cleanup, the discovery and application of innovative remediation technologies, and the status of the law, regulations and their interpretations.

In order to assess the potential impact on our consolidated financial statements, we estimate the possible remediation costs that we could reasonably incur. Such estimates take into consideration the professional judgment of our environmental professionals and, in most cases, consultations with outside environmental specialists.

If we are ultimately found to have liability at those sites where we have been designated a PRP, we expect that the actual costs of remediation will be shared with other liable PRPs. Generally, PRPs that are ultimately determined to be responsible parties are strictly liable for site clean-up and usually agree among themselves to share, on an allocated basis, the costs and expenses for investigation and remediation of hazardous materials. Under existing environmental laws, however, responsible parties are, in most circumstances and jurisdictions, jointly and severally liable and, therefore, potentially liable for the full cost of funding such remediation. In the unlikely event that we are required to fund the entire cost of such remediation, the statutory framework provides that we may pursue rights of contribution from the other PRPs. The amounts we record do not reflect the unlikely event that we would be required to fund the entire cost of such remediation, nor do they reflect the possibility that we may recover some of these environmental costs from insurance policies or from other PRPs, because neither manner of recovery is deemed probable. However, a portion of these costs are eligible for future recovery through the pricing of our products and services to the U.S. Government.

We manage various government-owned facilities on behalf of the U.S. Government. At such facilities, environmental compliance and remediation costs have historically been primarily the responsibility of the government and we relied (and continue to rely with respect to past practices) upon government funding to pay such costs. While the government remains responsible for capital and operating costs associated with environmental compliance, responsibility for fines and penalties associated with environmental noncompliance are typically borne by either the government or the contractor, depending on the contract and the relevant facts. Fines and penalties are unallowable costs under the contracts pursuant to which such facilities are managed.

Most of the laws governing environmental matters include criminal provisions. If we were convicted of a criminal violation of certain federal environmental statutes, including the Federal Clean Air Act and the Clean Water Act, the facility or facilities involved in the violation would be placed by the EPA on the "Excluded Parties List" maintained by the Government Services Administration. The listing would continue until the EPA concluded that the cause of the violation had been cured. Listed facilities cannot be used in performing any U.S. Government contract awarded during any period of listing by the EPA.

Additional information regarding the effect of compliance with environmental protection requirements and the resolution of environmental claims against Raytheon and its operations is contained in Item 1A "Risk Factors," Item 3

"Legal Proceedings," "Commitments and Contingencies" within Item 7 and "Note 11: Commitments and Contingencies" within Item 8 of this Form 10-K.

Available Information

Our internet address is www.raytheon.com. We use our Investor Relations website as a routine channel for distribution of important information, including news releases, analyst presentations, and financial information. We make available free of charge on or through our Investor Relations web site our annual reports and quarterly reports on Forms 10-K and 10-Q (including related filings in XBRL format), current reports on Form 8-K and amendments to those reports as soon as reasonably practicable after we electronically file such material with, or furnish it to, the Securities and Exchange Commission (SEC). Our SEC filings are also at the Public Reference Room of the SEC at 100 F Street, N.E., Washington, D.C. 20549. You may obtain information on the operation of the Public Reference Room by calling 1-800-SEC-0330. In addition, the SEC also maintains an internet site at www.sec.gov that contains reports, proxy statements and other information regarding registrants that file electronically, including Raytheon.

We also make available on or through our website copies of our key corporate governance documents, including our Governance Principles, Certificate of Incorporation, By-laws and charters for the Audit Committee, Management Development and Compensation Committee, Governance and Nominating Committee and Public Affairs Committee of the Board of Directors and our code of ethics entitled "Code of Conduct". Stockholders may request free copies of these documents from our Investor Relations Department by writing to Raytheon Company, Investor Relations, 870 Winter Street, Waltham, MA 02451, or by calling (781) 522-5123 or by sending an email request to invest@raytheon.com.

The content on any website referred to in this Form 10-K is not incorporated by reference into this Form 10-K unless expressly noted.

ITEM 1A. RISK FACTORS

This Form 10-K and the information we are incorporating by reference contain forward-looking statements within the meaning of federal securities laws, including information regarding our financial outlook, future plans, objectives, business prospects, trends and anticipated financial performance including with respect to our liquidity and capital resources, our pension expense and funding, our unrecognized tax benefits and the outcome of legal and administrative proceedings, claims, investigations, commitments and contingencies, as well as information regarding domestic and international defense spending and budgets. You can identify these statements by the fact that they include words such as "will," "believe," "anticipate," "expect," "estimate," "intend," "plan," or variations of these words, or similar expressions. These forward-looking statements are not statements of historical facts and represent only our current expectations regarding such matters. These statements inherently involve a wide range of known and unknown uncertainties. Our actual actions and results could differ materially from what is expressed or implied by these statements. Specific factors that could cause such a difference include, but are not limited to, those set forth below and other important factors disclosed previously and from time to time in our other filings with the Securities and Exchange Commission. Given these factors, as well as other variables that may affect our operating results, you should not rely on forward-looking statements, assume that past financial performance will be a reliable indicator of future performance, nor use historical trends to anticipate results or trends in future periods. We expressly disclaim any obligation or intention to provide updates to the forward-looking statements and the estimates and assumptions associated with them.

We depend on the U.S. Government for a substantial portion of our business and changes in government defense spending could have consequences on our financial position, results of operations and business.

In 2010, U.S. Government sales accounted for approximately 88% of our total net sales. U.S. Government sales included foreign military sales through the U.S. Government of $3.3 billion in 2010. Our revenues from the U.S. Government largely result from contracts awarded to us under various U.S. Government programs, primarily defense-related programs with the Department of Defense (DoD), as well as a broad range of programs with the Department of Homeland Security, the Intelligence Community and other departments and agencies. The funding of our programs is subject to the overall U.S. Government budget and appropriation decisions and processes which are driven by numerous

factors, including geo-political events and macroeconomic conditions. The overall level of U.S. defense spending has increased in recent years for numerous reasons, including increases in funding of operations in Iraq and Afghanistan and the DoD's modernization initiatives. Looking forward, defense spending levels are becoming increasingly difficult to predict and will be affected by numerous factors. Such factors include the external threat environment, funding for on-going operations in Iraq and Afghanistan, priorities of the Administration and the Congress, and the overall health of the U.S. and world economies and the state of governmental finances.

Significant changes in defense spending could have long-term consequences for our size and structure. In addition, changes in government priorities and requirements could impact the funding, or the timing of funding, of our programs which could negatively impact our results of operations and financial condition.

In addition, we are involved in U.S. Government programs, principally through our IIS and SAS business segments, which are classified by the U.S. Government and our ability to discuss these programs, including any risks and disputes and claims associated with and our performance under such programs, could be limited due to applicable security restrictions.

Our financial performance is dependent on our ability to perform on our U.S. Government contracts, which are subject to uncertain levels of funding and termination.

Our financial performance is dependent on our performance under our U.S. Government contracts. While we are involved in numerous programs and are party to thousands of U.S. Government contracts, the termination of one or more large contracts, whether due to lack of funding, for convenience, or otherwise, or the occurrence of delays, cost overruns and product failures in connection with one or more large contracts, could negatively impact our results of operations and financial condition. Furthermore, we can give no assurance that we would be awarded new U.S. Government contracts to offset the revenues lost as a result of termination of any of our contracts.

The funding of U.S. Government programs is subject to congressional appropriations. Congress generally appropriates funds on a fiscal year basis even though a program may extend over several fiscal years. Consequently, programs are often only partially funded initially and additional funds are committed only as Congress makes further appropriations. If appropriations for one of our programs become unavailable, or are reduced or delayed, our contract or subcontract under such program may be terminated or adjusted by the government, which could have a negative impact on our future sales under such contract or subcontract. From time to time, when a formal appropriation bill has not been signed into law before the end of the U.S. Government's fiscal year, Congress may pass a Continuing Resolution that authorizes agencies of the U.S. Government to continue to operate, generally at the same funding levels from the prior year, but does not authorize new spending initiatives, during a certain period. During such period (or until the regular appropriation bills are passed), delays can occur in procurement of products and services due to lack of funding, and these delays can affect our results of operations during the period of delay.

In addition, U.S. Government contracts generally also permit the government to terminate the contract, in whole or in part, without prior notice, at the government's convenience or for default based on performance. If one of our contracts is terminated for convenience, we would generally be entitled to payments for our allowable costs and would receive some allowance for profit on the work performed. If one of our contracts is terminated for default, we would generally be entitled to payments for our work that has been accepted by the government. A termination arising out of our default could expose us to liability and have a negative impact on our ability to obtain future contracts and orders. Furthermore, on contracts for which we are a subcontractor and not the prime contractor, the U.S. Government could terminate the prime contract for convenience or otherwise, irrespective of our performance as a subcontractor.

Our government contracts also typically involve the development, application and manufacture of advanced defense and technology systems and products aimed at achieving challenging goals. New technologies may be untested or unproven. In some instances, product requirements or specifications may be modified. As a result, we may experience technological and other performance difficulties, which may result in delays, setbacks, cost overruns and product failures, in connection with performing our government contracts.

Our international business is subject to geo-political and economic factors, regulatory requirements and other risks.

Our international business exposes us to geo-political and economic factors, regulatory requirements and other risks associated with doing business in foreign countries. These risks differ from and potentially may be greater than those associated with our domestic business. In addition, our exposure to such risks may increase if our international business continues to grow as we anticipate.

Our international business is sensitive to changes in the priorities and budgets of international customers and geo-political uncertainties, which may be driven by changes in threat environments and potentially volatile worldwide economic conditions, various regional and local economic and political factors, risks and uncertainties, as well as U.S. foreign policy. Our international sales are subject to U.S. laws, regulations and policies, including the International Traffic in Arms Regulations (ITAR) and the Foreign Corrupt Practices Act and other export laws and regulations. Due to the nature of our products, we must first obtain licenses and authorizations from various U.S. Government agencies before we are permitted to sell our products outside of the U.S. We can give no assurance that we will continue to be successful in obtaining the necessary licenses or authorizations or that certain sales will not be prevented or delayed. Any significant impairment of our ability to sell products outside of the U.S. could negatively impact our results of operations and financial condition.

Our international sales are also subject to local government laws, regulations and procurement policies and practices which may differ from U.S. Government regulations, including regulations relating to import-export control, investments, exchange controls and repatriation of earnings, as well as to varying currency, geo-political and economic risks. Our international contracts may include industrial cooperation agreements requiring specific in-country purchases, manufacturing agreements or financial support obligations, known as offset obligations, and provide for penalties if we fail to meet such requirements. Our international contracts may also be subject to termination at the customer's convenience or for default based on performance, and may be subject to funding risks. We also are exposed to risks associated with using foreign representatives and consultants for international sales and operations and teaming with international subcontractors, partners and suppliers in connection with international programs.

As a result of these factors, we could experience award and funding delays on international programs and could incur losses on such programs which could negatively impact our results of operations and financial condition.

Competition within our markets may reduce our revenues and market share.

We operate in highly competitive markets and our competitors may have more extensive or more specialized engineering, manufacturing and marketing capabilities than we do in some areas. We anticipate increasing competition in our core markets as a result of defense industry consolidation, which has enabled companies to enhance their competitive position and ability to compete against us. In addition, as discussed in more detail above, U.S. defense spending levels in the near future are increasingly difficult to predict. Changes in U.S. defense spending and the U.S. Government procurement environment may potentially limit certain future market opportunities. We are also facing increasing competition in our domestic and international markets from foreign and multinational firms. Additionally, some customers, including the DoD, are increasingly turning to commercial contractors, rather than traditional defense contractors, for information technology and other support work. If we are unable to continue to compete successfully against our current or future competitors, we may experience declines in revenues and market share which could negatively impact our results of operations and financial condition. In the current competitive environment there may be an increase in bid protests from unsuccessful bidders on new program awards. Generally, a bid protest will delay the start of contract activities, and could result in the award decision being overturned, requiring a re-bid of the contract.

Our future success depends on our ability to develop new offerings and technologies for our current and future markets.

To achieve our business strategies and continue to grow our revenues and operating profit, we must successfully develop new or adapt or modify our existing offerings and technologies for our current core defense markets and our future markets, including adjacent and emerging markets. Accordingly, our future performance depends on a number of factors, including our ability to:

- Identify emerging technological trends in our current and future markets;
- Identify additional uses for our existing technology to address customer needs in our current and future markets;

- Develop and maintain competitive products and services for our current and future markets;
- Enhance our offerings by adding innovative features that differentiate our offerings from those of our competitors;
- Develop and manufacture and bring solutions to market quickly at cost-effective prices; and
- Effectively structure our businesses, through the use of joint ventures, collaborative agreements and other forms of alliances, to reflect the competitive environment.

We believe that, in order to remain competitive in the future, we will need to continue to invest significant financial resources to develop new and adapt or modify our existing offerings and technologies, including through internal research and development, acquisitions and joint ventures or other teaming arrangements. These expenditures could divert our attention and resources from other projects, and we cannot be sure that these expenditures will ultimately lead to the timely development of new offerings and technologies. Due to the design complexity of our products, we may in the future experience delays in completing the development and introduction of new products. Any delays could result in increased costs of development or deflect resources from other projects. In addition, there can be no assurance that the market for our offerings will develop or continue to expand as we currently anticipate. The failure of our technology to gain market acceptance could significantly reduce our revenues and harm our business. Furthermore, we cannot be sure that our competitors will not develop competing technologies which gain market acceptance in advance of our products.

The possibility exists that our competitors might develop new technology or offerings that might cause our existing technology and offerings to become obsolete. If we fail in our new product development efforts or our products or services fail to achieve market acceptance more rapidly than our competitors, our ability to procure new contracts could be negatively impacted, which would negatively impact our results of operations and financial condition.

We enter into fixed-price and other contracts which could subject us to losses in the event that we experience cost growth that cannot be billed to customers.

Generally, our customer contracts are either fixed-priced or cost reimbursable contracts. Under fixed-priced contracts, which represent about half of our backlog, we receive a fixed price irrespective of the actual costs we incur and, consequently, we must carry the burden of any cost overruns. Due to their nature, fixed-priced contracts inherently have more risk than cost reimbursable contracts, particularly fixed-price development contracts where the costs to complete the development stage of the program can be highly variable, uncertain and difficult to estimate. Under cost reimbursable contracts, subject to a contract-ceiling amount in certain cases, we are reimbursed for allowable costs and paid a fee, which may be fixed or performance based. If our costs exceed the contract ceiling and are not authorized by the customer or are not allowable under the contract or applicable regulations, we may not be able to obtain reimbursement for all such costs and our fees may be reduced or eliminated. Because many of our contracts involve advanced designs and innovative technologies, we may experience unforeseen technological difficulties and cost overruns. Under both types of contracts, if we are unable to control costs or if our initial cost estimates are incorrect, we can lose money on these contracts. In addition, some of our contracts have provisions relating to cost controls and audit rights, and if we fail to meet the terms specified in those contracts, we may not realize their full benefits. Lower earnings caused by cost overruns and cost controls would have a negative impact on our results of operations.

Our business could be adversely affected by a negative audit by the U.S. Government.

As a government contractor, we are subject to routine audits and investigations by U.S. Government agencies such as the Defense Contract Audit Agency (DCAA). These agencies review a contractor's performance under its contracts, cost structure and compliance with applicable laws, regulations and standards. The DCAA also reviews the adequacy of and a contractor's compliance with its internal control systems and policies, including the contractor's purchasing, property, estimating, compensation and management information systems. Any costs found to be improperly allocated to a specific contract will not be reimbursed or must be refunded if already reimbursed. If an audit uncovers improper or illegal activities, we may be subject to civil and criminal penalties and administrative sanctions, which may include termination of contracts, forfeiture of profits, suspension of payments, fines and suspension or prohibition from doing business with the U.S. Government. In addition, we could suffer serious reputational harm if allegations of impropriety were made against us.

As a U.S. Government contractor, we are subject to a number of procurement rules and regulations.

Government contractors must also comply with specific procurement regulations and other requirements. These requirements, although customary in government contracts, impact our performance and compliance costs. In addition, current U.S. Government budgetary constraints could lead to changes in the procurement environment, including the DoD's recent initiative focused on efficiencies, affordability and cost growth and other changes to its procurement practices. If and to the extent such changes occur, they could impact our results of operations and liquidity, and could affect whether and, if so, how we pursue certain opportunities and the terms under which we are able to do so.

In addition, failure to comply with these regulations and requirements could result in reductions of the value of contracts, contract modifications or termination, and the assessment of penalties and fines, which could negatively impact our results of operations and financial condition. Our failure to comply with these regulations and requirements could also lead to suspension or debarment, for cause, from government contracting or subcontracting for a period of time. Among the causes for debarment are violations of various statutes, including those related to procurement integrity, export control, government security regulations, employment practices, protection of the environment, accuracy of records and the recording of costs, and foreign corruption. The termination of a government contract as a result of any of these acts could have a negative impact on our results of operations and financial condition and could have a negative impact on our reputation and ability to procure other government contracts in the future.

We depend on component availability, subcontractor performance and our key suppliers to manufacture and deliver our products and services.

We are dependent upon the delivery by suppliers of materials and the assembly by subcontractors of major components and subsystems used in our products in a timely and satisfactory manner and in full compliance with applicable terms and conditions. Some products require relatively scarce raw materials. We are generally subject to specific procurement requirements, which may, in effect, limit the suppliers and subcontractors we may utilize. In some instances, we are dependent on sole-source suppliers. If any of these suppliers or subcontractors fails to meet our needs, we may not have readily available alternatives. While we enter into long-term or volume purchase agreements with certain suppliers and take other actions to ensure the availability of needed materials, components and subsystems, we cannot be sure that such items will be available in the quantities we require, if at all. In addition, some of our suppliers or subcontractors may be impacted by the recent global financial crisis, which could impair their ability to meet their obligations to us. If we experience a material supplier or subcontractor problem, our ability to satisfactorily and timely complete our customer obligations could be negatively impacted which could result in reduced sales, termination of contracts and damage to our reputation and relationships with our customers. We could also incur additional costs in addressing such a problem. Any of these events could have a negative impact on our results of operations and financial condition.

We use estimates in accounting for many of our programs and changes in our estimates could adversely affect our future financial results.

Contract accounting requires judgment relative to assessing risks, including risks associated with customer directed delays and reductions in scheduled deliveries, unfavorable resolutions of claims and contractual matters, judgments associated with estimating contract revenues and costs, and assumptions for schedule and technical issues. Due to the size and nature of many of our contracts, the estimation of total revenues and cost at completion is complicated and subject to many variables. For example, we must make assumptions regarding the length of time to complete the contract because costs also include expected increases in wages and prices for materials; consider whether the intent of entering into multiple contracts was effectively to enter into a single project in order to determine whether such contracts should be combined or segmented; consider incentives or penalties related to performance on contracts in estimating sales and profit rates, and record them when there is sufficient information for us to assess anticipated performance; and use estimates of award fees in estimating sales and profit rates based on actual and anticipated awards. Because of the significance of the judgments and estimation processes described above, it is likely that materially different amounts could be recorded if we used different assumptions or if the underlying circumstances were to change. Changes in underlying assumptions, circumstances or estimates may adversely affect our future results of operations and financial condition.

Significant changes in key estimates and assumptions, such as discount rates and assumed long-term return on assets (ROA), as well as our actual investment returns on our pension plan assets, and other factors could affect our earnings, equity and pension contributions in future periods.

We must determine our pension and other benefit plans' expense or income which involves significant judgment, particularly with respect to our discount rate, long-term ROA and other actuarial assumptions. If our assumptions change significantly due to changes in economic, legislative, and/or demographic experience or circumstances, our pension and other benefit plans' expense and funded status, and our cash contributions to such plans could negatively change which would negatively impact our results of operations. In addition, differences between our actual investment returns and our long-term ROA assumption would result in a change to our pension and other benefit plans' expense and funded status and our required contributions to the plans. They may also be impacted by changes in regulatory, accounting and other requirements applicable to pensions.

For a complete discussion regarding how our financial statements can be affected by pension and other benefit plan accounting policies, see "Critical Accounting Estimates" on page 35 within Item 7 of this Form 10-K.

We have made, and expect to continue to make, strategic acquisitions and investments, and these activities involve risks and uncertainties.

In pursuing our business strategies, we continually review, evaluate and consider potential investments and acquisitions. In evaluating such transactions, we are required to make difficult judgments regarding the value of business opportunities, technologies and other assets, and the risks and cost of potential liabilities. Furthermore, acquisitions and investments involve certain other risks and uncertainties, including the difficulty in integrating newly-acquired businesses, the challenges in achieving strategic objectives and other benefits expected from acquisitions or investments, the diversion of our attention and resources from our operations and other initiatives, the potential impairment of acquired assets and the potential loss of key employees of the acquired businesses.

We have entered, and expect to continue to enter, into joint venture, teaming and other arrangements, and these activities involve risks and uncertainties.

We have entered, and expect to continue to enter, into joint venture, teaming and other arrangements. These activities involve risks and uncertainties, including the risk of the joint venture or applicable entity failing to satisfy its obligations, which may result in certain liabilities to us for guarantees and other commitments, the challenges in achieving strategic objectives and expected benefits of the business arrangement, the risk of conflicts arising between us and our partners and the difficulty of managing and resolving such conflicts, and the difficulty of managing or otherwise monitoring such business arrangements.

Goodwill and other intangible assets represent a significant portion of our assets and any impairment of these assets could negatively impact our results of operations.

At December 31, 2010, we had goodwill and other intangible assets of approximately $12.6 billion, net of accumulated amortization, which represented approximately 51% of our total assets. Our goodwill is subject to an impairment test on an annual basis and is also tested whenever events and circumstances indicate that goodwill may be impaired. Any excess goodwill resulting from the impairment test must be written off in the period of determination. Intangible assets (other than goodwill) are generally amortized over the useful life of such assets. In addition, from time to time, we may acquire or make an investment in a business which will require us to record goodwill based on the purchase price and the value of the acquired assets. We may subsequently experience unforeseen issues which adversely affect the value of our goodwill or the intangible assets and trigger an evaluation of the recoverability of the recorded goodwill and intangible assets. Future determinations of significant write-offs of goodwill or intangible assets as a result of an impairment test or any accelerated amortization of other intangible assets could have a negative impact on our results of operations and financial condition.

The outcome of litigation in which we have been named as a defendant is unpredictable and an adverse decision in any such matter could have a material adverse effect on our financial position or results of operations.

We are defendants in a number of litigation matters and are subject to various other claims, demands and investigations. These matters may divert financial and management resources that would otherwise be used to benefit our operations. No assurances can be given that the results of these matters will be favorable to us. An adverse resolution or outcome of any of these lawsuits, claims, demands or investigations could have a negative impact on our financial condition, results of operations and liquidity.

We depend on the recruitment and retention of qualified personnel, and our failure to attract and retain such personnel could seriously harm our business.

Due to the specialized nature of our business, our future performance is highly dependent upon the continued services of our key engineering personnel and executive officers, the development of additional management personnel and the hiring of new qualified engineering, manufacturing, marketing, sales and management personnel for our operations. Competition for personnel is intense, and we may not be successful in attracting or retaining qualified personnel. In addition, certain personnel may be required to receive security clearance and substantial training in order to work on certain programs or perform certain tasks. The loss of key employees, our inability to attract new qualified employees or adequately train employees, or the delay in hiring key personnel could seriously harm our business, results of operations and financial condition.

Our business could be negatively impacted by security threats and other disruptions.

As a U.S. defense contractor, we face certain security threats, including threats to our information technology infrastructure, attempts to gain access to our proprietary or classified information, and threats to physical security. These types of events could disrupt our operations, require significant management attention and resources, and could negatively impact our reputation among our customers and the public, which could have a negative impact on our financial condition, results of operations and liquidity.

Some of our workforce is represented by labor unions so our business could be harmed in the event of a prolonged work stoppage.

Approximately 5,800 of our employees are unionized, which represents approximately 8% of our employee-base at December 31, 2010. As a result, we may experience work stoppages, which could adversely affect our business. We cannot predict how stable our union relationships will be or whether we will be able to successfully negotiate successor agreements without impacting our financial condition. In addition, the presence of unions may limit our flexibility in dealing with our workforce. Work stoppages could negatively impact our ability to manufacture our products on a timely basis, which could negatively impact our results of operations and financial condition.

We may be unable to adequately protect our intellectual property rights, which could affect our ability to compete.

We own many U.S. and foreign patents and patent applications, and have rights in unpatented know-how, data, software, trademarks and copyrights. The U.S. Government has licenses under certain of our patents and certain other intellectual property that are developed in performance of government contracts, and it may use or authorize others to use such patents and intellectual property for government purposes. There can be no assurance that any of our patents and other intellectual property will not be challenged, invalidated, misappropriated or circumvented by third parties. In some instances, we have augmented our technology base by licensing the proprietary intellectual property of others. In the future, we may not be able to obtain necessary licenses on commercially reasonable terms. We enter into confidentiality and invention assignment agreements with our employees and enter into non-disclosure agreements with our suppliers and appropriate customers so as to limit access to and prevent disclosure of our proprietary information. These measures may not suffice to deter misappropriation or third party development of similar technologies. Moreover, the laws concerning intellectual property vary among nations and the protection provided to our intellectual property by the laws and courts of foreign nations may not be as advantageous to us as the remedies available under U.S. law.

Our operations expose us to the risk of material environmental liabilities.

We use and generate large quantities of hazardous substances and wastes in our manufacturing operations. As a result, we are subject to potentially material liabilities related to personal injuries or property damages that may be caused by hazardous substance releases and exposures. For example, we are investigating and remediating contamination related to our past practices at numerous properties and, in some cases, have been named as a defendant in related "toxic tort" claims for costs of cleanup and property damages.

We are also subject to increasingly stringent laws and regulations that impose strict requirements for the proper management, treatment, storage and disposal of hazardous substances and wastes, restrict air and water emissions from our manufacturing operations, including government-owned facilities we manage, and require maintenance of a safe workplace. These laws and regulations can impose substantial fines and criminal sanctions for violations, and may require the installation of costly pollution control equipment or operational changes to limit pollution emissions and/or decrease the likelihood of accidental hazardous substance releases. In addition, if we were convicted of a violation of the Federal Clean Air Act or the Clean Water Act, the facility involved in the violation could not be used in performing any U.S. Government contract awarded during the violation period. We incur, and expect to continue to incur, capital and operating costs to comply with these laws and regulations. In addition, new laws and regulations, changes in the enforcement of existing laws and regulations, the discovery of previously unknown contamination or the imposition of new clean-up requirements could require us to incur costs in the future that would have a negative effect on our financial condition or results of operations.

We face certain significant risk exposures and potential liabilities that may not be adequately covered by indemnity or insurance.

A significant portion of our business relates to designing, developing and manufacturing advanced defense and technology systems and products. New technologies may be untested or unproven. In addition, we may incur significant liabilities that are unique to our products and services, including missile systems, command and control systems, border security systems, and air traffic management systems. In some, but not all, circumstances, we may be entitled to indemnification from our customers, either through contractual provisions, qualification of our products and services by the Department of Homeland Security under the SAFETY Act provisions of the Homeland Security Act of 2002, or otherwise. The amount of our insurance coverage we maintain may not be adequate to cover all claims or liabilities, and it is not possible to obtain insurance to protect against all operational risks and liabilities. Accordingly, we may be forced to bear substantial costs resulting from risks and uncertainties of our business which would negatively impact our results of operations and financial condition.

Unanticipated changes in our tax provisions or exposure to additional income tax liabilities could affect our profitability.

We are subject to income taxes in the United States and many foreign jurisdictions. Significant judgment is required in determining our worldwide provision for income taxes. In the ordinary course of our business, there are many transactions and calculations where the ultimate tax determination is uncertain. Furthermore, changes in domestic or foreign income tax laws and regulations, or their interpretation, could result in higher or lower income tax rates assessed or changes in the taxability of certain sales or the deductibility of certain expenses, thereby affecting our income tax expense and profitability. In addition, we regularly are under audit by tax authorities. The final determination of tax audits and any related litigation could be materially different from our historical income tax provisions and accruals. Additionally, changes in the geographic mix of our sales could also impact our tax liabilities and affect our income tax expense and profitability.

ITEM 1B. UNRESOLVED STAFF COMMENTS

None.

ITEM 2. PROPERTIES

We and our subsidiaries operate in a number of plants, laboratories, warehouses and office facilities in the United States and abroad.

As of December 31, 2010, we owned, leased and/or utilized (through operating agreements) approximately 29.3 million square feet of floor space for manufacturing, engineering, research, administration, sales and warehousing, approximately 93% of which was located in the United States. Of such total, approximately 44% was owned (or held under a long term ground lease with ownership of the improvements), approximately 51% was leased, and approximately 5% was made available under facilities contracts for use in the performance of United States Government contracts. Of the 29.3 million square feet of floor space owned, leased and/or utilized by us, approximately 0.7 million square feet was leased or subleased to unrelated third parties. In addition to the 29.3 million square feet, we had approximately 0.7 million square feet of floor space that was vacant.

There are no major encumbrances on any of our facilities other than financing arrangements which in the aggregate are not material. In the opinion of management, our properties have been well maintained, are suitable and adequate for us to operate at present levels, and the productive capacity and extent of utilization of the facilities are appropriate for the existing real estate requirements of the Company.

As of December 31, 2010, our business segments had major operations at the following locations:

- Integrated Defense Systems—Huntsville, AL; San Diego, CA; Andover, MA; Billerica, MA; Maple Lawn, MD; Sudbury, MA; Tewksbury, MA; Woburn, MA; Portsmouth, RI; Keyport, WA; and Kiel, Germany;
- Intelligence and Information Systems—Aurora, CO; Riverdale, MD; Omaha, NE; State College, PA; Garland, TX; Dulles, VA; Reston, VA; Springfield, VA; and Uxbridge, England;
- Missile Systems—East Camden, AR; Tucson, AZ; Rancho Cucamonga, CA; Louisville, KY; and Farmington, NM;
- Network Centric Systems—Fullerton, CA; Goleta, CA; Largo, FL; Ft. Wayne, IN; Marlboro, MA; Cambridge, MA; Dallas, TX; McKinney, TX; Plano, TX; Richardson, TX; Midland, Ontario, Canada; Waterloo, Ontario, Canada; Harlow, England; Malaga, Spain; and Glenrothes, Scotland;
- Space and Airborne Systems—El Segundo, CA; Goleta, CA; Forest, MS; Dallas, TX; and McKinney TX;
- Technical Services—Chula Vista, CA; Orlando, FL; Indianapolis, IN; Burlington, MA; Troy, MI; Norfolk, VA; Dulles, VA; Canberra, Australia; and Christchurch, New Zealand;
- Corporate—Billerica, MA; Waltham, MA; Garland, TX; Plano, TX; Dulles, VA; and Arlington, VA;

A summary of the space owned, leased and/or utilized by us as of December 31, 2010, by business segment is as follows:

	Leased	Owned[1]	Government Owned[2]	Total[3]
Integrated Defense Systems	2,143,000	3,219,000	109,000	5,471,000
Intelligence and Information Systems	2,197,000	792,000	—	2,989,000
Missile Systems	2,705,000	1,150,000	1,247,000	5,102,000
Network Centric Systems	2,542,000	3,367,000	—	5,909,000
Space and Airborne Systems	2,210,000	3,691,000	—	5,901,000
Technical Services	2,652,000	207,000	188,000	3,047,000
Corporate	547,000	378,000	—	925,000
Totals	14,996,000	12,804,000	1,544,000	29,344,000

(1) Ownership may include either fee ownership of land and improvements or a long term land lease with ownership of improvements.
(2) "Government Owned" shall mean space utilized by the Company pursuant to an operating agreement (GOCO).
(3) Excludes approximately 660,000 square feet of vacant space.

ITEM 3. LEGAL PROCEEDINGS

We primarily engage in providing products and services under contracts with the U.S. Government and, to a lesser degree, under direct foreign sales contracts, some of which the U.S. Government funds. These contracts are subject to extensive legal and regulatory requirements and, from time to time, agencies of the U.S. Government investigate whether our operations are being conducted in accordance with these requirements. U.S. Government investigations of us, whether relating to these contracts or conducted for other reasons, could result in administrative, civil or criminal liabilities, including repayments, fines or penalties being imposed upon us, the suspension of government export licenses or the suspension or debarment from future U.S. Government contracting. U.S. Government investigations often take years to complete and many result in no adverse action against us. Government contractors are also subject to many levels of audit and investigation. Agencies that oversee contract performance include: the Defense Contract Audit Agency, the Defense Contract Management Agency, the Inspector General of the Department of Defense and other departments and agencies, the Government Accountability Office, the Department of Justice (DoJ) and Congressional Committees. The DoJ, from time to time, has convened grand juries to investigate possible irregularities by us. We also provide products and services to customers outside of the U.S. and those sales are subject to local government laws, regulations and procurement policies and practices. Our compliance with such local government regulation or any applicable U.S. Government regulation (e.g., the Foreign Corrupt Practices Act and the International Traffic in Arms Regulations) may also be investigated or audited.

We are currently conducting a self-initiated internal review of certain of our international operations, focusing on compliance with the Foreign Corrupt Practices Act. In the course of the review, we have identified several possible areas of concern relating to payments made in connection with certain international operations related to a jurisdiction where we do business. We have voluntarily contacted the Securities and Exchange Commission and the DoJ to advise both agencies that an internal review is underway. Because the internal review is ongoing, we cannot predict the ultimate consequences of the review. Based on the information available to date, we do not believe that the results of this review will have a material adverse effect on our financial condition, results of operations or liquidity.

We are involved in various stages of investigation and cleanup related to remediation of various environmental sites. We accrued all appropriate costs we expect to incur in connection therewith. Due to the complexity of environmental laws and regulations, the varying costs and effectiveness of alternative cleanup methods and technologies, the uncertainty of insurance coverage and the unresolved extent of our responsibility, it is difficult to determine the ultimate outcome of these matters. However, in the opinion of management, we do not expect any additional liability to have a material effect on our financial position, results of operations or liquidity. Additional information regarding the effect of compliance with environmental protection requirements and the resolution of environmental claims against us and our operations can be found in "Environmental Regulation" within Item 1, Item 1A "Risk Factors," "Commitments and Contingencies" within Item 7 and "Note 11: Commitments and Contingencies" within Item 8 of this Form 10-K.

On July 22, 2010, Raytheon Systems Limited (RSL) was notified by the UK Border Agency that it had been terminated for cause on a program. The termination notice included allegations that RSL had failed to perform on certain key milestones and other matters in addition to claims to recover certain losses incurred and previous payments made to RSL. We believe that RSL performed well and delivered substantial capabilities to the UK Border Agency under the program, which has been operating successfully and providing actionable information since live operations began in May 2009. On July 29, 2010, RSL filed a dispute notice on the grounds that the termination by the UK Border Agency was not valid. On August 18, 2010, the UK Border Agency initiated arbitration proceedings on this issue. We expect the arbitration procedures to commence in the first half of 2011. We intend to pursue vigorously the collection of receivables for the program and damages in connection with the termination and defend ourselves against the UK Border Agency's claims for losses and previous payments.

As a result of the termination notice, we adjusted our estimated amount of revenue and costs under the program in the second quarter of 2010. The adjustment was based on our determination that certain assets were no longer expected to be recovered and for estimated costs for certain exit cost obligations under the contract and the estimated settlement of expected future subcontractor claims. The impact of the adjustment reduced Intelligence and Information Systems' total net sales and operating income by $316 million and $395 million, respectively, for the year ended December 31, 2010. At

December 31, 2010, we had approximately $80 million in letters of credit and approximately $70 million of receivables and other assets remaining under the program for technology and services delivered, which we believe, are probable of recovery in litigation or arbitration. No amounts have been drawn down on the letters of credit. We currently do not believe it is probable that we are liable for losses, previous payments or other claims asserted by the UK Border Agency. Due to the inherent uncertainties in litigation and arbitration as noted above, and the complexity and technical nature of potential claims and counterclaims, as well as the resolution of the related matters involving subcontractors, it is reasonably possible that the ultimate amount of any resolution of the termination could be less or greater than our estimate and at this time, we are unable to estimate a range of the potential difference in such amounts, if any. If we are unsuccessful in recovering amounts drawn on the letters of credit, if any, fail to collect the receivable balance, are required to make payments against claims or other losses asserted by the UK Border Agency or pay subcontractor claims in excess of our estimates made in connection with the adjustment in the second quarter of 2010 described above, it could have a material adverse effect on our financial position, results of operations or liquidity.

In addition, various other claims and legal proceedings generally incidental to the normal course of business are pending or threatened against us. While we cannot predict the outcome of these matters, in the opinion of management, any liability arising from them will not have a material adverse effect on our financial position, results of operations or liquidity.

ITEM 4. (REMOVED AND RESERVED)

EXECUTIVE OFFICERS OF THE REGISTRANT

Our executive officers are listed below. Each executive officer was elected by our Board of Directors to serve for a term of one year and until his or her successor is elected and qualified or until his or her earlier removal, resignation or death.

Daniel J. Crowley

Mr. Crowley has served as Vice President of Raytheon Company and President of the Network Centric Systems (NCS) business unit since December 2010. From November 2010 to December 2010, he was President of the NCS business unit. Prior to joining Raytheon, Mr. Crowley spent 27 years in various management positions of increasing responsibility at Lockheed Martin Corporation, a global security and information technology company. From June 2010 to November 2010, Mr. Crowley served as chief operating officer of Lockheed Martin Corporation's Aeronautics business unit and from May 2005 to June 2010, he served as executive vice president and general manager of the F-35 Joint Strike Fighter program. Age 48.

Lynn A. Dugle

Ms. Dugle has served as Vice President of Raytheon Company and President of the Intelligence and Information Systems (IIS) business unit since January 2009. From June 2008 to December 2008, she was Vice President and Deputy General Manager of the IIS business unit. From April 2004 to June 2008, she served as Vice President, Engineering, Technology and Quality for the Network Centric Systems business unit. Prior to rejoining Raytheon in April 2004, Ms. Dugle held a wide range of officer-level positions with ADC Communications, Inc., a global provider of network infrastructure products and services. Age 51.

Richard A. Goglia

Mr. Goglia has served as Vice President and Treasurer since January 1999. From August 2006 to May 2009, Mr. Goglia also served as Vice President—Corporate Development. Prior to joining Raytheon in March 1997, Mr. Goglia spent 16 years in various financial and management positions at General Electric Company, a diversified technology, media and financial services company, and General Electric Capital Corporation where his last position was Senior Vice President—Corporate Finance. Age 59.

John D. Harris II

Mr. Harris has served as Vice President of Raytheon Company and President of the Technical Systems (TS) business unit since March 2010. From May 2005 to May 2010, he was Vice President—Contracts and Supply Chain. From June 2003 to May 2005, Mr. Harris was Vice President of Contracts. From September 2002 to June 2003, Mr. Harris was Vice President of Contracts for Raytheon's government and defense businesses. From April 2001 to September 2002, he was Vice President of Operations for the former Electronic Systems business unit. Age 49.

Thomas A. Kennedy

Mr. Kennedy has served as Vice President of Raytheon Company and President of the Integrated Defense Systems (IDS) business unit since June 2010. From July 2007 to June 2010, he was Vice President of the Tactical Airborne Systems product line within the Space and Airborne Systems (SAS) business unit, and from May 2003 to July 2007 was Vice President of the Mission System Integration product line within the SAS business unit. Mr. Kennedy joined Raytheon in 1983 and has held positions of increasing responsibility as a new business leader and program manager for several radar and electronic warfare systems development programs. Age 55.

Taylor W. Lawrence

Dr. Lawrence has served as Vice President of Raytheon Company and President of the Missiles Systems (MS) business unit since July 2008. Dr. Lawrence joined Raytheon in April 2006 and until July 2008, he served as Vice President, Engineering, Technology and Mission Assurance. From August 2001 to April 2006, Dr. Lawrence was sector vice president and general manager, C4ISR & Space Sensors Division for Northrop Grumman Electronic Systems. From March 1999 to August 2001, Dr. Lawrence was vice president, Products and Technology for Northrop Grumman's Systems Development & Technology Division. Before joining Northrop Grumman, Dr. Lawrence served as the staff director for the Select Committee on Intelligence for the U.S. Senate and, previously, as deputy director, Information Systems Office of the Defense Advanced Research Projects Agency. Age 47.

Keith J. Peden

Mr. Peden has served as Senior Vice President—Human Resources since March 2001. From November 1997 to March 2001, Mr. Peden was Vice President and Deputy Director—Human Resources. From April 1993 to November 1997, Mr. Peden was Corporate Director of Benefits and Compensation. Age 60.

Jay B. Stephens

Mr. Stephens has served as Senior Vice President and General Counsel since October 2002. In December 2006, he was also elected as Secretary of the Company. From January 2002 to October 2002, Mr. Stephens served as Associate Attorney General of the United States. From 1997 to 2002, Mr. Stephens was Corporate Vice President and Deputy General Counsel for Honeywell International, Inc. (formerly AlliedSignal, Inc.). From 1993 to 1997, he was a partner in the Washington office of the law firm of Pillsbury, Madison & Sutro (now Pillsbury Winthrop Shaw Pittman LLP). Mr. Stephens served as United States Attorney for the District of Columbia from 1988 to 1993. From 1986 to 1988, he served in the White House as Deputy Counsel to the President. Mr. Stephens currently serves on the Board of the New England Legal Foundation. Age 64.

William H. Swanson

Mr. Swanson has served as Chairman since January 2004 and as Chief Executive Officer since July 2003. Mr. Swanson joined Raytheon in 1972 and has held increasingly responsible management positions, including: President from July 2002 to May 2004; Executive Vice President of Raytheon Company and President of Raytheon's Electronic Systems business unit from January 2000 to July 2002; Executive Vice President of Raytheon Company and Chairman and CEO of Raytheon Systems Company from January 1998 to January 2000; Executive Vice President of Raytheon Company and General Manager of Raytheon's Electronic Systems business unit from March 1995 to January 1998; and Senior Vice President and General Manager of the Missile Systems division from August 1990 to March 1995. Mr. Swanson has served on the Board of Directors of NextEra Energy, Inc., a leading clean energy company, since October 2009. Age 62.

David C. Wajsgras

Mr. Wajsgras has served as Senior Vice President and Chief Financial Officer since March 2006. From August 2005 to March 2006, Mr. Wajsgras served as Executive Vice President and Chief Financial Officer of Lear Corporation, an automotive interior systems and components supplier. From January 2002 to August 2005, he served as Senior Vice President and Chief Financial Officer of Lear. Mr. Wajsgras joined Lear in September 1999 as Vice President and Controller. Age 51.

Michael J. Wood

Mr. Wood has served as Vice President and Chief Accounting Officer since October 2006. Prior to joining Raytheon, Mr. Wood held positions of increasing responsibility over a 16-year career at KPMG LLP, an accounting firm, including most recently as an Audit Partner serving various aerospace and defense clients. Age 42.

Richard R. Yuse

Mr. Yuse has served as Vice President of Raytheon Company and President of the Space and Airborne Systems (SAS) business unit since March 2010. From May 2007 to March 2010, he was President of the TS business unit. From March 2007 to May 2007, Mr. Yuse was Vice President and Deputy General Manager of the TS business unit, and from January 2006 to March 2007, he served as Vice President of the Integrated Air Defense product line of the IDS business unit. Mr. Yuse joined Raytheon in 1976 and has held positions of increasing responsibility on a variety of programs ranging from system architecture and design to flight test director and program manager. Age 59.

PART II

ITEM 5. MARKET FOR REGISTRANT'S COMMON EQUITY, RELATED STOCKHOLDER MATTERS AND ISSUER PURCHASES OF EQUITY SECURITIES

At February 11, 2011, there were 34,217 record holders of our common stock. Our common stock is traded on the New York Stock Exchange under the symbol "RTN". For information concerning stock prices and dividends paid during the past two years, see "Note 17: Quarterly Operating Results (Unaudited)" within Item 8 of this Form 10-K.

Securities Authorized for Issuance Under Equity Compensation Plans

The following table provides information about our equity compensation plans that authorize the issuance of shares of our common stock. This information is provided as of December 31, 2010.

Plan Category	(A) Number of securities to be issued upon exercise of outstanding options, warrants and rights[1]	(B) Weighted average exercise price of outstanding options, warrants and rights[2]	(C) Number of securities remaining available for future issuance under equity compensation plans (excluding securities reflected in column A)
Equity compensation plans approved by stockholders	8,897,787	$37.23	11,865,166
Equity compensation plans not approved by stockholders	—	—	—
Total	8,897,787	$37.23	11,865,166

(1) This amount includes 2,266,538 shares, which is the aggregate of the actual number of shares issued pursuant to the 2008 Long-Term Performance Plan (LTTP) awards and the maximum number of shares that may be issued upon settlement of outstanding 2009 and 2010 LTPP awards, including estimated dividend equivalent amounts. The shares to be issued pursuant to the 2008, 2009 and 2010 LTPP awards will be issued under the 2010 Stock Plan. The material terms of the 2008, 2009 and 2010 LTPP awards are described in more detail in "Note 13: Stock-based Compensation Plans" within Item 8 of this Form 10-K. These awards, which are granted as restricted stock units, may be settled in cash or in stock at the discretion of the Management Development and Compensation Committee.

This amount also includes 181,067 shares that may be issued upon settlement of restricted stock units, generally issued to non-U.S. employees. The shares to be issued in settlement of the restricted stock units will be issued under the 2010 Stock Plan. The awards of restricted stock units generally vest one-third per year on the second, third and fourth anniversaries of the date of grant.

This amount also includes 1,818,069 shares issuable upon exercise of stock options granted under the 1995 Stock Option Plan. The 1995 Stock Option Plan expired in March 2005 and no additional options may be granted pursuant to that plan.

(2) Since restricted stock awards and restricted stock unit awards do not have an exercise price, the weighted average exercise price does not take into account restricted stock awards and the 2008, 2009 and 2010 LTPP awards and restricted stock units generally granted to non-U.S. employees.

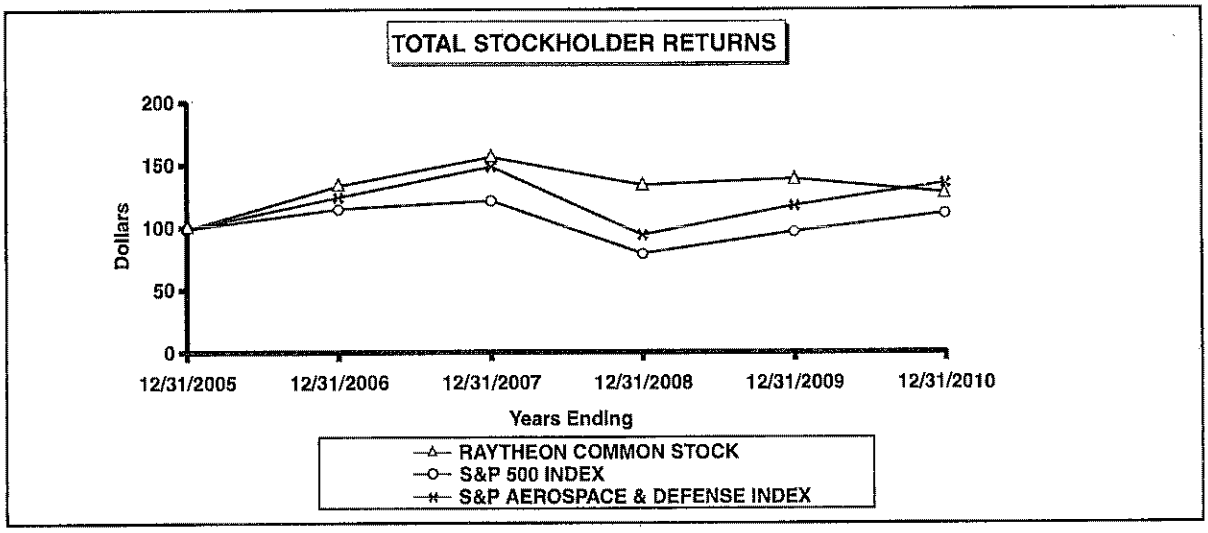
Stock Performance Graph

The following chart compares the total return on a cumulative basis of $100 invested in our common stock on December 31, 2005 to the Standard & Poor's 500 Stock Index and the Standard & Poor's Aerospace & Defense Index.

Total Return To Shareholders
(Includes reinvestment of dividends)

	Annual Return Percentage Years Ending				
Company / Index	12/31/2006	12/31/2007	12/31/2008	12/31/2009	**12/31/2010**
Raytheon Common Stock	34.17	17.02	(14.20)	3.62	(8.00)
S&P 500 Index	15.79	5.49	(37.00)	26.46	15.06
S&P Aerospace & Defense Index	25.16	19.32	(36.54)	24.64	15.11

		Indexed Returns Years Ending				
Company / Index	Base Period 12/31/2005	12/31/2006	12/31/2007	12/31/2008	12/31/2009	**12/31/2010**
Raytheon Common Stock	100	134.17	157.01	134.71	139.59	128.42
S&P 500 Index	100	115.79	122.16	76.96	97.33	111.99
S&P Aerospace & Defense Index	100	125.16	149.34	94.77	118.12	135.98



Issuer Purchases of Equity Securities

Period	Total Number of Shares Purchased[1]	Average Price Paid per Share	Total Number of Shares Purchased as Part of Publicly Announced Plans	Approximate Dollar Value of Shares that May Yet Be Purchased Under the Plan[2]
October (September 27, 2010-October 24, 2010)	7,102	$45.33	—	$1.7 billion
November (October 25, 2010-November 21, 2010)	2,654,375	47.54	2,628,185	$1.5 billion
December (November 22, 2010-December 31, 2010)	2,681,503	46.75	2,677,662	$1.4 billion
Total	5,342,980	$47.14	5,305,847	

(1) Includes shares purchased related to treasury activity under our stock plans. Such activity during the fourth quarter of 2010 includes the surrender by employees of 37,133 shares to satisfy tax withholding obligations in connection with the vesting of restricted stock issued to employees.

(2) In March, 2010 our Board of Directors authorized the repurchase of up to an additional $2.0 billion of our outstanding common stock. All previous repurchase programs have been completed as of December 31, 2010. Share repurchases will take place from time to time at management's discretion depending on market conditions.

ITEM 6. SELECTED FINANCIAL DATA

The following selected consolidated financial data should be read in conjunction with the information contained in Item 7, "Management's Discussion and Analysis of Financial Condition and Results of Operations" and the consolidated financial statements and notes thereto included in Item 8 of this Form 10-K, which are incorporated herein by reference, in order to understand the factors that may affect the comparability of the financial data presented below.

FIVE-YEAR STATISTICAL SUMMARY

(In millions, except per share amounts and total employees)	**2010**	2009	2008	2007	2006
Results of Operations					
Total net sales	$25,183	$24,881	$23,174	$21,301	$19,707
Operating income	2,607	3,042	2,620	2,354	1,966
Interest expense, net	110	109	65	33	197
Income from continuing operations	1,843	1,977	1,698	1,719	1,209
Income (loss) from discontinued operations, net of tax	36	(1)	(2)	885	96
Net income	1,879	1,976	1,696	2,604	1,305
Net income attributable to Raytheon Company	1,840	1,935	1,672	2,578	1,283
Net cash provided by operating activities from continuing operations	1,931	2,745	2,036	1,249	2,477
Net cash provided by operating activities	1,942	2,725	2,015	1,198	2,743
Diluted earnings per share from continuing operations attributable to Raytheon Company common stockholders	$ 4.79	$ 4.89	$ 3.93	$ 3.78	$ 2.62
Diluted earnings per share attributable to Raytheon Company common stockholders	4.88	4.89	3.92	5.75	2.83
Dividends declared per share	1.50	1.24	1.12	1.02	0.96
Average diluted shares outstanding	377.0	395.7	426.5	448.4	453.9
Financial Position at Year-End					
Cash and cash equivalents	$ 3,638	$ 2,642	$ 2,259	$ 2,655	$ 2,460
Current assets	8,822	7,868	7,417	7,616	9,517
Property, plant and equipment, net	2,003	2,001	2,024	2,058	2,025
Total assets	24,422	23,607	23,134	23,152	25,396
Current liabilities	5,960	5,523	5,149	4,788	6,715
Long-term liabilities (excluding debt)	4,962	5,816	6,488	3,467	4,232
Long-term debt	3,610	2,329	2,309	2,268	3,278
Total debt	3,610	2,329	2,309	2,268	3,965
Total equity	9,890	9,939	9,188	12,629	11,171
General Statistics					
Bookings	$24,449	$25,058	$26,820	$25,498	$22,417
Total backlog	34,551	36,877	38,884	36,614	33,838
Additions to property, plant and equipment	319	280	304	313	294
Depreciation and amortization	420	402	390	372	361
Total employees from continuing operations	72,400	75,100	72,800	72,100	69,900

ITEM 7. MANAGEMENT'S DISCUSSION AND ANALYSIS OF FINANCIAL CONDITION AND RESULTS OF OPERATIONS

OVERVIEW

Introduction

Raytheon Company develops technologically advanced, integrated products, services and solutions in four core defense markets, sensing, effects, command, control, communications and intelligence (C3I), and mission support, as well as the cybersecurity and homeland security markets. We serve both domestic and international customers, as both a prime and subcontractor on a broad portfolio of defense and related programs for government customers.

We operate in six business segments: Integrated Defense Systems (IDS), Intelligence and Information Systems (IIS), Missile Systems (MS), Network Centric Systems (NCS), Space and Airborne Systems (SAS) and Technical Services (TS). For a more detailed description of our segments, see "Business Segments" within Item 1 of this Form 10-K.

In this section, we discuss our industry and how certain factors may affect our business, key elements of our strategy, how our financial performance is assessed and measured by management, and other business considerations, including certain risks and challenges to our business. Next, we discuss our critical accounting estimates, which are those estimates that are most important to both the reporting of our financial condition and results of operations and require management's subjective judgment. We then review our results of operations for 2010, 2009 and 2008 beginning with an overview of our total company results, followed by a more detailed review of those results by business segment. We also review our financial condition and liquidity including our capital structure and resources, off-balance sheet arrangements, commitments and contingencies, and conclude with a discussion of our exposure to various market risks.

Industry Considerations

Domestic Considerations

U.S. Government budget deficits for 2010 and 2011 are expected to be high by historical standards. The U.S. economic recovery has been weaker than anticipated and unemployment remains high. As a result, we expect that the Administration and the Congress will have to consider deficit reduction initiatives within the context of a weak economy and competing spending priorities. These spending priorities include entitlement spending, such as Social Security, Medicare, and Medicaid, and programs that are appropriated on an annual basis, including defense, homeland security, international affairs, and a host of civil programs, ranging from education to veterans' health care to law enforcement to transportation infrastructure and more.

In February 2010, the Department of Defense (DoD) released the Quadrennial Defense Review (QDR), setting forth its strategic priorities for the next four years. The QDR emphasized the need to successfully prosecute the operations in Afghanistan and Iraq while also reshaping DoD forces to be able to respond to a wide range of future contingencies. Among the priorities emphasized in the QDR were Intelligence, Surveillance and Reconnaissance, cyberwarfare, missile defense, unmanned systems, and interoperability with allied forces. We believe that these priorities are well aligned with our product offerings, technologies and capabilities.

The 2010 mid-term election results are expected to elevate the priority of deficit reduction. It remains unclear how much of the deficit will be reduced by revenue changes and cuts to entitlement programs. We therefore expect all programs that are appropriated on an annual basis, including defense, to undergo close scrutiny by both the Administration and the Congress in the near future. We also anticipate that the fragile economic recovery will mean that policymakers will take potential job losses into consideration, which could mitigate calls for more significant cuts in spending, particularly in the near term.

In June 2010, the DoD launched its own series of initiatives to ensure more efficient use of its resources in order to sufficiently fund its highest priorities: maintaining force structure and modernizing its weapons systems and equipment. According to the DoD, its "Efficiencies Initiative," coupled with funding the base budget at one percent annual real

growth, should enable it to adequately pursue its strategic objectives as outlined in the QDR. If and to the extent that aspects of the Efficiencies Initiative are implemented, they could impact our results of operations and liquidity and could affect whether and, if so, how we pursue certain opportunities and the terms under which we are able to do so.

In addition, the U.S. Government has been operating under a series of Continuing Resolutions since the start of fiscal year (FY) 2011 on October 1, 2010. A Continuing Resolution authorizes agencies of the U.S. Government to continue to operate, generally at the same funding levels from the prior year, but does not authorize new spending initiatives. If the Continuing Resolution continues in effect for an extended period, it could impact the performance of our current programs and continue to delay new awards.

The U.S. Government including foreign military sales accounted for 88% of our total net sales in 2010. Our principal U.S. Government customer is the DoD, and DoD funding has grown substantially since fiscal year (FY) 2001, when it was $300 billion. However, given the current environment, defense spending levels in the near future are difficult to predict. At a minimum, we expect lower growth rates in the overall DoD budget than those of the past decade, with a number of factors potentially impacting the DoD budget, including the following:

- External threats to our national security, including potential security threats posed by terrorists, emerging nuclear states and other countries;
- Funding for on-going operations in Iraq and Afghanistan, which will require funding above and beyond the DoD base budget for their duration;
- Priorities of the Administration and the Congress, including deficit reduction given the historically high deficit and unemployment levels and the 2010 mid-term election results, and the relatively fragile state of the economic recovery, which could result in changes in the DoD budget overall and various allocations within the DoD budget; and
- The overall health of the U.S. and world economies and the state of governmental finances.

For FY 2011, the DoD had requested a base budget of $549 billion, an increase of approximately $18 billion or 3% over FY 2010, which excludes funding for operations in Afghanistan and Iraq. This request included $189 billion for DoD modernization funding (an increase of approximately $4 billion or 2%), consisting of procurement and research and development (R&D), and $200 billion for the DoD Operations and Maintenance Account (O&M) (an increase of approximately $16 billion or 9%), including funding for training, services and other logistical support functions.

Overseas Contingency Operations (OCO) in Afghanistan and Iraq have largely been funded apart from the DoD base budget to better maintain visibility and oversight of war costs. The DoD's request for FY 2011 OCO funding was $159 billion, which is just slightly lower than the $163 billion enacted for FY 2010 OCO activities. Looking forward, OCO funding is expected to decline as troops redeploy out of Iraq and later from Afghanistan. The request for future OCO funding will be determined on an as-needed basis and will likely be closely correlated to the amount of troops required for each operation.

With respect to other domestic customers beyond the DoD, we have contracts with a wide range of U.S. Government agencies, including the Department of Homeland Security (DHS), the Department of Justice (DoJ), the Department of State, the Department of Energy, the Intelligence Community, the National Aeronautics and Space Administration (NASA), the Federal Aviation Administration (FAA) and the National Science Foundation (NSF). Similar to the budget environment for the DoD, we expect the Administration will have to take deficit considerations into account when determining spending priorities for these agencies. Our relationship with these agencies, however, generally is determined more by specific program requirements than by a direct correlation to the overall funding levels for these agencies. We also have contracts with various state and local government agencies that also are subject to budget constraints and conflicts in spending priorities.

For more information on the risks and uncertainties that could impact the U.S. Government's demand for our products and services, see Item 1A "Risk Factors" of this Form 10-K.

International Considerations

In 2010, our sales to customers outside of the U.S. accounted for 23% of our total net sales (including foreign military sales through the U.S. Government). Internationally, the growing threat of additional terrorist activity, emerging nuclear states, long-range missiles and conventional military threats have led to an increase in demand for defense products and

services and homeland security solutions. In North Asia, both short and long-term security concerns are increasing demand for air and missile defense, air/naval modernization, maritime security, homeland security and air traffic management. In the Middle East, threats from state and non-state actors are increasing demand for air and missile defense, air/land/naval force modernization, precision engagement, maritime security, border security, and homeland security solutions. In South America, the economic growth in some developing countries is being accompanied by an increase in defense spending. While this region has traditionally been a smaller market for U.S.-based suppliers, it is likely to see above average growth rates. Global economic challenges are likely to restrain or even shrink the defense budgets of many European nations. Overall, we believe many international defense budgets have the potential to grow faster than the U.S. defense budget.

International customers are also expected to continue to adopt similar defense modernization initiatives as the U.S. DoD. We believe this trend will continue as many international customers are facing a threat environment which is similar to the U.S. and they are looking for advanced weapons and sensor systems. Alliance members also wish to assure their forces and systems will be interoperable with U.S. and North Atlantic Treaty Organization (NATO) forces. However, international demand is sensitive to changes in the priorities and budgets of international customers and geo-political uncertainties, which may be driven by changes in threat environments and potentially volatile worldwide economic conditions, various regional and local economic and political factors, risks and uncertainties, as well as U.S. foreign policy. For more information on the risks and uncertainties that could impact international demand for our products and services, see Item 1A "Risk Factors" of this Form 10-K.

Our Strategy and Opportunities

The following are the broad elements of our strategy:

- Focus on key strategic pursuits, technology and Mission Assurance to protect and grow our position in four core defense markets: Sensing, Effects, C3I and Mission Support.
- Leverage our domain knowledge in these core markets as well as the Homeland Security and Cybersecurity markets.
- Expand international business by broadening our focus and satisfying customer needs in both core and growth markets.
- Continue to be a Customer-focused company based on performance, relationships and solutions.

Our Markets

We believe that our broad mix of technologies, domain knowledge and key capabilities and our cost-effective, best value solutions and their alignment with customer needs in our core defense markets, position us favorably to continue to grow and increase our market share. Our core markets also serve as a solid base from which to expand into growth areas, such as Homeland Security and Cybersecurity. We continually explore opportunities to leverage our existing capabilities, or develop or acquire additional ones, to expand into growth markets.

Sensing—Sensing encompasses technologies that acquire precise situational data across air, space, ground and underwater domains and then generate the information needed for effective battlespace decisions. Our sensing technologies span the full electromagnetic spectrum, from traditional radio frequency (RF) and electro-optical (EO) to wideband, hyperspectral and acoustic sensors. We are focused on leveraging our sensing technologies to provide a broad range of capabilities as well as expanding into growth markets such as sensors to detect Weapons of Mass Destruction.

Effects—Effects achieve specific military actions or outcomes, from force protection to theater/national missile defense. The missions may be achieved by kinetic means, directed energy or information operations. Our Effects capabilities include advanced airframes, guidance and navigation systems, multiple sensor seekers, targeting, net-enabled systems, multi-dimensional effects, directed energy and cyber systems.

Command, Control, Communication and Intelligence (C3I)—C3I systems provide integrated real-time support to decision-makers on and off the battlefield, transforming raw data into actionable intelligence. We are seeking to continue to grow our market presence in C3I and also expand our knowledge management and discovery capabilities. Our C3I capabilities include situational awareness, persistent surveillance, communications, mission planning, battle management command and control, intelligence and analysis, and integrated ground solutions.

Mission Support—We are focused on enabling customer success through total life-cycle support that predicts customer needs, senses potential problems and proactively responds with the most appropriate solutions. Our Mission Support capabilities include technical services, system engineering, logistics, training, operations and maintenance. Our training business continues to expand and we now train in over 80 countries and in 40 different languages.

Homeland Security—We also intend to continue to grow our presence in the domestic and international homeland security markets, focusing on transportation security, immigration control/identity management, critical infrastructure protection, maritime security, energy security, intelligence program support, law enforcement solutions and emergency preparedness and response.

Cybersecurity—We continue to enhance our capabilities in the cybersecurity market. In 2010, we acquired three companies in this area: Compucat Research Pty, Trusted Computer Solutions Inc. and Technology Associates Inc. We are focused on providing cyber capabilities to the Intelligence, DoD and DHS markets as well as embedding cybersecurity in our products and in our own IT infrastructure.

International Growth

Because of the breadth of our offerings, our systems integration capability, the value of our solutions and our strong legacy in the international marketplace, we believe that we are well-positioned to continue to grow our international business. As discussed under "International Considerations," we believe demand is growing for solutions in air and missile defense, homeland security, air traffic management, precision engagement, naval systems integration and intelligence, surveillance and reconnaissance. In addition, as coalition forces increasingly integrate military operations worldwide, we believe that our capabilities in network-enabled operations will continue to be a key discriminator in these markets.

In 2010, our international sales, including foreign military sales through the U.S. Government, were $5.8 billion compared to $5.3 billion in 2009. In 2010, our international bookings were $4.4 billion compared to $7.6 billion in 2009.

Focus on the Customer and Execution

Our customer focus continues to be a critical part of our strategy—underpinned by a focus on performance, relationships and solutions. Performance means being able to meet customer commitments and is ensured through strong processes, metrics and oversight. We maintain a "process architecture" that spans our broad programs and pursuits. It consists of processes such as Integrated Product Development System (IPDS) which assures consistency of evaluation and execution at each step in a program's life-cycle. It also includes our Achieving Process Excellence (APEX), which is our SAP business system software for accounting, finance and program management; Process Re-Invention Integrating Systems for Manufacturing (PRISM), which is our SAP software for manufacturing operations; and Raytheon Enterprise Supplier Assessment (RESA) tool for Supply Chain Management. These processes and systems are linked to an array of front-end and back-end metrics. With this structure, we are able to track results and be alerted to potential issues through numerous oversight mechanisms, including operating reviews and annual operating plan reviews.

We are also continuing to build strong customer relationships by listening to customers, working with them as partners and including them on Raytheon Six Sigma™ teams to jointly improve their programs and processes. We are increasingly focused on responding to our customers' changing requirements with rapid and effective solutions to real problems. In recognition of our customers' constraints and priorities, we also continue to drive various cost reductions across the Company through Raytheon Six Sigma™, lean processes, reducing cycle times and numerous other initiatives.

Other Business Considerations

We currently are involved in over 15,000 contracts, with no single contract accounting for more than 5% of our total net sales in 2010. We believe that our diverse portfolio of programs and capabilities is well suited to a changing defense environment. However, we face numerous challenges and risks, as discussed below and under Item 1A. "Risk Factors" of this Form 10-K.

We remain dependent on the U.S. Government for a substantial portion of our business. Sales to the U.S. Government may be affected by changes in procurement policies, budget/economic considerations, changing defense requirements and political developments such as changes in Congress and the Administration. The influence of these factors could impact our financial position and results of operations. In addition, we operate in highly competitive markets. These markets are becoming increasingly more concentrated in response to the trend of certain customers awarding a smaller number of large multi-service contracts. Additionally, the DoD and international customers are increasingly turning to commercial contractors for information technology and other support work.

Our future success is dependent on our ability to execute our business strategies. First, we must continue to perform on existing programs, as past performance is an important selection criteria for new competitive awards. Second, we must successfully execute our growth strategies, as discussed above. In order to execute, we must be able to identify the most appropriate opportunities to leverage our capabilities and technologies, as well as emerging customer needs in these markets. We then must successfully develop, market and support new offerings and technologies for those markets which will require the investment of significant financial resources and substantial management attention.

We also focus on significant changes in our estimates of contract sales, costs and profits, to assess program performance and the potential impact of such changes on our results of operations. As discussed in greater detail in "Critical Accounting Estimates" our method of accounting for our contracts requires that we estimate contract revenues and costs. Due to the size, length of time and nature of the work required to be performed on many of our contracts, our estimates are complicated and subject to many variables. We review our contract estimates periodically to assess whether revisions are warranted and make revisions and adjustments to our estimates in the ordinary course. Changes in estimates of contract sales, costs and profits are recognized using a cumulative catch-up, which recognizes in the current period the cumulative effect of the changes on current and prior periods. A significant change in one or more of these estimates could affect the profitability of one or more of our contracts. In addition, given our number of contracts and our accounting methods, we may recognize changes in multiple contracts in a fiscal quarter that, individually, may be significant, but that result, on a net basis, in no impact on our results of operations. Alternatively, we may recognize changes in numerous contracts in a fiscal quarter that, individually, may be immaterial, but that result, collectively, in a significant change to our results of operations.

FINANCIAL SUMMARY

We use the following key financial performance measures to manage our business on a consolidated basis and by business segment and to monitor and assess our results of operations:

- Bookings—a forward-looking metric that measures the value of new contracts awarded to us during the year.
- Net Sales—a growth metric that measures our revenue for the current year.
- Operating Income—a measure of our profit from continuing operations for the year, before non-operating expenses, net and taxes.
- Operating Margin—a measure of our operating income as a percentage of total net sales.

We also focus on earnings per share (EPS), including Adjusted EPS, and measures to assess our cash generation and the efficiency and effectiveness of our use of capital such as free cash flow (FCF) and return on invested capital (ROIC).

Considered together, we believe these metrics are strong indicators of our overall performance and our ability to create shareholder value. We feel these measures are balanced among long-term and short-term performance, growth and efficiency. We use these and other performance metrics for executive compensation purposes.

In addition, we maintain a strong focus on program execution and the prudent management of capital and investments in order to maximize operating income and cash and to continue to improve ROIC. We pursue a capital deployment strategy that balances funding for growing our business, including capital expenditures, acquisitions, and research and development; managing our balance sheet, including debt repayments and pension contributions; and returning cash to our stockholders, including dividend payments and share repurchases.

Bookings were $24.4 billion, $25.1 billion and $26.8 billion in 2010, 2009 and 2008, respectively resulting in backlog of $34.6 billion, $36.9 billion and $38.9 billion at December 31, 2010, 2009 and 2008, respectively. Backlog represents the

dollar value of contracts awarded for which work has not been performed. Backlog generally increases with bookings and generally converts into sales as we incur costs under the related contractual commitments. We therefore discuss changes in backlog, including any significant cancellations, for each of our segments, as we believe such discussion provides an understanding of the awarded but not executed portion of our contracts. As described in Commitments and Contingencies on page 64, in the second quarter of 2010, RSL was notified of its termination on the UK Border Agency program, which resulted in a net backlog adjustment of $556 million at IIS. In the second quarter of 2009, Kinetic Energy Interceptor (KEI), a developmental program with the Missile Defense Agency (MDA), was terminated for convenience, which resulted in a net backlog adjustment of approximately $2.4 billion at MS. The program was cancelled by the MDA due to a change in missile defense priorities.

Total net sales were $25.2 billion, $24.9 billion and $23.2 billion in 2010, 2009 and 2008, respectively.

Operating income was $2.6 billion, $3.0 billion and $2.6 billion in 2010, 2009 and 2008, respectively. Operating margin was 10.4%, 12.2% and 11.3% in 2010, 2009 and 2008, respectively. Included in operating income was a FAS/CAS Pension Adjustment, described below in Critical Accounting Estimates, of $230 million of expense, $27 million of income and $123 million of expense in 2010, 2009 and 2008, respectively.

Operating cash flow from continuing operations was $1.9 billion, $2.7 billion and $2.0 billion in 2010, 2009 and 2008, respectively.

A discussion of our results follows below in Consolidated Results of Operations; Segment Results; Financial Condition and Liquidity; and Capital Resources.

CRITICAL ACCOUNTING ESTIMATES

Our consolidated financial statements are based on the application of U.S. Generally Accepted Accounting Principles (GAAP), which require us to make estimates and assumptions about future events that affect the amounts reported in our consolidated financial statements and the accompanying notes. Future events and their effects cannot be determined with certainty. Therefore, the determination of estimates requires the exercise of judgment. Actual results could differ from those estimates, and any such differences may be material to our consolidated financial statements. We believe the estimates set forth below may involve a higher degree of judgment and complexity in their application than our other accounting estimates and represent the critical accounting estimates used in the preparation of our consolidated financial statements. We believe our judgments related to these accounting estimates are appropriate. However, if different assumptions or conditions were to prevail, the results could be materially different from the amounts recorded.

Revenue Recognition

We determine the appropriate method by which we recognize revenue by analyzing the type, terms and conditions of each contract or arrangement entered into with our customers. The significant estimates we consider in recognizing revenue for the types of revenue-generating activities in which we are involved are described below. We classify contract revenues as product or service according to the predominant attributes of the relevant underlying contracts unless the contract can clearly be split between product and service. We define service revenue as revenue from activities which are not associated with the design, development or production of tangible assets, the delivery of software code or a specific capability. Our services sales are primarily related to our TS operating segment.

Percentage-of-Completion Accounting—We account for our long-term contracts associated with the design, development, manufacture, or modification of complex aerospace or electronic equipment and related services, such as certain cost-plus service contracts, using the percentage-of-completion accounting method. Under this method, revenue is recognized based on the extent of progress towards completion of the long-term contract. The selection of the method by which to measure such progress towards completion requires judgment and is based on the nature of the products or services to be provided. Our analysis of these contracts also contemplates whether contracts should be combined or segmented. The combination of two or more contracts requires significant judgment in determining whether the intent of entering into the contracts was effectively to enter into a single project, which should be combined to reflect an overall profit rate. Additionally, judgment is involved in determining whether a single contract or group of contracts may be segmented based on how the contract was negotiated and the performance criteria. The decision to combine a group of contracts or

segment a contract could change the amount of revenue and gross profit recorded in a given period had consideration not been given to these factors. We combine closely related contracts when all the applicable criteria under GAAP are met. Similarly, we may segment a project, which may consist of a single contract or a group of contracts, with varying rates of profitability, only if all the applicable criteria under GAAP are met.

We generally use the cost-to-cost measure of progress for all our long-term contracts unless we believe another method more clearly measures progress towards completion of the contract. Under the cost-to-cost measure of progress, the extent of progress towards completion is measured based on the ratio of costs incurred-to-date to the total estimated costs at completion of the contract. Contract costs include material, labor and subcontracting costs, as well as an allocation of indirect costs. Revenues, including estimated earned fees or profits, are recorded as costs are incurred. Due to the nature of the work required to be performed on many of our contracts, the estimation of total revenue and cost at completion is complex and subject to many variables. Management must make various assumptions and estimates related to contract deliverables including design requirements, performance of subcontractors, cost and availability of materials, productivity and manufacturing efficiency and labor availability. These estimates also include the estimated cost of satisfying our industrial cooperation agreements, sometimes referred to as offset obligations required under certain contracts. Incentive and award fees are generally awarded at the discretion of the customer or upon achievement of certain program milestones or cost targets. Incentive and award fees, as well as penalties or other damages related to contract performance, are considered in estimating profit rates. Estimates of award fees are based on actual awards and anticipated performance, which may include the performance of subcontractor or partners depending upon the individual contract requirements. Incentive provisions that increase or decrease earnings based solely on a single significant event are generally not recognized until the event occurs. Such incentives and penalties are recorded when there is sufficient information for us to assess anticipated performance. Our claims on contracts are recorded only if it is probable the claim will result in additional contract revenue and the amounts can be reliably estimated.

We have a standard quarterly process in which management reviews the progress and performance of our significant contracts. As part of this process, management reviews include, but are not limited to, any outstanding key contract matters, progress towards completion and the related program schedule, identified risks and opportunities, and the related changes in estimates of revenues and costs. Based on this analysis, any adjustments to net sales, costs of sales and the related impact to operating income are recorded as necessary in the period they become known. Changes in estimates of net sales, costs of sales and the related impact to operating income are recognized using a cumulative catch-up, which recognizes in the current period the cumulative effect of the changes on current and prior periods. A significant change in one or more of these estimates could affect the profitability of one or more of our contracts. When estimates of total costs to be incurred on a contract exceed total estimates of revenue to be earned, a provision for the entire loss on the contract is recorded in the period the loss is determined.

Other Revenue Methods—To a much lesser extent, we enter into contracts that are not associated with the design, development, manufacture, or modification of complex aerospace or electronic equipment and related services. Revenue under such contracts is generally recognized upon delivery or as the service is performed. Revenue on contracts to sell software is recognized when evidence of an arrangement exists, the software has been delivered and accepted by the customer, the fee is fixed or determinable and collection is probable. Revenue from non-software license fees is recognized over the expected life of the continued involvement with the customer. Royalty revenue is recognized when earned. Revenue generated from fixed-price service contracts not associated with the design, development, manufacture or modification of complex aerospace or electronic equipment is recognized as services are rendered once persuasive evidence of an arrangement exists, our price is fixed or determinable, and we have determined collectability is reasonably assured.

We apply the separation guidance under GAAP for contracts with multiple deliverables. Revenue arrangements with multiple deliverables are evaluated to determine if the deliverables should be divided into more than one unit of accounting. For contracts with more than one unit of accounting, we recognize revenue for each deliverable based on the revenue recognition policies described above.

Other Considerations—The majority of our sales are driven by pricing based on costs incurred to produce products or perform services under contracts with the U.S. Government. Cost-based pricing is determined under the Federal Acquisition Regulations (FAR). The FAR provide guidance on the types of costs that are allowable in establishing prices

for goods and services under U.S. Government contracts. For example, costs such as those related to charitable contributions, certain merger and acquisition costs, lobbying costs, interest expense and certain litigation defense costs are unallowable. In addition, we may enter into agreements with the U.S. Government that address the allowability and allocation of costs to contracts for specific matters. Certain costs incurred in the performance of our U.S. Government contracts are required to be recorded under GAAP but are not currently allocable to contracts. Such costs are deferred and primarily include a portion of our environmental expenses, asset retirement obligations, deferred state income tax, workers' compensation and certain other accruals. These costs are allocated to contracts when they are paid or otherwise agreed. We regularly assess the probability of recovery of these costs. This assessment requires us to make assumptions about the extent of cost recovery under our contracts and the amount of future contract activity. If the level of backlog in the future does not support the continued deferral of these costs, the profitability of our remaining contracts could be adversely affected.

Pension and other postretirement benefit costs are allocated to our contracts as allowed costs based upon the U.S. Government Cost Accounting Standards (CAS). The CAS requirements for pension and other postretirement benefit costs differ from the Financial Accounting Standards (FAS) requirements under GAAP. Given the inability to match with reasonable certainty individual expense and income items between the CAS and FAS requirements to determine specific recoverability, we have not estimated the incremental FAS income or expense to be recoverable under our expected future contract activity, and therefore did not defer any FAS expense for pension and other postretirement benefit plans in 2007-2009. This resulted in $230 million of expense in 2010, $27 million of income in 2009, and $123 million of expense in 2008, reflected in our results of operations for the difference between CAS and FAS requirements for our pension plans in those years.

Pension Costs

We have pension plans covering the majority of our employees, including certain employees in foreign countries. We must calculate our pension costs under both CAS and FAS requirements under GAAP. The calculations under CAS and FAS require judgment. CAS prescribes the allocation to and recovery of pension costs on U.S. Government contracts through the pricing of products and services and the methodology to determine such costs. GAAP outlines the methodology used to determine pension expense or income for financial reporting purposes. The CAS requirements for pension costs and its calculation methodology differ from the FAS requirements and calculation methodology. As a result, while both CAS and FAS use long-term assumptions in their calculation methodologies, each method results in different calculated amounts of pension cost. In addition, the cash funding requirements for our pension plans are determined under the Employee Retirement Income Security Act of 1974 (ERISA). ERISA funding requirements use a third and different method to determine funding requirements, which is primarily based on the year's expected service cost and amortization of other previously unfunded liabilities. Effective January 1, 2011, we are subject to the funding requirements under the Pension Protection Act of 2006 (PPA), which amended ERISA. Under the PPA, we are required to fully fund our pension plans over a rolling seven-year period as determined annually based upon the funded status at the beginning of each year. Due to the foregoing differences in requirements and calculation methodologies, our FAS pension expense or income is not indicative of the funding requirements or amount of government recovery. Additionally, the recognition of pension costs for government contractors under the CAS rules is required to be harmonized with the PPA. On May 10, 2010, the CAS Pension Harmonization Notice of Proposed Rulemaking (NPRM) was published in the Federal Register with a 60 day comment period. The NPRM is the third step of a four step statutory process to implement a final CAS standard (Harmonization Rule) related to the recognition of pension costs for government contractors. Based upon the feedback received during the comment period, the CAS Board will either issue the final rule or alternatively reissue the NPRM. We expect that the final rule would increase our future CAS recovery amount and decrease the FAS/CAS Pension Adjustment. We record CAS expense in the results of our business segments. Due to the differences between FAS and CAS amounts, we also present the difference between FAS and CAS expense, referred to as our FAS/CAS Pension Adjustment, as a separate line item in our segment results. This effectively increases or decreases the amount of total pension expense in our results of operations so such amount is equal to the FAS expense amount under GAAP. Due to the foregoing differences in requirements and calculation methodologies, our FAS pension expense or income is not necessarily indicative of the funding requirements or amount of government recovery.

The assumptions in the calculations of our FAS expense and CAS expense, which involve significant judgment, are described below.

FAS Expense—Our long-term return on plan assets (ROA) and discount rate assumptions are the key variables in determining pension expense or income and the funded status of our pension plans under GAAP.

The long-term ROA represents the average rate of earnings expected over the long term on the assets invested to provide for anticipated future benefit payment obligations. We employ a "building block" approach in determining the long-term ROA assumption. Historical markets are studied and long-term relationships between equities and fixed income are assessed. Current market factors such as inflation and interest rates are evaluated before long-term capital market assumptions are determined. The long-term ROA assumption is also established giving consideration to investment diversification, rebalancing and active management of the investment portfolio. Peer data and historical returns are reviewed periodically to assess reasonableness and appropriateness.

The investment policy asset allocation ranges for our domestic pension plans, as set by the Company's Investment Committee, for the year ended December 31, 2010 were as follows:

Asset Category	
U.S. equities	25% - 40%
International equities	15% - 30%
Fixed-income securities	25% - 40%
Cash and cash equivalents	3% - 15%
Other (including private equity and real estate)	0% - 20%

During 2010, the Investment Committee modified the investment policy allocation ranges for our domestic pension plans based upon the most recent periodic asset allocation study and in consideration of current market conditions. In validating the 2010 long-term ROA assumption, we also reviewed our pension plan asset performance since 1986. Our average actual annual rate of return since 1986 has exceeded our estimated 8.75% assumed annual return. Based upon these analyses and our internal investing targets, we determined our long-term ROA assumption for our domestic pension plans in 2010 was 8.75%, consistent with our 2009 assumption. Our domestic pension plans' actual rates of return were approximately 11%, 17% and (26%) for 2010, 2009 and 2008, respectively. The difference between the actual rate of return and our long-term ROA assumption is included in deferred losses as described below. If we significantly change our long-term investment allocation or strategy, then our long-term ROA assumption could change.

The long-term ROA assumptions for foreign pension benefit plans are based on the asset allocations and the economic environment prevailing in the locations where the pension plans reside. Foreign pension assets do not make up a significant portion of the total assets for all of our pension plans.

The discount rate represents the interest rate that should be used to determine the present value of future cash flows currently expected to be required to settle the pension and postretirement benefit obligations. The discount rate assumption is determined by using a theoretical bond portfolio model consisting of bonds AA rated or better by Moody's for which the timing and amount of cash flows approximate the estimated benefit payments of our pension plans. The discount rate assumption for our domestic pension plans at December 31, 2010 is 5.75%, compared to the December 31, 2009 discount rate of 6.25% as a result of the bond environment at December 31, 2010.

An increase or decrease of 25 basis points in the long-term ROA and the discount rate assumptions would have had the following approximate impacts on 2010 pension results:

(In millions)	
Change in assumption used to determine net periodic benefit cost for the year ended December 31, 2010	
Discount rate	$ 49
Long-term ROA	34
Change in assumption used to determine benefit obligations for the year ended December 31, 2010	
Discount rate	$510

CAS Expense—In addition to providing the methodology for calculating pension costs, CAS also prescribes the method for assigning those costs to specific periods. While the ultimate liability for pension costs under FAS and CAS is similar, the pattern of cost recognition is different. The key drivers of CAS pension expense include the funded status and the method used to calculate CAS reimbursement for each of our plans, and our long-term ROA assumption. Unlike FAS, CAS requires the discount rate to be consistent with the long-term ROA assumption, which changes infrequently given its long-term nature. As a result, changes in bond or other interest rates generally do not impact CAS. In addition, unlike FAS, we can only allocate pension costs for a plan under CAS until such plan is fully funded as determined under CAS requirements. When the estimated future CAS pension costs increase, which occurred at December 31, 2008, driven mainly by the significant decline in the value of our plan assets, the estimated CAS cost to be allocated to our contracts in the future increases.

Other FAS and CAS Considerations—On an annual basis, at December 31st, we update our estimate of future FAS and CAS pension expense based upon actual asset returns and other actuarial factors. Other variables that can impact the pension plans' funded status and FAS and CAS income or expense include demographic experience such as the expected rates of salary increase, retirement age, turnover and mortality. In addition, certain pension plans provide a lump sum form of benefit that varies based upon externally determined interest rates. Assumptions for these variables are set at the beginning of the year, and are based on actual and projected plan experience. On a periodic basis, generally planned annually in the third quarter, we update our actuarial estimate of the unfunded projected benefit obligation for both FAS and CAS with final census data from the end of the prior year.

The components of the FAS/CAS Pension Adjustment were as follows:

(In millions)	**2010**	2009	2008
FAS expense	$(896)	$(646)	$(524)
CAS expense	666	673	401
FAS/CAS Pension Adjustment	$(230)	$ 27	$(123)

As described above, a key driver of the difference between FAS and CAS expense (and consequently, the FAS/CAS Pension Adjustment) is the pattern of earnings and expense recognition for gains and losses that arise when our asset and liability experience differ from our assumptions under each set of requirements. Generally, such gains or losses are amortized under FAS over the average future working lifetime of the eligible employee population of approximately 11 years, and are amortized under CAS over a 15-year period. In accordance with both FAS and CAS, a "market-related value" of our plan assets is used to calculate the amount of deferred asset gains or losses to be amortized. The market-related value of assets is determined using actual asset gains or losses over a certain prior period (three years for FAS and five years for CAS, subject to certain limitations under CAS on the difference between the market-related value and actual market value of assets). Because of this difference in the number of years over which actual asset gains or losses are recognized and subsequently amortized, FAS expense generally tends to reflect the recent gains or losses faster than CAS. Another driver of CAS expense (but not FAS expense) is the funded status of our pension plans under CAS. As noted above, CAS expense is only recognized for plans that are not fully funded; consequently, if plans become or cease to be fully funded under CAS due to our asset or liability experience, our CAS expense will change accordingly.

The change in the FAS/CAS Pension Adjustment of $257 million in 2010 compared to 2009 was driven by a $250 million increase in our FAS expense. The $250 million increase in our FAS expense was driven primarily by the continued recognition of the 2008 losses in the market related value of assets, which had an impact of approximately $260 million. Our CAS expense decreased $7 million as a result of actual versus expected asset and liability experience.

The change in the FAS/CAS Pension Adjustment of $150 million in 2009 compared to 2008 was driven by a $272 million increase in our CAS expense. The $272 million increase in our CAS expense was driven primarily by negative asset returns in 2008, which caused certain plans to no longer be fully funded under CAS and had an impact of $287 million. Our FAS expense also increased by $122 million. The primary components of the change in FAS expense included an increase of $297 million due to the lower than expected return on pension assets during 2008, partially offset by a decrease of $106 million due to the expected return on our discretionary cash contribution to our

plans in 2008 as well as the expected return on the expected cash contributions in 2009. In addition, the FAS expense decreased by $47 million due to the recognition of previous historical asset returns which were greater than the expected return.

For 2011, we currently expect our FAS expense will increase more than our CAS expense, which will increase the FAS/CAS Pension Adjustment. We expect the FAS/CAS Pension Adjustment to be approximately $370 million of expense driven by the lower discount rate environment and the difference in amortization periods under FAS and CAS, described above, of the net unrecognized liability, principally due to the negative 2008 asset returns. This expected increase in FAS expense in excess of CAS expense is subject to our annual update, generally planned in the third quarter, of our actuarial estimate of the unfunded benefit obligation for both FAS and CAS for final 2010 census data and does not include any potential change for the Harmonization Rule. After 2011, the FAS/CAS Pension Adjustment is more difficult to predict because future FAS and CAS expense is based on a number of key assumptions for future periods. Differences between those assumptions and future actual results could significantly change both FAS and CAS expense in future periods. However, based solely on our current assumptions at December 31, 2010 and without any adjustment for the Harmonization Rule, we would expect our FAS/CAS Pension Adjustment to decline as CAS continues to recognize the market related value of the 2008 asset losses through 2013 which FAS will have fully recognized through 2011.

The pension and other postretirement plans' investments are stated at fair value. Investments in equity securities (common and preferred) are valued at the last reported sales price when an active market exists. Investments in fixed-income securities are generally valued using methods based upon market transactions for comparable securities and various relationships between securities which are generally recognized by institutional traders. Investments in private equity funds, hedge funds and private real estate funds are estimated at fair market value which primarily utilizes net asset values reported by the investment manager. The pension investment team reviews independently appraised values, audited financial statements and additional pricing information to evaluate the net asset values. For the very limited group of securities and other assets for which market quotations are not readily available or for which the above valuation procedures are deemed not to reflect fair value, additional information is obtained from the investment manager and evaluated internally to determine whether any adjustments are required to reflect fair value.

In addition, we had $7.9 billion and $7.5 billion of deferred losses (pre-tax) in accumulated other comprehensive loss related to our pension and other postretirement benefit plans at December 31, 2010 and 2009, respectively, composed primarily of differences between actual and expected asset returns, changes in discount rates, changes in plan provisions and differences between actual and assumed demographic experience. The $0.4 billion increase in 2010 was driven primarily by the decrease in the discount rate from 6.25% at December 31, 2009 to 5.75% at December 31, 2010, partially offset by actual asset returns which exceeded our expected return and amortization of previous deferred losses in 2009 pension expense. To the extent we continue to experience such differences between these items, our funded status and related accrued retiree benefit obligation will change. Changes to our accrued retiree benefit obligation are initially reflected as a reduction to other comprehensive income. The deferred losses are amortized and included in future pension expense over the average employee service period of approximately 11 years.

Impairment of Goodwill

We evaluate goodwill for impairment annually on the first day of the fourth quarter and in any interim period in which circumstances arise that indicate our goodwill may be impaired. Indicators of impairment include, but are not limited to, the loss of significant business, significant decreases in federal government appropriations or funding for our contracts, or other significant adverse changes in industry or market conditions. No events occurred during the periods presented that indicated the existence of an impairment with respect to our goodwill related to our continuing operations. We estimate the fair value of our reporting units using a discounted cash flow (DCF) model based on our most recent long-range plan, and compare the estimated fair value of each reporting unit to its net book value, including goodwill. We discount the cash flow forecasts using the weighted-average cost of capital method at the date of evaluation. The weighted-average cost of capital is comprised of the estimated required rate of return on equity, based on publicly available data for peer companies, plus an equity risk premium related to specific company risk factors, and the after-tax rate of return on debt, weighted at the relative values of the estimated debt and equity for the industry. Preparation of forecasts for use in the long-range plan and the selection of the discount rate involve significant judgments that we base primarily on existing firm orders, expected future orders, contracts with suppliers, labor agreements and general market

conditions. Significant changes in these forecasts or the discount rate selected could affect the estimated fair value of one or more of our reporting units and could result in a goodwill impairment charge in a future period. The combined estimated fair value of all of our reporting units from our DCF model often results in a premium over our market capitalization, commonly referred to as a control premium. We believe our control premium is reasonable based upon historic data of premiums paid on actual transactions within our industry. When available and as appropriate, we also use comparative market multiples to corroborate our DCF model results. There was no indication of goodwill impairment as a result of our 2010 impairment analysis. The fair values of each of our reporting units exceeded their respective net book values, including goodwill. Based upon our 2010 impairment analysis, the reporting unit that was closest to impairment had a fair value in excess of net book value, including goodwill, of more than 20%. If we are required to record an impairment charge in the future, it could materially affect our results of operations.

CONSOLIDATED RESULTS OF OPERATIONS

Selected consolidated results were as follows:

				% of Total Net Sales		
(In millions, except percentages and per share data)	**2010**	2009	2008	**2010**	2009	2008
Net sales						
Products	$21,386	$21,761	$20,923	84.9%	87.5%	90.3%
Services	3,797	3,120	2,251	15.1%	12.5%	9.7%
Total net sales	25,183	24,881	23,174	100.0%	100.0%	100.0%
Operating expenses						
Cost of sales						
Cost of sales—products	17,022	17,071	16,570	67.6%	68.6%	71.5%
Cost of sales—services	3,281	2,676	1,919	13.0%	10.8%	8.3%
Total Cost of sales	20,303	19,747	18,489	80.6%	79.4%	79.8%
Administrative and selling expenses	1,648	1,527	1,548	6.5%	6.1%	6.7%
Research and development expenses	625	565	517	2.5%	2.3%	2.2%
Total operating expenses	22,576	21,839	20,554	89.6%	87.8%	88.7%
Operating income	2,607	3,042	2,620	10.4%	12.2%	11.3%
Non-operating (income) expense						
Interest expense	126	123	129	0.5%	0.5%	0.6%
Interest income	(16)	(14)	(64)	(0.1)%	(0.1)%	(0.3)%
Other (income) expense	65	3	33	0.3%	—%	0.1%
Non-operating (income) expense, net	175	112	98	0.7%	0.5%	0.4%
Federal and foreign income taxes	589	953	824	2.3%	3.8%	3.6%
Income from continuing operations	1,843	1,977	1,698	7.3%	7.9%	7.3%
Income (loss) from discontinued operations, net of tax	36	(1)	(2)	0.1%	—%	—%
Net income	1,879	1,976	1,696	7.5%	7.9%	7.3%
Less: Net income (loss) attributable to noncontrolling interests in subsidiaries	39	41	24	0.2%	0.2%	0.1%
Net income attributable to Raytheon Company	$ 1,840	$ 1,935	$ 1,672	7.3%	7.8%	7.2%
Diluted earnings per share from continuing operations attributable to Raytheon Company common stockholders	$ 4.79	$ 4.89	$ 3.93			
Diluted earnings (loss) per share from discontinued operations attributable to Raytheon Company common stockholders	0.10	—	(0.01)			
Diluted earnings per share attributable to Raytheon Company common stockholders	4.88	4.89	3.92			

Total Net Sales

The increase in total net sales of $302 million in 2010 compared to 2009 was primarily due to higher external net sales of $282 million at TS, $273 million at SAS and $134 million at MS, partially offset by lower external net sales of $442 million at IIS. The increase in external net sales at TS was primarily due to higher net sales from growth on TS' training programs. The increase in external net sales at SAS was primarily due to higher volume, as planned, as work increased on

certain classified business. The increase in external net sales at MS was primarily due to higher net sales on Standard Missile-3 and the Advanced Medium Range Air-to-Air Missile (AMRAAM) program. The decrease in external net sales at IIS was primarily due to $385 million of lower net sales on a UK Border Agency Program, on which RSL was notified of its termination in the second quarter of 2010 (UK Border Agency Program), as described in Commitments and Contingencies on page 64, driven principally by the $316 million adjustment recorded in the second quarter of 2010 from a change in our estimated revenue and costs. The decrease in product net sales of $375 million in 2010 compared to 2009 was primarily due to lower external product net sales of $576 million at IIS primarily due to lower net sales on the UK Border Agency Program, described above, partially offset by higher external product net sales of $179 million at SAS and $137 million at MS. The increase in service net sales of $677 million in 2010 compared to 2009 was primarily due to higher external service net sales of $312 million at TS, principally due to higher net sales from growth on TS' programs, $144 million at NCS and $136 million at IIS.

The increase in total net sales of $1,707 million in 2009 compared to 2008 was primarily due to higher external net sales of $550 million at TS, $413 million at IDS, $286 million at SAS and $210 million at NCS. The increase in external net sales at TS was primarily due to higher volume on training programs. The increase in IDS external net sales was primarily due to higher volume on Patriot programs. The increase in SAS external net sales was primarily due to higher volume on certain classified business and international airborne tactical radar programs. The increase in external net sales at NCS was primarily due to higher volume across various production programs, primarily certain U.S. Army programs. The increase in product net sales of $838 million in 2009 compared to 2008 was primarily due to the higher external product sales of $261 million at IDS, $252 million at SAS, $176 million at NCS and $142 million at MS. The increase in service net sales of $869 million in 2009 compared to 2008 was primarily due to the higher external service sales of $607 million at TS and $152 million at IDS.

Sales to the U.S. DoD were 85%, 84% and 83% of total net sales in 2010, 2009 and 2008, respectively. Sales to the U.S. Government were 88% of total net sales in 2010 and 2009 and 87% of total net sales in 2008. Included in both DoD and U.S. Government sales were foreign military sales through the U.S. Government of $3.3 billion, $2.8 billion and $1.8 billion in 2010, 2009 and 2008, respectively. As described above in Industry Considerations, U.S. defense spending levels are difficult to predict due to numerous factors, including U.S. Government budget appropriation decisions and geo-political events and macroeconomic conditions. Total international sales, including foreign military sales through the U.S. Government, were $5.8 billion or 23% of total net sales, $5.3 billion or 21% of total net sales and $4.6 billion or 20% of total net sales in 2010, 2009 and 2008, respectively.

Cost of Sales

The increase in cost of sales of $556 million in 2010 compared to 2009 was primarily due to $299 million of increased costs, the primary drivers of which are described above in Total Net Sales and in Segment Results below, and higher expense of $257 million related to the FAS/CAS Pension Adjustment described below in Segment Results.

The increase in cost of sales of $1,258 million in 2009 compared to 2008 was primarily due to $1,408 million of increased costs, the primary drivers of which are described above in Total Net Sales and in Segment Results below, offset by lower expense of $150 million related to the FAS/CAS Pension Adjustment described below in Segment Results.

The FAS/CAS Pension Adjustment, which was $230 million of expense, $27 million of income and $123 million of expense in 2010, 2009 and 2008, respectively, is reported as a separate line item in our segment results. The FAS/CAS Pension Adjustment represents the difference between our pension expense or income under FAS in accordance with GAAP and our pension expense under CAS. The results of each segment only include pension expense under CAS that we generally recover through the pricing of our products and services to the U.S. Government. For more information on the FAS/CAS Pension Adjustment, see our discussion below in Segment Results.

Administrative and Selling Expenses

Administrative and selling expenses remained relatively consistent as a percentage of sales in 2010 compared to 2009. The decrease in administrative and selling expenses of $21 million in 2009 compared to 2008 was primarily due to lower state tax payments driven by the utilization of overpayment credits from 2008. The provision for state income taxes can generally be recovered through the pricing of products and services to the U.S. Government. Net state income taxes allocated to our contracts were $59 million, $25 million and $122 million in 2010, 2009 and 2008, respectively.

Research and Development Expenses

Research and development expenses remained relatively consistent as a percent of total net sales in 2010, 2009 and 2008.

Total Operating Expenses

The increase in total operating expenses of $737 million in 2010 compared to 2009 was primarily due to $299 million of increased costs, the primary drivers of which are described above in Total Net Sales and below in Segment Results, and higher expense of $257 million related to the FAS/CAS Pension Adjustment described below in Segment Results.

The increase in total operating expenses of $1,285 million in 2009 compared to 2008 was primarily due to $1,435 million of increased costs, the primary drivers of which are described above in Total Net Sales and in Segment Results below, offset by lower expense of $150 million related to the FAS/CAS Pension Adjustment described below in Segment Results.

Operating Income

The decrease in operating income of $435 million in 2010 compared to 2009 was primarily due to the $419 million impact of the UK Border Agency Program, as described in Commitments and Contingencies on page 64, driven principally by the $395 million adjustment recorded in the second quarter of 2010 from a change in our estimated revenue and costs and higher expense of $257 million related to the FAS/CAS Pension Adjustment. These decreases were partially offset by improved program performance, which had approximately a $140 million impact on operating income and increased volume, which had approximately a $90 million impact on operating income, the primary drivers of which are described below in Segment Results.

The increase in operating income of $422 million in 2009 compared to 2008 was primarily due to lower expense of $150 million related to the FAS/CAS Pension Adjustment and increased volume, which had an impact of approximately $150 million and $69 million due to the increase in estimated future CAS pension costs at December 31, 2008 described below in Segment Results. For a discussion of the drivers of individual business operating income and related margin, see Segment Results below.

Non-Operating Expense, Net

The increase in non-operating expense, net of $63 million in 2010 compared to 2009 was primarily due to the $73 million pretax charge associated with the make-whole provision on the early repurchase of long-term debt in the fourth quarter of 2010 compared to the $22 million pretax charge associated with the make-whole provision on the early repurchase of long-term debt in the fourth quarter of 2009, and $11 million of lower year-over-year returns on investments held in rabbi trusts associated with certain of our non-qualified deferred compensation plans due to net gains of $17 million in 2010 compared to net gains of $28 million in 2009.

The increase in non-operating expense, net of $14 million in 2009 compared to 2008 was primarily due to the decrease in interest income of $50 million which was principally due to a decrease in interest rates driven by a shift in our strategy to invest more of our cash in U.S. Treasury bills, partially offset by a decrease of $30 million in other expense, net. The decrease in other expense, net was primarily due to a $58 million favorable year-over-year change in the fair value of investments held in rabbi trusts associated with certain of our non-qualified deferred compensation plans due to net gains of $28 million in 2009 compared to net losses of $30 million in 2008, partially offset by a $22 million pretax charge associated with the make-whole provision on early repurchase of long-term debt in the fourth quarter of 2009.

Federal and Foreign Income Taxes

Our effective tax rate, which is used to determine federal and foreign income tax expense, differs from the U.S. statutory rate due to the following:

	2010	2009	2008
Statutory tax rate	35.0%	35.0%	35.0%
Research and development tax credit	-1.1%	-0.9%	-1.0%
Tax settlements and refund claims	-8.0%	-0.9%	-0.5%
Domestic manufacturing deduction benefit	-1.7%	-0.9%	-0.5%
Other items, net	—%	0.2%	-0.3%
Effective tax rate	24.2%	32.5%	32.7%

Our effective tax rate reflects the 35% U.S. statutory rate adjusted for various permanent differences between book and tax reporting. Our effective tax rate in 2010 was 8.3% lower than 2009 primarily due to the receipt of final approval from the IRS and the U.S. Congressional Joint Committee on Taxation in the third quarter of 2010 of the IRS' examination of our tax returns for the 1998-2005 tax years (Tax Settlement), which decreased our tax expense from continuing operations by $170 million in 2010, partially offset by the change in mix of jurisdictional income, as a result of the UK Border Agency Program, primarily reflected in other items, net, in the table above. Our effective tax rate in 2009 was 0.2% lower than 2008 primarily due to increased manufacturing tax benefits and certain refund claims, partially offset by various non-deductible expenses. Our effective tax rate in 2010 was lower than the U.S. statutory rate primarily due to the Tax Settlement. Our effective tax rate in 2009 was lower than the U.S. statutory rate due to various permanent differences between book and tax reporting, including domestic manufacturing tax benefits, tax benefits related to certain refund claims, including $26 million of benefits primarily related to certain U.S. and foreign research tax incentives and employee stock ownership plan dividend deductions, partially offset by various non-deductible expenses. The effective tax rate in 2008 was lower than the U.S. statutory rate due to manufacturing tax benefits, employee stock ownership plan dividend deductions and tax benefits related to certain refund claims, including $13 million of benefits primarily related to a foreign research incentive refund claim, partially offset by various non-deductible expenses.

The decrease in federal and foreign income taxes of $364 million in 2010 compared to 2009 was primarily due to the Tax Settlement described above, and lower income from continuing operations before taxes. The increase in federal and foreign income taxes of $129 million in 2009 compared to 2008 was primarily due to our higher income from continuing operations before taxes.

Income from Continuing Operations

Income from continuing operations was $1,843 million, $1,977 million and $1,698 million in 2010, 2009 and 2008, respectively. The decrease in income from continuing operations of $134 million in 2010 compared to 2009 was due to the $435 million decrease in operating income and the $63 million increase in non-operating expenses, net, partially offset by a $364 million decrease in federal and foreign income taxes as described above.

The increase in income from continuing operations of $279 million in 2009 compared to 2008 was primarily due to the $422 million increase in operating income. Partially offset by a $129 million increase in federal and foreign income taxes as described above.

Income (loss) from Discontinued Operations, Net of Tax

The increase in income (loss) from discontinued operations, net of tax, of $37 million in 2010 compared to 2009 was primarily due to the Tax Settlement, described above, which included an $89 million decrease in tax expense from discontinued operations, primarily related to our previous disposition of Raytheon Engineers and Constructors. The increase was partially offset by a $39 million, net of the federal tax benefit, excise tax assessment related to our previous disposition of Flight Options LLC (Flight Options), described below in Discontinued Operations.

Income (loss) from discontinued operations, net of tax, was ($1) million and ($2) million in 2009 and 2008, respectively.

Net Income

Net income was $1,879 million, 1,976 million and $1,696 million in 2010, 2009 and 2008, respectively. The decrease in net income of $97 million in 2010 compared to 2009 was primarily due to the decrease in income from continuing operations offset by the increase in income (loss) from discontinued operations, net of tax, described above. The increase in net income of $280 million in 2009 compared to 2008 was primarily due to the increase in income from continuing operations as described above.

Diluted Earnings per Share from Continuing Operations Attributable to Raytheon Company Common Stockholders

Diluted earnings per share from continuing operations attributable to Raytheon Company common stockholders was $4.79 per diluted share on 377.0 million average shares outstanding in 2010, $4.89 per diluted share on 395.7 million average shares outstanding in 2009 and $3.93 per diluted share on 426.5 million average shares outstanding in 2008. The decrease in diluted earnings per share from continuing operations attributable to Raytheon Company common stockholders of $0.10 in 2010 compared to 2009 was primarily due to the $0.75 per share impact of the adjustment from a

change in our estimated revenue and costs on the UK Border Agency Program, described above, and the FAS/CAS Pension Adjustment, which had an impact of $0.44. These decreases were partially offset by the Tax Settlement, described above, which had an impact of $0.45, operational improvements (volume, mix and program performance), which had an impact of $0.37 and a decrease in average shares outstanding, which had an impact of $0.23. The increase in diluted earnings per share from continuing operations attributable to Raytheon Company common stockholders of $0.96 in 2009 compared to 2008 was primarily due to a decrease in average shares outstanding, which had an impact of $0.35, operational improvements (volume, mix and program performance), which had an impact of $0.28 and the FAS/CAS Pension Adjustment, which had an impact of $0.23 due to the increase in income from continuing operations. The decrease in average diluted shares outstanding in 2010 and 2009 was primarily due to the repurchase of 29.0 million and 25.8 million shares in 2010 and 2009, respectively.

Diluted Earnings (Loss) per Share from Discontinued Operations Attributable to Raytheon Company Common Stockholders

Diluted earnings (loss) per share from discontinued operations attributable to Raytheon Company common stockholders was $0.10 in 2010, had no impact per diluted share in 2009 and was $(0.01) per diluted share in 2008. The increase in diluted earnings (loss) per share from discontinued operations attributable to Raytheon Company common stockholders of $0.10 in 2010 compared to 2009 was primarily due to the Tax Settlement, described above, partially offset by the excise tax assessment related to our previous disposition of Flight Options, described below in Discontinued Operations.

Diluted Earnings per Share Attributable to Raytheon Company Common Stockholders

Diluted earnings per share attributable to Raytheon Company common stockholders was $4.88 per diluted share in 2010, $4.89 per diluted share in 2009 and $3.92 per diluted share in 2008. The decrease in diluted earnings per share attributable to Raytheon Company common stockholders of $0.01 in 2010 compared to 2009 was due to decrease in diluted earnings per share from continuing operations attributable to Raytheon Company common stockholders, partially offset by the increase in diluted Earnings (Loss) per share from discontinued operations attributable to Raytheon Company common stockholders described above. The increase in diluted earnings per share attributable to Raytheon Company common stockholders of $0.97 in 2009 compared to 2008 was primarily due to the increase in net income.

Adjusted EPS

Adjusted EPS is diluted EPS from continuing operations attributable to Raytheon Company common stockholders excluding the earnings per share impact of the FAS/CAS Pension Adjustment and, from time to time, certain other items. In addition to the FAS/CAS Pension Adjustment, our 2010 Adjusted EPS also excludes the earnings per share impact of the Tax Settlement as a result of our receipt of final approval from the IRS and the U.S Congressional Joint Committee on Taxation of the IRS' examination of our tax returns for the 1998-2005 tax years, the earnings per share impact of the UK Border Agency Program, and the make-whole provision on the early repurchase of debt, all previously described, and the impact of the acceleration of deferred gains related to the terminated interest rate swaps on the retired debt. Our 2008 Adjusted EPS also excludes the earnings per share impact of the unfavorable adjustment due to the impact of pension investment returns on existing contracts in 2008. We are providing Adjusted EPS because management uses it for the purpose of evaluating and forecasting the Company's financial performance and believes that it provides additional insights into the Company's underlying business performance. We believe it allows investors to benefit from being able to assess our operating performance in the context of how our principal customer, the U.S. Government, allows us to recover pension costs and to better compare our operating performance to others in the industry on that same basis. Adjusted EPS is not a measure of financial performance under GAAP and should be considered supplemental to and not a substitute for financial performance in accordance with GAAP. Adjusted EPS may not be defined and calculated by other companies in the same

manner and the amounts presented may not recalculate directly due to rounding. Adjusted EPS was as follows:

	2010	2009	2008
Diluted EPS from continuing operations attributable to Raytheon Company common stockholders	$ 4.79	$ 4.89	$3.93
Earnings per share impact of the FAS/CAS Pension Adjustment	0.40	(0.04)	0.19
Earnings per share impact of the unfavorable adjustment due to the impact of pension investment returns on existing contracts	—	—	0.11
Earnings per share impact of the UK Border Agency Program	0.75	—	—
Earnings per share impact of the Tax Settlement	(0.45)	—	—
Earnings per share impact of the early retirement of debt charges	0.13	0.04	—
Earnings per share impact of the acceleration of deferred gains related to terminated interest rate swaps on retired debt	(0.03)	(0.01)	—
Adjusted EPS	$ 5.58	$ 4.87	$4.22

SEGMENT RESULTS

We report our results in the following segments: Integrated Defense Systems (IDS), Intelligence and Information Systems (IIS), Missile Systems (MS), Network Centric Systems (NCS), Space and Airborne Systems (SAS) and Technical Services (TS). The following provides some context for viewing our segment performance through the eyes of management.

Given the nature of our business, bookings, net sales and operating income (including operating margin percentage), which we disclose and discuss at the segment level, are most relevant to an understanding of management's view of our segment performance, and often these measures have significant interrelated effects as described below. In addition, we disclose and discuss backlog, which represents future sales that we expect to recognize over the contract period, which is generally the next several years.

Bookings: We disclose the amount of bookings for each segment and notable contract awards. Bookings generally represent the dollar value of new contracts awarded to us during the reporting period and include firm orders for which funding has not been appropriated. We believe bookings are an important measure of future performance and are an indicator of potential future changes in net sales, since we cannot record revenues under a new contract without first having a booking in the current or preceding period (i.e., a contract award).

Total Net Sales and Total Operating Expenses: We generally express changes in net sales in terms of volume. Volume generally refers to increases or decreases in revenues related to varying amounts of total operating expenses, which are comprised of cost of sales, administrative and selling expenses and research and development expenses, incurred on individual contracts (i.e., from performance against contractual commitments on our bookings related to engineering, production or service activity). Therefore, we discuss volume changes attributable principally to individual programs unless there is a discrete event (e.g., a major contract termination, natural disaster or major labor strike, etc.), or some other unusual item that has a material effect on changes in a segment's volume for a reported period. Due to the nature of our contracts, the amount of costs incurred and related revenues will naturally fluctuate over the life of the contracts. As a result, in any reporting period, the changes in volume on numerous contracts are likely to be due to normal fluctuations in our production activity or service levels.

Operating Income (and the related operating margin percentage): We generally express changes in segment operating income in terms of volume, changes in program performance or changes in contract mix. Changes in volume discussed in net sales typically drive corresponding changes in our operating income based on the profit rate for a particular contract. Changes in program performance typically relate to profit recognition associated with revisions to total estimated costs at completion that reflect improved or deteriorated operating performance or award fee rates. Changes in contract mix refer to changes in operating margin due to a change in the relative volume of contracts with higher or lower fee rates such that the overall average margin rate for the segment changes. Because each segment has thousands of contracts, in any reporting period, changes in operating income and margin are likely to be due to normal changes in volume, program performance and mix on many contracts with no single change or series of related changes materially driving a segment's change in operating income or operating margin percentage.

Backlog: We disclose period ending backlog for each segment. Backlog represents the dollar value of contracts awarded for which work has not been performed. Backlog generally increases with bookings and generally converts into sales as we incur costs under the related contractual commitments. We therefore discuss changes in backlog, including any significant cancellations, for each of our segments, as we believe such discussion provides an understanding of the awarded but not executed portion of our contracts.

Segment financial results were as follows:

Total Net Sales (In millions)	**2010**	2009	2008
Integrated Defense Systems	$ 5,470	$ 5,525	$ 5,148
Intelligence and Information Systems	2,757	3,204	3,132
Missile Systems	5,732	5,561	5,408
Network Centric Systems	4,918	4,822	4,510
Space and Airborne Systems	4,830	4,582	4,280
Technical Services	3,472	3,161	2,601
Corporate and Eliminations	(1,996)	(1,974)	(1,905)
Total	$25,183	$24,881	$23,174

Operating Income (In millions)	**2010**	2009	2008
Integrated Defense Systems	$ 879	$ 859	$ 870
Intelligence and Information Systems	(150)	259	253
Missile Systems	654	604	584
Network Centric Systems	701	674	575
Space and Airborne Systems	686	647	569
Technical Services	300	215	174
FAS/CAS Pension Adjustment	(230)	27	(123)
Corporate and Eliminations	(233)	(243)	(282)
Total	$ 2,607	$ 3,042	$ 2,620

Bookings (In millions)	**2010**	2009	2008
Integrated Defense Systems	$ 3,269	$ 5,969	$ 5,933
Intelligence and Information Systems	3,709	2,529	3,204
Missile Systems	6,485	5,548	6,043
Network Centric Systems	4,034	3,933	4,938
Space and Airborne Systems	4,321	4,446	3,927
Technical Services	2,631	2,633	2,753
Corporate	—	—	22
Total	$24,449	$25,058	$26,820

Included in bookings were international bookings of $4,371 million, $7,634 million and $7,564 million in 2010, 2009 and 2008, respectively, which included foreign military bookings through the U.S. Government. International bookings amounted to 18%, 30% and 28% of total bookings in 2010, 2009 and 2008, respectively. International bookings in 2010 were affected by the timing of international awards. Classified bookings were 16%, 14% and 13% of total bookings in 2010, 2009 and 2008, respectively.

We record bookings for not-to-exceed contract awards based on a reasonable estimate of expected contract definitization, which will generally not be less than 75% of the award. We subsequently adjust bookings to reflect the actual amounts definitized, or, when prior to definitization, when facts and circumstances indicate our previous estimate is no longer reasonable. The timing of awards that may cover multiple fiscal years influences bookings in each year. Bookings exclude unexercised contract options and potential orders under ordering-type contracts (i.e., indefinite delivery/indefinite quantity (IDIQ) type contracts), and are reduced for contract cancellations and terminations of bookings recognized in the current year. We reflect contract cancellations and terminations from prior year bookings, as well as the impact of changes in foreign exchange rates, directly as an adjustment to backlog in the period in which the cancellation or termination occurs and the impact is determinable.

Backlog at December 31 (In millions)	Funded Backlog 2010	2009	2008	Total Backlog 2010	2009	2008
Integrated Defense Systems	$ 6,433	$ 5,595	$ 4,802	$ 8,473	$10,665	$ 9,883
Intelligence and Information Systems	725	1,588	1,890	4,319	4,360	5,137
Missile Systems	6,385	6,454	6,082	8,212	7,657	9,937
Network Centric Systems	3,740	4,389	4,593	4,912	5,501	5,733
Space and Airborne Systems	3,266	3,402	2,731	5,981	5,921	5,442
Technical Services	2,083	2,051	1,888	2,654	2,773	2,752
Total	$22,632	$23,479	$21,986	$34,551	$36,877	$38,884

Total backlog includes both funded backlog (unfilled orders for which funding is authorized, appropriated and contractually obligated by the customer) and unfunded backlog (firm orders for which funding has not been appropriated and/or contractually obligated by the customer). Backlog excludes unexercised contract options and potential orders under ordering-type contracts (e.g., IDIQ). Both funded and unfunded backlog are affected by changes in foreign exchange rates. In the second quarter of 2010, IIS recorded a net backlog adjustment of $556 million as a result of the UK Border Agency Program. In the second quarter of 2009, Kinetic Energy Interceptor (KEI), a developmental program with the MDA, was terminated for convenience, which resulted in a net backlog adjustment of approximately $2.4 billion at MS. The program was cancelled by the U.S. Missile Defense Agency (MDA) due to a change in missile defense priorities.

Integrated Defense Systems

(In millions, except percentages)	2010	2009	2008	% Change 2010 compared to 2009	2009 compared to 2008
Total Net Sales	$5,470	$ 5,525	$5,148	-1.0%	7.3%
Total Operating Expenses	4,591	4,666	4,278	-1.6%	9.1%
Operating Income	879	859	870	2.3%	-1.3%
Operating Margin	16.1%	15.5%	16.9%		
Bookings	$3,269	$ 5,969	$5,933	-45.2%	0.6%
Total Backlog	8,473	10,665	9,883	-20.6%	7.9%

IDS is a leader in global capabilities integration, providing affordable, integrated solutions to a broad international and domestic customer base. IDS leverages its core domain knowledge and capabilities in sensors, command, control and communication (C3), persistent surveillance/intelligence, surveillance and reconnaissance (ISR), effects and mission support, to provide integrated naval, air and missile defense and civil security response solutions. Key customers include the U.S. Navy, Army and Air Force, and the U.S. Missile Defense Agency (MDA), and numerous international customers.

Total Net Sales and Total Operating Expenses—The decrease in net sales of $55 million in 2010 compared to 2009 was primarily due to $243 million of lower net sales on various U.S. Navy programs due to scheduled completion of design and production efforts, including $175 million from the scheduled completion of certain design phases on a U.S. Navy combat systems program, and $211 million of lower net sales on two joint battlefield sensor programs, driven principally by lower volume due to the completion of scheduled program production efforts and a scheduled decrease in design and development effort. The decrease in net sales was partially offset by $383 million of higher net sales on Patriot programs, primarily due to $288 million of higher net sales driven by scheduled design and production effort on an international Patriot program awarded in the fourth quarter of 2008. The decrease in operating expenses of $75 million in 2010 compared to 2009 was primarily due to the activity in the programs described above.

The increase in net sales of $377 million in 2009 compared to 2008 was primarily due to $660 million of higher net sales on Patriot programs principally due to $595 million of higher net sales driven by scheduled design effort on an international Patriot program awarded in the fourth quarter of 2008. The increase in net sales was partially offset by $266

million of lower net sales on various U.S. Navy programs due to scheduled completion of design and production efforts on numerous programs, including $129 million from the completion of certain design phases on a U.S. Navy combat systems program. The increase in operating expenses of $388 million in 2009 compared to 2008 was driven primarily by the activity in the programs described above.

Operating Income and Margin—The increase in operating income of $20 million in 2010 compared to 2009 was primarily due to a change in contract mix principally driven by the change in net sales described above, which had a $24 million impact on operating income. The increase in operating margin in 2010 compared to 2009 was primarily due to the change in contract mix described above.

The decrease in operating income of $11 million in 2009 compared to 2008 was primarily due to a change in contract mix driven by the completion of certain international air and missile defense programs in 2008, which had an $81 million impact on operating income, partially offset by increased volume, which had a $47 million impact on operating income and $25 million from improved program performance across various programs. IDS' operating income also benefited from $14 million of sales of certain licensed software in 2009 compared to $28 million in 2008. The decline in operating margin in 2009 compared to 2008 was primarily due to the change in contract mix described above.

Backlog and Bookings—The decrease in backlog of $2,192 million at December 31, 2010 compared to December 31, 2009 was primarily due to lower bookings in 2010 described below. The increase in backlog of $782 million at December 31, 2009 compared to December 31, 2008 was primarily due to the 2009 bookings described below.

The decrease in bookings of $2,700 million in 2010 compared to 2009 was primarily due to higher Patriot bookings in 2009. In 2010, IDS booked $400 million to provide advanced Patriot air and missile defense capability for an international customer, $271 million on the Zumwalt-class destroyer program for the U.S. Navy, $228 million on the Aegis weapon system for the U.S. Navy, $222 million to provide engineering services support for a Patriot air and missile defense program for U.S. and international customers, $190 million for a U.S. Army/U.S. Navy Transportable Radar Surveillance (AN/TPY-2) radar for the MDA, $148 million to provide Common Contractor Logistics Support (CCLS) for the MDA, $131 million to provide Patriot Guidance Enhanced Missile-Tactical (GEM-T) missiles for Kuwait, and $112 million on the Air & Missile Defense Radar (AMDR) program for the U.S. Navy.

Bookings in 2009 remained relatively consistent with 2008. In 2009, IDS booked $3.2 billion to provide advanced Patriot air and missile defense capability for several domestic and international customers, including the U.S. Army, Taiwan and UAE. IDS also booked $650 million on the Zumwalt-class destroyer program, $157 million to provide Finland with Surface Launched Medium Range Air-to-Air Missile (SL-AMRAAM) systems and $150 million for Joint Land Attack Cruise Missile Defense Elevated Netted Sensor Systems (JLENS) for the U.S. Army.

In 2008, IDS booked $2.5 billion to provide the Patriot Air & Missile System to the UAE and $533 million on certain contracts for the design, development and support of the Patriot System for other international customers, including $288 million for South Korea, $140 million for Kuwait and $105 million for Taiwan. IDS also booked $237 million to provide engineering services support for Patriot air and missile defense programs and $229 million for the Rapid Aerostat Initial Deployment (RAID) program, both for the U.S. Army and $166 million for the production of torpedo kits for the U.S. Navy.

Intelligence and Information Systems

				% Change	
(In millions, except percentages)	**2010**	2009	2008	**2010 compared to 2009**	2009 compared to 2008
Total Net Sales	$2,757	$3,204	$3,132	-14.0%	2.3%
Total Operating Expenses	2,907	2,945	2,879	-1.3%	2.3%
Operating Income	(150)	259	253	-157.9%	2.4%
Operating Margin	-5.4%	8.1%	8.1%		
Bookings	$3,709	$2,529	$3,204	46.7%	-21.1%
Total Backlog	4,319	4,360	5,137	-0.9%	-15.1%

IIS is a leader in intelligence, surveillance and reconnaissance (ISR), advanced cyber solutions, weather and environmental solutions, and information-based solutions for law enforcement and homeland security. Approximately half of its business is for classified customers. Other key customers include the U.S. Intelligence Community, DoD agencies, the Federal Bureau of Investigations (FBI), and the National Oceanographic and Atmospheric Association (NOAA).

Total Net Sales and Total Operating Expenses—The decrease in net sales of $447 million in 2010 compared to 2009 was primarily due to $385 million of lower net sales on the UK Border Agency Program driven principally by the $316 million adjustment recorded in the second quarter of 2010 from a change in our estimated revenue and costs on the UK Border Agency Program, $68 million of lower net sales on a distributed ground systems program for the U.S. Air Force principally from lower volume as a result of the planned program schedule, and $65 million of lower net sales on certain classified programs. The decrease in net sales was partially offset by $104 million of higher net sales, as a result of scheduled design and build efforts on Global Positioning System Advanced Control Segment (GPS-OCX), a GPS command, control and mission capabilities program awarded in the first quarter of 2010. Operating expenses in 2010 remained relatively consistent with 2009.

The increase in net sales of $72 million in 2009 compared to 2008 was primarily due to $114 million of higher net sales on three major classified programs and $29 million of higher net sales on a U.S. Air Force program, principally from higher volume driven by additional task orders from expanded customer scope, partially offset by $98 million of lower net sales on an international advanced border control and security program, principally from lower volume as subcontractor work related to the initial development phase was completed in June 2009. The increase in operating expenses of $66 million in 2009 compared to 2008 was driven primarily by the activity in the programs described above.

Operating Income and Margin—The decrease in operating income of $409 million in 2010 compared to 2009 and the related decrease in operating margin was primarily due to $419 million of operating income impact related to the UK Border Agency Program driven by the $395 million adjustment recorded in the second quarter of 2010 from a change in our estimated revenue and costs previously described, partially offset by $16 million of improved program performance spread across numerous programs. IIS' operating income was also reduced by approximately $17 million in 2010 and 2009 by certain cybersecurity-related acquisition costs and investments.

The increase in operating income of $6 million in 2009 compared to 2008 was primarily due to lower cybersecurity-related acquisition costs and investments, which had a $12 million impact on operating income. Operating margin in 2009 remained consistent with 2008. IIS' operating margin was reduced by approximately $17 million in 2009 and approximately $29 million in 2008 by certain cybersecurity-related acquisition costs and investments.

Backlog and Bookings—The decrease in backlog of $41 million at December 31, 2010 compared to December 31, 2009 was primarily due to a $556 million net backlog adjustment on the UK Border Agency Program, recorded in the second quarter of 2010, partially offset by higher bookings in 2010 described below. The decrease in backlog of $777 million at December 31, 2009 compared to December 31, 2008 was primarily due to lower 2009 bookings described below.

The increase in bookings of $1,180 million in 2010 compared to 2009 included a $901 million award on a contract to develop the next-generation GPS-OCX for the U.S. Air Force, a $167 million booking on a major U.S. Air Force program, $80 million on the Earth Observing System Data and Information System (EOSDIS) contract for NASA and $1,723 million on a number of classified contracts, including $371 million on a major classified program, compared to $1,364 million in 2009.

The decrease in bookings of $675 million in 2009 was primarily due to $426 million of lower classified bookings and $154 million of lower bookings on the U.K. e-Borders contract. In 2009, IIS booked $1,364 million on a number of classified contracts compared to $1,790 million in 2008. Bookings in 2009 included $148 million and $123 million on two major classified programs and $158 million on a contract to provide intelligence, surveillance and reconnaissance (ISR) to the U.S. Air Force.

In 2008, IIS booked $1.8 billion on a number of classified contracts, including $379 million and $271 million on two major classified programs.

Missile Systems

(In millions, except percentages)	2010	2009	2008	% Change 2010 compared to 2009	% Change 2009 compared to 2008
Total Net Sales	$5,732	$5,561	$5,408	3.1%	2.8%
Total Operating Expenses	5,078	4,957	4,824	2.4%	2.8%
Operating Income	654	604	584	8.3%	3.4%
Operating Margin	11.4%	10.9%	10.8%		
Bookings	$6,485	$5,548	$6,043	16.9%	-8.2%
Total Backlog	8,212	7,657	9,937	7.2%	-22.9%

MS is a premier developer and producer of missile systems for the armed forces of the U.S. and other allied nations. Leveraging its key capabilities in advanced airframes, guidance and navigation systems, high-resolution sensors, targeting, and netted systems, MS develops and supports a broad range of cutting-edge weapon systems, including missiles, smart munitions, close-in weapon systems, projectiles, kinetic kill vehicles and directed energy effectors. Key customers include the U.S. Navy, Army, Air Force and Marine Corps, the MDA, and the armed forces of more than 40 allied nations.

Total Net Sales and Total Operating Expenses—The increase in net sales of $171 million in 2010 compared to 2009 was primarily due to $108 million of higher net sales on the Standard Missile-3 program, principally from higher volume driven by scheduled development efforts, $100 million of higher net sales on the AMRAAM program, principally from higher volume driven by scheduled higher production build rates, $92 million of higher net sales on the tube-launched, optically-tracked, wireless guided missile program, principally from higher volume driven by scheduled higher production build rates and $84 million of higher net sales on the Paveway™ program, principally from higher volume driven by scheduled production efforts on an international award. The increase in net sales was partially offset by $96 million of lower net sales on a non line-of-sight missile program, principally from lower volume, as the program received a stop work-order in the second quarter of 2010 and $82 million of lower net sales on the KEI program, which was terminated for convenience in the second quarter of 2009 as described above. The increase in operating expenses of $121 million in 2010 compared to 2009 was driven primarily by the activity in the programs described above.

The increase in net sales of $153 million in 2009 compared to 2008 was primarily due to $76 million of higher net sales on the Standard Missile-3 program, principally from increased volume due to higher subcontractor effort related to program deliveries along with increased development efforts, $60 million of higher net sales on the Maverick Missile program due primarily to material costs resulting from international orders received in 2009, and $57 million of higher net sales related to development effort on a competitive missile program. The increase in net sales was partially offset by $71 million in lower net sales on the KEI program, which was terminated for convenience in the second quarter of 2009, as described above. The increase in operating expenses of $133 million in 2009 compared to 2008 was driven primarily by the activity in the programs described above.

Operating Income and Margin—The increase in operating income of $50 million in 2010 compared to 2009 was primarily due to a change in contract mix spread across numerous programs, with no individual or common significant driver, which had a $19 million impact on operating income, improved program performance, which had a $18 million impact on operating income, primarily due to $11 million from labor and material production efficiencies on various air weapons systems programs and increased volume, which had a $13 million impact on operating income. The increase in operating margin in 2010 compared to 2009 was primarily due to the contract mix and the improved program performance described above.

The increase in operating income of $20 million in 2009 compared to 2008 was primarily due to higher volume, which had a $12 million impact on operating income. Included in operating income for 2009 was improved program performance of $26 million on the Phalanx program primarily as a result of the implementation of value engineering change proposals (VECP), which reduced production costs, primarily from material and labor efficiencies. Operating income in 2008 included $25 million from higher award fees recognized on the Standard Missile-3 program driven by a successful flight test milestone. Operating margin in 2009 remained relatively consistent with 2008.

Backlog and Bookings—The increase in backlog of $555 million at December 31, 2010 compared to December 31, 2009 was primarily due to higher bookings in 2010. The decrease in backlog of $2,280 million at December 31, 2009 compared to December 31, 2008 was primarily due to the termination for convenience of the KEI program as previously described.

The 2010 bookings, which increased $937 million over 2009 included $743 million for Standard Missile-3 for the MDA and an international customer, $698 million for the production of AMRAAM for the U.S. Air Force and international customers, $675 million on a classified program, $668 million for the production of Paveway™ for the Kingdom of Saudi Arabia and other international customers, $501 million for the production of Tomahawk missiles for the U.S. Navy and an international customer, $451 million for engineering and manufacturing development of Small Diameter Bomb II (SDB II) for the joint U.S. Air Force and U.S Navy program, $425 million for the production of Standard Missile-2 for the U.S. Navy and international customers, $274 million for the production of Rolling Airframe Missile (RAM) for the U.S. Navy and international customers, $271 million for the Phalanx Weapons System for the U.S. Navy, Army and international customers, $262 million for development work on the Exoatmospheric Kill Vehicle program for the MDA, $209 million for the production of AIM-9X Sidewinder short range air-to-air missiles for the U.S. Navy and international customers, $198 million for the Javelin program for the U.S. Army and international customers, $168 million on the Miniature Air-Launched Decoy (MALD) for the U.S. Air Force, Army, and Navy, $147 million for Evolved Sea Sparrow Missiles (ESSM) for the U.S. Navy and international customers, $122 million for the production of TOW missiles for U.S. Army and international customers, and $114 million for the production of the Joint Stand-off Weapon (JSOW) for the U.S. Navy and international customers.

The decrease in bookings of $495 million in 2009 was primarily due to $318 million of awards for Standard Missile-3 for the U.S. Navy and the MDA in 2009 compared to $1.2 billion in 2008. In 2009, MS booked $645 million for AMRAAM systems for international customers and the U.S. Air Force, $514 million for the tube launched, optically-tracked, wireless guided missile program for international customers and the U.S. Army, $508 million for ESSM for international customers and the U.S. Navy and $402 million for Phalanx Weapon Systems. MS also booked $384 million on Standard Missile-2 for international customers and the U.S. Navy, $318 million for Standard Missile-3 for the MDA and $294 million for Tactical Tomahawk cruise missiles for the U.S. Navy.

In 2008, MS booked $1.2 billion for the production of Standard Missile-3 for the U.S. Navy and the MDA, $624 million for the production of the AMRAAM program for international customers and the U.S. Air Force, $577 million on Standard Missile Development and Production, and $478 million for the production of Tactical Tomahawk cruise missiles for the U.S. Navy.

Network Centric Systems

				% Change	
(In millions, except percentages)	**2010**	2009	2008	**2010 compared to 2009**	2009 compared to 2008
Total Net Sales	$4,918	$4,822	$4,510	2.0%	6.9%
Total Operating Expenses	4,217	4,148	3,935	1.7%	5.4%
Operating Income	701	674	575	4.0%	17.2%
Operating Margin	14.3%	14.0%	12.7%		
Bookings	$4,034	$3,933	$4,938	2.6%	-20.4%
Total Backlog	4,912	5,501	5,733	-10.7%	-4.0%

NCS is a leading provider of net-centric mission solutions for federal, state and local government and civil customers. NCS leverages its capabilities in networking, sensors, command and control, and communications to develop and produce solutions for customers in key markets such as U.S. Army modernization, international and domestic homeland security, civil communications, and transportation solutions. NCS customers include the DoD and other U.S. government customers, as well as numerous international customers.

Total Net Sales and Total Operating Expenses—The increase in net sales of $96 million in 2010 compared to 2009 was primarily due to $223 million of higher net sales related to programs associated with Raytheon BBN Technologies (BBN), which was acquired in the fourth quarter of 2009, primarily due to increased DoD research activities and force protection awards, and $127 million of higher net sales, as planned due to a scheduled increase in design and production efforts on a classified international program awarded in the fourth quarter of 2009. The increase in net sales was partially offset by $144 million of lower net sales on a U.S. Army sensor program due to a planned decline in production and $81 million of lower net sales on a combat vehicle sensor program, principally from lower volume, due to a program restructuring. The increase in operating expenses of $69 million in 2010 compared to 2009 was driven primarily by the activity described above.

The increase in net sales of $312 million in 2009 compared to 2008 was primarily due to $261 million of higher net sales across various production programs, primarily certain U.S. Army programs, principally from higher volume driven by increases in production to meet program delivery schedule requirements, as anticipated, as well as $112 million of higher intersegment sales related to precision mechanical products and related design engineering. The increase in net sales was also due to $53 million of higher net sales, principally from higher volume on a precision approach and landing program for the U.S. Navy awarded in the third quarter of 2008 and $41 million of higher net sales related to BBN. The increase in net sales was partially offset by $144 million of lower net sales, principally from lower volume on a U.S. Army communications program that substantially completed production efforts on the initial contract, as planned, in the third quarter of 2008. The increase in operating expenses of $213 million in 2009 compared to 2008 was driven primarily by the activity described above.

Operating Income and Margin—The increase in operating income of $27 million in 2010 compared to 2009 was primarily due to improved program performance spread across numerous programs, with no individual or common significant driver, which had an $18 million impact on operating income and increased volume, which had a $13 million impact on operating income, partially offset by a change in contract mix, which had a $4 million negative impact on operating income, driven principally by lower volume on a U.S. Army sensor program. Operating margin in 2010 remained relatively consistent with 2009.

The increase in operating income of $99 million in 2009 compared to 2008 was primarily due to improved program performance on a broad range of programs of $76 million and higher volume, which had an $18 million impact on operating income. Of the $76 million in improved program performance, $29 million is attributable to the production programs described above, driven by lower estimated labor and material costs at completion from achieved production efficiencies. These production efficiencies were the result of increased production volume across these programs which allowed us to leverage existing capacity, incur lower production labor hours and experience improved yields. The remaining improved program performance included overhead cost improvement initiatives and other program performance that was spread across numerous contracts with no other individual or common significant driver. The improvement in operating margin in 2009 compared to 2008 was primarily due to the improved program performance described above.

Backlog and Bookings—The decrease in backlog of $589 million at December 31, 2010 compared to December 31, 2009 was primarily due to external sales in excess of bookings in 2010, principally within our Combat Systems product line. The decrease in backlog of $232 million at December 31, 2009 compared to December 31, 2008 was primarily due to lower bookings in 2009.

Bookings in 2010 remained relatively consistent with bookings in 2009. In 2010, NCS booked $254 million on the Standard Terminal Automation Replacement System (STARS) program for the Federal Aviation Agency (FAA) and the DoD, $250 million for the Long Range Advanced Scout Surveillance Systems (LRAS3) program for the U.S. Army, $146 million on a

command and control program for an international customer, $111 million for Horizontal Technology Integration (HTI) forward-looking infrared kits for the U.S. Army, $104 million on the Navy Multiband Terminal (NMT) program for the U.S. Navy and $96 million for Improved Thermal Sight Systems (ITSS) for an international customer.

The decrease in bookings of $1,005 million in 2009 was primarily due to awards for HTI forward-looking infrared kits, the LRAS3, the Joint Precision Approach and Landing System (JPALS) contract and other programs in 2008 described below. In 2009, NCS booked $446 million on an international classified program, $163 million for Improved Target Acquisition Systems (ITAS), $146 million for HTI forward looking infrared kits, $127 million for a toll system replacement program, $117 million for Commander's Independent Viewers (CIV) and $107 million for the Secure Mobile Anti-Jam Reliable Tactical Terminal (SMART-T) program.

In 2008, NCS booked $570 million to provide HTI forward-looking infrared kits and $279 million for the LRAS3 contract for the U.S. Army. NCS also booked $233 million for the design and development phase of JPALS for the U.S. Navy, $231 million for the production of ITAS for the U.S. Army and Marine Corps and $115 million for the Airborne, Maritime and Fixed Site (AMF) Joint Tactical Radio System (JTRS) program.

Space and Airborne Systems

				% Change	
(In millions, except percentages)	**2010**	2009	2008	**2010 compared to 2009**	2009 compared to 2008
Total Net Sales	$4,830	$4,582	$4,280	5.4%	7.1%
Total Operating Expenses	4,144	3,935	3,711	5.3%	6.0%
Operating Income	686	647	569	6.0%	13.7%
Operating Margin	14.2%	14.1%	13.3%		
Bookings	$4,321	$4,446	$3,927	-2.8%	13.2%
Total Backlog	5,981	5,921	5,442	1.0%	8.8%

SAS is a leader in the design and development of integrated systems and solutions for advanced missions, including traditional and non-traditional intelligence, surveillance and reconnaissance (ISR), precision engagement, unmanned aerial operations and space. Leveraging advanced concepts, state-of-the-art technologies and mission systems knowledge, SAS provides electro-optical/infrared sensors, airborne radars for surveillance and fire control applications, lasers, precision guidance systems, processors, electronic warfare systems and space-qualified systems for civil and military applications. Key customers include the U.S. Navy, Air Force and Army, as well as classified and international customers.

Total Net Sales and Total Operating Expenses—The increase in net sales of $248 million in 2010 compared to 2009 was primarily due to $235 million of higher net sales from higher volume, as planned, as work increased on certain classified business awarded principally in the first half of 2009, $87 million of higher net sales on a multi-spectral targeting system program driven by increased planned production efforts to meet the program delivery schedule and $75 million of higher net sales from higher volume, as planned, as production work increased on an international airborne tactical radar program awarded in the first quarter of 2010. The increase in net sales was partially offset by $111 million of lower net sales from lower volume, as planned, as an advanced targeting program moved toward completion. The increase in operating expenses of $209 million in 2010 compared to 2009 was primarily driven by the activity described above.

The increase in net sales of $302 million in 2009 compared to 2008 was primarily due to $212 million of higher net sales, principally from higher volume as work increased on certain classified business awarded in the second half of 2008 and in the first quarter of 2009, $100 million of higher net sales, principally from higher volume on international airborne tactical radar programs driven by increased production efforts as planned to meet the program delivery schedule and $93 million of higher net sales, principally on a multi-spectral targeting system program driven by increased production efforts as planned to meet the program schedule. The increase in operating expenses of $224 million in 2009 compared to 2008 was primarily driven by the activity described above.

Operating Income and Margin—The increase in operating income of $39 million in 2010 compared to 2009 was primarily due to higher volume, which had a $28 million impact on operating income, and a change in contract mix driven by higher volume on an international airborne tactical radar program, which had a $26 million impact on operating income. The increase in operating income was partially offset by the $19 million in 2009 from the favorable settlement of affirmative claims and the resolution of a contract termination described below. Operating margin in 2010 remained relatively consistent with 2009.

The increase in operating income of $78 million in 2009 compared to 2008 was primarily due to a change in mix from higher volume on the international tactical radar programs described above, which had a $43 million impact on operating income, increased volume, which had a $30 million impact on operating income, and $19 million from the favorable settlement of affirmative claims related to contract scope on two fixed-price programs and the resolution of a contract termination claim. The improvement in operating margin in 2009 compared to 2008 was primarily due to the change in mix and favorable settlement of the affirmative claims and resolution of the contract termination claim.

Backlog and Bookings—Backlog remained relatively consistent at December 31, 2010 compared to December 31, 2009. The increase in backlog of $479 million at December 31, 2009 compared to December 31, 2008 was primarily due to the 2009 awards, primarily classified, described below.

Bookings in 2010 remained relatively consistent with 2009. In 2010, SAS booked $1,106 million on a number of classified contracts, including $332 million on a major classified space program. In 2010, SAS also booked $618 million for the production of Active Electronically Scanned Array (AESA) radars for the U.S. Air Force, U.S. Navy, Air National Guard and international customers and $90 million for the production of Advanced Countermeasures Electronic System (ACES) for Egypt.

The increase in bookings of $519 million in 2009 was primarily due to higher international and domestic tactical radar awards in 2009. In 2009, SAS booked $422 million to supply APG-63 fire control radars and support equipment for the Japan Air Self-Defense Force, $295 million for the B-2 RMP and $147 million on the Integrated Sensor Is Structure (ISIS) radar program for the Defense Advanced Research Projects Agency (DARPA). SAS also booked $1,330 million on a number of classified contracts.

In 2008, SAS booked $1.5 billion on a number of classified contracts.

Technical Services

				% Change	
(In millions, except percentages)	**2010**	2009	2008	**2010 compared to 2009**	2009 compared to 2008
Total Net Sales	$3,472	$3,161	$2,601	9.8%	21.5%
Total Operating Expenses	3,172	2,946	2,427	7.7%	21.4%
Operating Income	300	215	174	39.5%	23.6%
Operating Margin	8.6%	6.8%	6.7%		
Bookings	$2,631	$2,633	$2,753	-0.1%	-4.4%
Total Backlog	2,654	2,773	2,752	-4.3%	0.8%

TS provides a full spectrum of technical, scientific and professional services to defense, federal, international and commercial customers worldwide. It specializes in training, logistics, engineering services and solutions, product support and operational support services. TS provides solutions for mission support, homeland security, space, civil aviation, counterproliferation and counterterrorism markets. Key customers include all branches of the U.S. Armed Forces, as well as the DHS, NASA, FAA, Department of Energy, Defense Threat Reduction Agency (DTRA) and international governments.

Total Net Sales and Total Operating Expenses—The increase in net sales of $311 million in 2010 compared to 2009 was primarily due to $232 million of higher net sales from growth on TS' training programs, principally domestic and foreign training programs supporting the U.S. Army's Warfighter FOCUS activities due to an increase in customer determined activity levels, and $53 million of higher net sales from programs with the Transportation Security Administration (TSA), driven primarily by system integration efforts on a program awarded in the first quarter of 2010. The increase in operating expenses of $226 million in 2010 compared to 2009 was driven primarily by the activity in the programs described above.

The increase in net sales of $560 million in 2009 compared to 2008 was primarily due to $589 million of higher net sales from growth on TS' training programs, principally domestic and foreign training programs supporting the U.S. Army's Warfighter FOCUS activities, which began significant efforts in May 2008, and training activities performed on the Air Traffic Control Optimum Training Solutions (ATCOTS) contract for the FAA, a program awarded in 2008, which began training activities in the fourth quarter of 2008. The increase was partially offset by $98 million of lower net sales on a DTRA program, principally from lower volume due to the substantial completion of contract scope in the fourth quarter of 2008. The increase in operating expenses of $519 million in 2009 compared to 2008 was driven primarily by the activity in the programs described above.

Operating Income and Margin—The increase in operating income of $85 million in 2010 compared to 2009 was primarily due to improved program performance, which had a $65 million impact on operating income, and increased volume, which had an $18 million impact on operating income. The improved program performance was driven primarily by cost efficiencies associated with increased levels of program activities on various training programs, which had a $22 million positive impact on 2010 operating income, the majority of which was on programs nearing completion; contract modifications that impacted the scope on certain training programs and an international mission support program, which had an $11 million positive impact on 2010 operating income; prior year profit adjustments due to a change in estimate related to certain mission support program costs, which had a $6 million negative impact on 2009 operating income; and higher award fees on a fixed-price service contract, which had a $3 million positive impact on 2010 operating income. The increase in operating margin in 2010 compared to 2009 was primarily due to the improved program performance described above.

The increase in operating income of $41 million in 2009 compared to 2008 was primarily due to increased volume, which had a $37 million impact on operating income. Operating margin in 2009 remained relatively consistent with 2008.

Backlog and Bookings—Backlog at December 31, 2010 remained relatively consistent with December 31, 2009 and December 31, 2008.

Bookings in 2010 remained relatively consistent with 2009. In 2010, TS booked $952 million on domestic training programs and $328 million on foreign training programs in support of the Warfighter FOCUS activities, $173 million to provide operational and logistics support to the National Science Foundation (NSF) Office of Polar Programs and $88 million on the Security Equipment Integration Services (SEIS) contract for the TSA.

Bookings in 2009 remained relatively consistent with 2008. In 2009, TS booked $1.0 billion on domestic training programs and $300 million on foreign training programs in support of the U.S. Army's Warfighter FOCUS activities, $160 million to upgrade Phalanx Weapon Systems for the Royal Canadian Navy and $100 million for DTRA.

In 2008, TS booked $890 million on domestic training programs and $67 million on foreign training programs in support of the U.S. Army's Warfighter FOCUS activities as well as $436 million on the FAA's ATCOTS contract.

FAS/CAS Pension Adjustment

The FAS/CAS Pension Adjustment represents the difference between our pension expense or income under FAS in accordance with GAAP and our pension expense under CAS. The results of each segment only include pension expense under CAS that we generally recover through the pricing of our products and services to the U.S. Government.

The components of the FAS/CAS Pension Adjustment was as follows:

(In millions)	**2010**	2009	2008
FAS expense	$(896)	$(646)	$(524)
CAS expense	666	673	401
FAS/CAS Pension Adjustment	$(230)	$ 27	$(123)

As described above in Critical Accounting Estimates, a key driver of the difference between FAS and CAS expense (and consequently, the FAS/CAS Pension Adjustment) is the pattern of earnings and expense recognition for gains and losses that arise when our asset and liability experience differ from our assumptions under each set of requirements. Generally, such gains or losses are amortized under FAS over the average future working lifetime of the eligible employee population of approximately 11 years, and are amortized under CAS over a 15-year period. In accordance with both FAS and CAS, a "market-related value" of our plan assets is used to calculate the amount of deferred asset gains or losses to be amortized. The market-related value of assets is determined using actual asset gains or losses over a certain prior period (three years for FAS and five years for CAS, subject to certain limitations under CAS on the difference between the market-related value and actual market value of assets). Because of this difference in the number of years over which actual asset gains or losses are recognized and subsequently amortized, FAS expense generally tends to reflect the recent gains or losses faster than CAS. Another driver of CAS expense (but not FAS expense) is the funded status of our pension plans under CAS. As noted above, CAS expense is only recognized for plans that are not fully funded; consequently, if plans become or cease to be fully funded under CAS due to our asset or liability experience, our CAS expense will change accordingly.

The change in the FAS/CAS Pension Adjustment of $257 in 2010 compared to 2009 was driven by a $250 million increase in our FAS expense. The $250 million increase in our FAS expense was driven primarily by the continued recognition of the 2008 losses in the market related value of assets, which had an impact of approximately $260 million. Our CAS expense decreased $7 million as a result of actual versus expected asset and liability experience.

The change in the FAS/CAS Pension Adjustment of $150 million in 2009 compared to 2008 was driven by a $272 million increase in our CAS expense. The $272 million increase in our CAS expense was driven primarily by negative asset returns in 2008, which caused certain plans to no longer be fully funded under CAS and had an impact of $287 million. Our FAS expense also increased by $122 million. The primary components of the change in FAS expense included an increase of $297 million due to the lower than expected return on pension assets during 2008, partially offset by a decrease of $106 million due to the expected return on our discretionary cash contribution to our plans in 2008 as well as the expected return on the expected cash contributions in 2009. In addition, the FAS expense decreased by $47 million due to the recognition of previous historical asset returns which were greater than the expected return.

For 2011, we currently expect our FAS expense will increase more than our CAS expense, which will increase the FAS/CAS Pension Adjustment. We expect the FAS/CAS Pension Adjustment to be approximately $370 million of expense driven by the lower discount rate environment and the difference in amortization periods under FAS and CAS, described above, of the net unrecognized liability, principally due to the negative 2008 asset returns. This expected increase in FAS expense in excess of CAS expense is subject to our annual update, generally planned in the third quarter, of our actuarial estimate of the unfunded benefit obligation for both FAS and CAS for final 2010 census data and does not include any potential change for the Harmonization Rule. After 2011, the FAS/CAS Pension Adjustment is more difficult to predict because future FAS and CAS expense is based on a number of key assumptions for future periods. Differences between those assumptions and future actual results could significantly change both FAS and CAS expense in future periods. However, based solely on our current assumptions at December 31, 2010 and without an adjustment for the Harmonization Rule, we would expect our FAS/CAS Pension Adjustment to decline as CAS continues to recognize the market related value of the 2008 asset losses through 2013 which FAS will have fully recognized through 2011.

Beginning in 2011, in order to more clearly show each business' underlying operational performance, we began treating for management reporting purposes the amounts related to the FAS/CAS Post Retirement benefit (FAS/CAS PRB Adjustment) consistent with the FAS/CAS Pension Adjustment. Also beginning in 2011, we changed our segment presentation to exclude from each business the amounts related to the FAS/CAS PRB Adjustment and combined such

amounts with our FAS/CAS Pension Adjustment. The FAS/CAS PRB Adjustment represents the difference between our Post Retirement benefits (PRB) credit under FAS in accordance with GAAP and our PRB adjustment under CAS. This will result in a combined FAS/CAS adjustment at Corporate as follows:

(In millions)	**2010**	2009	2008
FAS/CAS Pension Adjustment as Reported	$(230)	$27	$(123)
FAS/CAS PRB Adjustment	43	52	58
Total FAS/CAS Adjustment	$(187)	$79	$ (65)

The change will have an insignificant impact to each of the business segments operating income and margins for 2010, 2009, and 2008.

Corporate and Eliminations

Corporate and Eliminations includes corporate expenses and intersegment sales and profit eliminations. Corporate expenses represent unallocated costs and certain other corporate costs not considered part of management's evaluation of reportable segment operating performance, including the net costs associated with our residual commuter aircraft portfolio.

The components of total net sales related to Corporate and Eliminations were as follows:

(In millions)	**2010**	2009	2008
Intersegment sales eliminations	$(2,023)	$(2,004)	$(1,884)
Corporate	27	30	(21)
Total	$(1,996)	$(1,974)	$(1,905)

The components of operating income related to Corporate and Eliminations were as follows:

(In millions)	**2010**	2009	2008
Intersegment profit eliminations	$ (189)	$ (173)	$ (166)
Corporate	(44)	(70)	(116)
Total	$ (233)	$ (243)	$ (282)

Total net sales and operating income related to corporate in 2010 remained relatively consistent with 2009. The increase in net sales and operating income related to corporate in 2009 compared to 2008 was primarily due to the increase in estimated future CAS pension costs at December 31, 2008, described below.

As described above in Critical Accounting Estimates, pension costs as calculated under CAS are a component of our estimated costs to complete each of our U.S. Government contracts. On an annual basis, we update our estimate of future CAS pension costs based upon actual asset returns and other actuarial factors. When these estimated future costs increase, which occurred at December 31, 2008, driven mainly by the significant decline in the value of our pension assets in 2008, the estimated costs to complete each existing contract increases. The amounts of revenue and profit which are recognizable based upon our estimated percent complete and expected margins on our contracts, principally on our fixed-price contracts, were reduced. In 2008, we recorded a cumulative catch-up adjustment for this reduction in revenue and profit of $69 million as part of Corporate and Eliminations consistent with our internal management reporting and performance evaluation. The components of the adjustment were as follows:

(In millions)	
Integrated Defense Systems	$20
Intelligence and Information Systems	7
Missile Systems	14
Network Centric Systems	12
Space and Airborne Systems	12
Technical Services	4
Total	$69

Discontinued Operations

In pursuing our business strategies we have divested certain non-core businesses, investments and assets when appropriate. All residual activity relating to our previously disposed businesses appears in discontinued operations.

We retained certain assets and liabilities of our previously disposed businesses. At December 31, 2010 and December 31, 2009, we had $41 million and $71 million, respectively, of assets primarily related to our retained interest in general aviation finance receivables previously sold by Raytheon Aircraft Company (Raytheon Aircraft). At December 31, 2010 and December 31, 2009, we had $113 million and $57 million, respectively, of liabilities primarily related to non-income tax obligations, certain environmental and product liabilities, various contract obligations and aircraft lease obligations. We also have certain income tax obligations relating to these disposed businesses, which we include in our income tax disclosures. In the fourth quarter of 2010, IRS appeals proceedings failed to resolve the federal excise tax dispute related to the treatment of monthly management fees, and as a result, the IRS assessed Flight Options for excise taxes. In the divestiture of Flight Options, Raytheon agreed to indemnify Flight Options in the event Flight Options was assessed and paid these excise taxes. This indemnification obligation gave rise to our retained non-income tax obligation. In 2011, Flight Options paid the assessment and we indemnified Flight Options given our indemnification obligation. As a result, In the fourth quarter of 2010 we recorded a $39 million charge, net of federal tax benefit, in discontinued operations. On behalf of Flight Options, we intend to vigorously contest the matter through litigation and, if successful, we would be entitled to recover substantially all of the amounts paid. We also retained certain U.K. pension assets and obligations for a limited number of U.K. pension plan participants as part of the Raytheon Aircraft sale, which we include in our pension disclosures.

During 2010, in connection with the Tax Settlement, we recorded a $280 million reduction in our unrecognized tax benefits, which included a decrease of $89 million in tax expense from discontinued operations, including interest, primarily related to our previous disposition of Raytheon Engineers and Constructors.

FINANCIAL CONDITION AND LIQUIDITY

Overview

We pursue a capital deployment strategy that balances funding for growing our business, including capital expenditures, acquisitions and research and development; managing our balance sheet, including debt repayments and pension contributions; and returning cash to our stockholders, including dividend payments and share repurchases, as outlined below. Our need for, cost of and access to funds are dependent on future operating results, as well as other external conditions. We currently expect that cash and cash equivalents, cash flow from operations and other available financing resources will be sufficient to meet anticipated operating, capital expenditure, investment, debt service and other financing requirements during the next twelve months and for the foreseeable future.

In addition, the following table highlights selected measures of our liquidity and capital resources at December 31, 2010 and 2009:

(In millions)	**2010**	2009
Cash and cash equivalents	$3,638	$2,642
Working capital	2,862	2,345
Amount available under our credit facilities	1,497	1,479

The increase of $517 million in working capital in 2010 compared to 2009 was primarily due to the $954 million increase in total current assets, principally driven by increased cash, partially offset by the $437 million increase in total current liabilities, principally driven by increases in other incurred expenses and accounts payable as a result of the timing of payments.

Operating Activities

(In millions)	**2010**	2009	2008
Net cash provided by (used in) operating activities from continuing operations	$1,931	$2,745	$2,036
Net cash provided by (used in) operating activities	1,942	2,725	2,015

The decrease of $783 million in net cash provided by (used in) operating activities in 2010 compared to 2009 was primarily due to $750 million of higher discretionary pension contributions. The increase of $710 million in net cash provided by (used in) operating activities in 2009 compared to 2008 was primarily due to $240 million of lower net tax payments, driven by the $350 million refund described below and $69 million of overpayment credits; $42 million of lower pension and other postretirement benefit payments described below; and $37 million of proceeds from the termination of our interest rate swap agreements. The remainder of the increase in net cash was primarily due to an increase in net cash receipts in line with total net sales growth.

Tax Payments—In 2010, we received federal tax refunds totaling $96 million and made $433 million in federal and net foreign tax payments and $54 million in net state tax payments. In 2009, we received federal tax refunds totaling $350 million and made $558 million in federal and net foreign tax payments, net of $69 million of overpayment credits. In 2009, we received state tax refunds totaling $23 million and made $45 million in state tax payments. In 2008, we made $448 million in federal and net foreign tax payments and $125 million in net state tax payments. Federal and foreign tax payments for 2011 are expected to approximate $700 million.

In March 2010, the Patient Protection and Affordable Care Act, as modified by the Health Care and Education Reconciliation Act of 2010, was enacted which changed the tax treatment of the U.S. Government subsidies for companies that provide qualifying drug coverage to Medicare eligible retirees. Although some companies have been adversely affected by this act, we do not receive such U.S. Government subsidies and therefore this change will not have an effect on our financial position, results of operations or liquidity.

Pension Plan Contributions—We make both required and discretionary contributions to our pension plans. Required contributions are primarily determined under the ERISA rules and are affected by the actual return on plan assets and plan funded status. We made the following required and discretionary contributions to our pension plans during December 31:

(In millions)	**2010**	2009	2008
Required contributions	$1,152	$1,115	$ 514
Discretionary contributions	750	—	660
Total	$1,902	$1,115	$1,174

Required contributions in 2010 were consistent with 2009. Required contributions in 2009 were higher than 2008 due to the impact of the decline in the value of pension plan assets in 2008. We expect to make required contributions to our pension plans of approximately $1.1 billion in 2011. We will continue to periodically evaluate whether to make additional discretionary contributions. Effective January 1, 2011, we are subject to the funding requirements under the Pension Protection Act of 2006 (PPA), which amended ERISA. Under the PPA, we are required to fully fund our pension plans over a rolling seven-year period as determined annually based upon the funded status at the beginning of each year. Additionally, the recognition of pension costs for government contractors under the CAS rules is required to be harmonized with the PPA. On May 10, 2010, the CAS Pension Harmonization Notice of Proposed Rulemaking (NPRM) was published in the Federal Register with a 60 day comment period. The NPRM is the third step of a four step statutory process to implement a final CAS standard (Harmonization Rule) related to the recognition of pension costs for government contractors. Based upon the feedback received during the comment period, the CAS Board will either issue the final rule or alternatively reissue the NPRM. We expect that the final rule would increase our CAS recovery amount and decrease the FAS/CAS Pension Adjustment. Other postretirement benefit payments were $31 million, $45 million and $28 million in 2010, 2009 and 2008, respectively.

We made interest payments of $134 million, $147 million and $142 million in 2010, 2009 and 2008, respectively. The decrease in interest payments in 2010 compared to 2009 was primarily due to the repurchase, in the fourth quarter of 2009, of our 4.85% Notes due 2011. Interest payments in 2009 remained relatively consistent with 2008.

Investing Activities

(In millions)	**2010**	2009	2008
Net cash provided by (used in) investing activities	$(535)	$(692)	$(417)

The decrease of $157 million in net cash provided by (used in) investing activities in 2010 compared to 2009 was primarily due to the acquisition of BBN in the fourth quarter of 2009 in which we paid $334 million, net of cash acquired, offset by 2010 acquisitions of $152 million, net of cash acquired, described below. This decrease is offset by $39 million of higher additions to property, plant and equipment. The increase of $275 million in net cash provided by (used in) investing activities in 2009 compared to 2008 was primarily due to the acquisition of BBN in the fourth quarter of 2009.

Additions to property plant and equipment and capitalized internal use software—Additions to property, plant and equipment and capitalized internal use software were as follows:

(In millions)	**2010**	2009	2008
Additions to property, plant and equipment	$319	$280	$304
Additions to capitalized internal use software	67	67	74

We expect our property, plant and equipment and capitalized internal use software expenditures to be approximately $400 million and $110 million, respectively, in 2011, consistent with the anticipated growth of our business and for specific investments including program capital assets and facility improvements.

In pursuing our business strategies, we acquire and make investments in certain businesses that meet strategic and financial criteria, and divest of certain non-core businesses, investments and assets when appropriate.

As described in Note 18: Subsequent Events on page 115, on January 31, 2011, we completed the acquisition of Applied Signal Technology, Inc. (AST), pursuant to a definitive agreement dated December 18, 2010.

Acquisitions—In 2010, we acquired Trusted Computer Solutions Inc., Technology Associates Inc. and substantially all of the assets of an Australian company, Compucat Research Pty. Ltd, for a total amount for all three of $152 million in cash, net of cash acquired. These acquisitions enhance our cybersecurity and information assurance capabilities. In connection with these acquisitions, we recorded $125 million of goodwill, primarily related to expected synergies from combining operations and the value of the existing workforce, and $28 million of intangible assets, primarily related to technology, trade names and customer relationships with a weighted-average life of five years.

In 2009, we acquired BBN which enhances our advanced networking, speech and language technologies, information technologies, sensor systems and cybersecurity, for $334 million in cash, net of $22 million of cash acquired, exclusive of retention and management incentive payments.

In 2008, we acquired Telemus Solutions, Inc. and SI Government Solutions, which enhance our cybersecurity capabilities, for an aggregate of $52 million in cash.

Financing Activities

(In millions)	**2010**	2009	2008
Net cash provided by (used in) financing activities	$(411)	$(1,650)	$(1,994)

We have used cash provided by operating activities, and proceeds from the issuance of new debt in 2010 and 2009 as our primary source for the repayment of debt, payment of dividends and the repurchase of our common stock. The increase of $1,239 million in net cash provided by (used in) financing activities in 2010 compared to 2009 was primarily due to the issuance of $2.0 billion fixed rate long-term debt, as described below, partially offset by $250 million of higher repurchases of common stock under our share repurchase programs and $678 million related to the repurchase of long-term debt described below. The decrease of $344 million in net cash provided by (used in) financing activities in 2009 compared to 2008 was primarily due to $500 million of lower repurchases of common stock under our share repurchase program, partially offset by a $112 million reduction in activity under common stock plans due to lower stock option exercises, described below.

Debt—In the fourth quarter of 2010, we received proceeds of $1,975 million for the issuance of $2.0 billion fixed rate long-term debt and exercised our call rights to repurchase, at prices based on fixed spreads to U.S. Treasuries, $678 million of our long-term debt due in 2012 and 2013 at a loss of $73 million pretax, $47 million after-tax, which is included in other (income) expense.

In the fourth quarter of 2009, we received proceeds of $496 million from the issuance of $500 million fixed-rate long-term debt and exercised our call rights to repurchase, at prices based on fixed spreads to U.S. Treasuries, $474 million of our long-term debt maturing in 2011 at a loss of $22 million pretax, $14 million after-tax, which is included in other (income) expense. We made no debt repayments in 2008.

Stock Repurchases—Information on repurchases of our common stock under our share repurchase programs was as follows:

(In millions)	**2010**	2009	2008
Amount of stock repurchased	$1,450	$1,200	$1,700
Shares of stock repurchased	29.0	25.8	30.7

In March 2010, our Board of Directors authorized the repurchase of up to an additional $2.0 billion of our outstanding common stock. At December 31, 2010, we had approximately $1.4 billion remaining under this repurchase program. All previous repurchase programs had been completed as of December 31, 2010. Share repurchases will take place from time to time at management's discretion depending on market conditions.

In May 2010, our stockholders approved the Raytheon 2010 Stock Plan (the "Plan"). Under the Plan, we may grant restricted stock awards, restricted stock units, stock grants, stock options and stock appreciation rights.

Cash Dividends—Our Board of Directors authorized the following cash dividends:

(In millions, except per share amounts)	**2010**	2009	2008
Cash dividends per share	$1.50	$1.24	$1.12
Total dividends paid	536	473	460

In March 2010, our Board of Directors authorized a 21% increase to our annual dividend payout rate from $1.24 to $1.50 per share. In March 2009, our Board of Directors authorized an 11% increase in our annual dividend payout rate from $1.12 to $1.24 per share. Dividends are subject to quarterly approval by our Board of Directors.

CAPITAL RESOURCES

Total debt was $3.6 billion at December 31, 2010 and $2.3 billion at December 31, 2009 and 2008. Our outstanding debt bears contractual interest at fixed interest rates ranging from 1.6% to 7.2% and matures at various dates through 2040.

Cash and Cash Equivalents—Cash and cash equivalents were $3.6 billion and $2.6 billion at December 31, 2010 and December 31, 2009, respectively. We invest cash in U.S. Treasuries; commercial paper of financial institutions and corporations with a minimum long-term debt rating of AA- or Aa3 and minimum short-term debt rating of A-1 and P-1; AAA/Aaa rated U.S. Treasury money market funds; and bank certificates of deposit and time deposits with a minimum long-term debt rating of AA- or Aa3. Cash balances held at our foreign subsidiaries were approximately 15% of our total cash balance at December 31, 2010 and December 31, 2009, and are deemed to be indefinitely reinvested.

Credit Facilities—In November 2010, we entered into a $500 million revolving credit facility maturing in 2012, replacing the previous $500 million 364-day facility, which matured in November 2010. Under the facility we can borrow and backstop commercial paper.

We have a $1.0 billion facility maturing in November 2012, $150 million of which is available to Raytheon United Kingdom Limited, our U.K. subsidiary. Under the facility we can borrow, issue letters of credit and backstop commercial paper.

Borrowings under these facilities bear interest at various rate options, including LIBOR plus a margin based on our credit default swap spread, with minimum and maximum margins that are adjusted for our credit ratings. Based on our credit ratings at December 31, 2010 borrowings under the $1.0 billion and $500 million facilities would bear interest at LIBOR plus 100 basis points and 75 basis points, respectively, the minimum margin. The credit facilities are comprised of commitments from approximately 25 separate highly rated lenders, each committing no more than 10% of the aggregate of the facilities. As of December 31, 2010 and December 31, 2009, there were no borrowings outstanding under these

credit facilities or our previous credit facility. However, we had $3 million and $21 million of outstanding letters of credit at December 31, 2010 and December 31, 2009, respectively, which effectively reduced our borrowing capacity under these credit facilities and our previous credit facility by those same amounts.

Under the current and previous credit facilities, we must comply with certain covenants, including a ratio of total debt to total capitalization of no more than 50% and a ratio of consolidated earnings attributable to Raytheon Company before interest, taxes, depreciation and amortization to consolidated net interest expense, for any period of four consecutive fiscal quarters, of no less than 3 to 1. We were in compliance with these covenants during 2010 and 2009. Our ratio of total debt to total capitalization, as defined in the current and previous credit facilities, was 26.7% and 19.0% at December 31, 2010 and December 31, 2009, respectively. We are providing these ratios, which are financial covenants under our current credit facilities, as these metrics are used by our lenders to monitor the Company's leverage and debt service capacity and are also thresholds that limit our ability to utilize these two facilities.

Certain of our foreign subsidiaries maintain revolving bank lines of credit to provide them with a limited amount of short-term liquidity, including the $150 million Raytheon United Kingdom Limited facility described above. In addition, other uncommitted bank lines totaled approximately $2 million and $15 million at December 31, 2010 and December 31, 2009, respectively. There were no amounts outstanding under these lines of credit at December 31, 2010 and December 31, 2009. Compensating balance arrangements are not material.

Credit Ratings—Three major corporate debt rating organizations, Fitch Ratings (Fitch), Moody's Investors Service (Moody's) and Standard & Poor's (S&P), assign ratings to our short-term and long-term debt. The following chart reflects the current ratings assigned by each of these agencies as of December 31, 2010 to our short and long-term senior unsecured debt:

Rating Agency	Short-Term Debt	Long-Term Senior Debt Rating	Outlook	Date of Last Action
Fitch	F2	A-	Stable	September 2008
Moody's	P-2	Baa1	Stable	March 2007
S&P	A-2	A-	Stable	September 2008

Shelf Registrations—We have an effective shelf registration with the SEC, filed in October 2010, which covers the registration of debt securities, common stock, preferred stock and warrants.

CONTRACTUAL OBLIGATIONS

The following is a schedule of our contractual obligations outstanding at December 31, 2010:

(In millions)	Total	Less than 1 year (2011)	1 - 3 years (2012- 2013)	4 - 5 years (2014- 2015)	After 5 years (2016 and thereafter)
Debt[1]	$ 3,658	$ —	$ —	$ 400	$3,258
Interest payments	2,432	167	336	336	1,593
Operating leases	1,216	254	363	214	385
Purchase obligations	8,875	6,205	2,382	222	66
Total	$16,181	$6,626	$3,081	$1,172	$5,302

(1) Debt includes scheduled principal payments only.

Purchase obligations in the table above represent enforceable and legally binding agreements with suppliers to purchase goods or services. We enter into contracts with customers, primarily the U.S. Government, which entitles us to full recourse for costs incurred, including purchase obligations, in the event the contract is terminated by the customer for convenience. These purchase obligations are included above notwithstanding the amount for which we are entitled to full recourse from our customers. The table above does not include required pension and other postretirement contributions. We expect to make required pension and other postretirement contributions of $1.1 billion in 2011, exclusive of any U.S. Government recovery. Amounts beyond 2011 for required pension and other postretirement contributions depend upon actuarial assumptions, actual plan asset performance and other factors described under pension costs in Critical Accounting Estimates on page 35. However, based solely on our current assumptions, we expect our funding requirements to be approximately $1 billion in 2012 and 2013, exclusive of any U.S. Government recovery, and slowly decreasing thereafter.

Interest payments include interest on debt that is redeemable at our option.

As of December 31, 2010 and December 31, 2009, the total amount of unrecognized tax benefits for uncertain tax positions and the accrual for the related interest, net of the federal benefit, was $211 million and $549 million, respectively, and was included in accrued retiree benefits and other long-term liabilities. These amounts were not included in the table above since we are unable to make a reasonably reliable estimate of when a cash settlement, if any, will occur with a tax authority as the timing of examinations and ultimate resolutions of those examinations is uncertain.

OFF-BALANCE SHEET ARRANGEMENTS

At December 31, 2010, we had no significant off-balance sheet arrangements other than operating leases and guarantees to third parties on behalf of our affiliates as described below in Commitments and Contingencies. Such arrangements are not material to our overall liquidity or capital resources, market risk support or credit risk support as described below.

COMMITMENTS AND CONTINGENCIES

Environmental Matters—We are involved in various stages of investigation and cleanup related to remediation of various environmental sites. Our estimate of the liability of total environmental remediation costs includes the use of a discount rate and considers that a portion of these costs is eligible for future recovery through the pricing of our products and services to the U.S. Government. We consider such recovery probable based on government contracting regulations and our long history of receiving reimbursement for such costs and accordingly have recorded the estimated future recovery of these costs from the U.S. Government within contracts in process. Our estimates of total remediation costs, weighted average risk-free rate, total remediation costs—discounted and recoverable portion were as follows at December 31:

(In millions, except percentages)	**2010**	2009
Total remediation costs—undiscounted	$225	$208
Weighted average risk-free rate	5.6%	5.7%
Total remediation costs – discounted	$152	$139
Recoverable portion	107	97

We also lease certain government-owned properties and are generally not liable for remediation of preexisting environmental contamination at these sites; as a result, we generally do not reflect the provision for these costs in our consolidated financial statements.

Due to the complexity of environmental laws and regulations, the varying costs and effectiveness of alternative cleanup methods and technologies, the uncertainty of insurance coverage and the unresolved extent of our responsibility, it is difficult to determine the ultimate outcome of environmental matters; however, we do not expect any additional liability to have a material adverse effect on our financial position, results of operations or liquidity.

Environmental remediation costs expected to be incurred are:

(In millions)	
2011	$ 48
2012	23
2013	19
2014	14
2015	12
Thereafter	109

Financing Arrangements and Other—We issue guarantees and banks and surety companies issue, on our behalf, letters of credit and surety bonds to meet various bid, performance, warranty, retention and advance payment obligations of us or our affiliates. These instruments expire on various dates through 2020. Additional guarantees of project performance for which there is no stated value also remain outstanding. The stated values outstanding consisted of the following at December 31, 2010 and December 31, 2009:

(In millions)	**2010**	2009
Guarantees	$ 281	$227
Letters of Credit	1,067	898
Surety Bonds	213	203

Included in guarantees and letters of credit described above were $134 million and $256 million, respectively, at December 31, 2010, and $80 million and $206 million, respectively, at December 31, 2009, related to our joint venture in TRS. We provide these guarantees and letters of credit to TRS and other affiliates to assist these entities in obtaining financing on more favorable terms, making bids on contracts and performing their contractual obligations. While we expect these entities to satisfy their loans, project performance and other contractual obligations, their failure to do so may result in a future obligation to us. At December 31, 2010 and December 31, 2009, we had an estimated liability of $9 million and $6 million, respectively, related to these guarantees and letters of credit. We periodically evaluate the risk of TRS and other affiliates failing to satisfy their loans, project performance and meet other contractual obligations described above. At December 31, 2010, we believe the risk that TRS and other affiliates will not be able to perform or meet their obligations is minimal for the foreseeable future based on their current financial condition. All obligations were current at December 31, 2010.

Our residual turbo-prop commuter aircraft portfolio has exposure to outstanding financing arrangements with the aircraft serving as collateral. We have sold and leased commuter aircraft globally to thinly capitalized companies, whose financial condition could be significantly affected by a number of factors, including fuel and other costs, the availability of credit, industry consolidation, declining commercial aviation market conditions and the U.S. Government budget for the Essential Air Service program. Based on recent economic trends, including tightening credit markets and volatile fuel costs, these companies may increasingly experience difficulties meeting their financial commitments. At December 31, 2010 and December 31, 2009, our exposure on commuter aircraft assets held as inventory, collateral on notes or as leased assets, was approximately $68 million relating to 77 aircraft and approximately $109 million relating to 106 aircraft, respectively. The valuation of used aircraft is also considered in assessing the realizable value of certain commuter aircraft related to assets which serve as collateral for the underlying financial arrangements. As part of the assessment of realizable value, we evaluate many factors, including sales transaction history, current market conditions, anticipated future market conditions and age and condition of the aircraft. The carrying value of our commuter aircraft portfolio assumes an orderly disposition of these assets, consistent with our historical experience and strategy. The tightening of credit markets and economic conditions have reduced the number of potential buyers who are able to obtain financing and have negatively impacted the ability of existing customers to refinance their aircraft through a third party. If the long-term market prospects for these aircraft were to significantly erode or cease, our valuation of these assets would likely be less than the carrying value. We periodically evaluate potential alternative strategies for the disposal of these assets. If we were to dispose of these assets in an other than orderly manner or sell the portfolio in its entirety, the value realized would likely be less than the carrying value.

In 1997, we provided a first loss guarantee of $133 million on $1.3 billion of U.S. Export-Import Bank loans (maturing in 2015) to the Brazilian Government related to Network Centric Systems' System for the Vigilance of the Amazon (SIVAM) program. Loan repayments by the Brazilian Government were current at December 31, 2010.

We have entered into industrial cooperation agreements, sometimes referred to as offset agreements, as a condition to obtaining orders for our products and services from certain customers in foreign countries. These agreements are designed to enhance the social and economic environment of the foreign country by requiring the contractor to promote investment in the country. Offset agreements may be satisfied through activities that do not require us to use cash, including transferring technology, providing manufacturing and other consulting support to in-country projects, and the purchase by third parties *(e.g.,* our vendors) of supplies from in-country vendors. These agreements may also be satisfied through our use of cash for such activities as purchasing supplies from in-country vendors, providing financial support for in-country projects, building or leasing facilities for in-country operations and making investments in local ventures. We typically do not commit to offset agreements until orders for our products or services are definitive. The amounts ultimately applied against our offset agreements are based on negotiations with the customer and typically require cash outlays that represent only a fraction of the original amount in the offset agreement. Offfset programs usually extend over several years and may provide for penalties in the event we fail to perform in accordance with offset requirements. We have historically not been required to pay any such penalties.

Government contractors are subject to many levels of audit and investigation. Agencies that oversee contract performance include: the Defense Contract Audit Agency, the Defense Contract Management Agency, the Inspector General of the Department of Defense and other departments and agencies, the Government Accountability Office, the Department of Justice and Congressional Committees. The Department of Justice has, from time to time, convened grand juries to investigate possible irregularities by us. We also provide products and services to customers outside of the U.S. and those sales are subject to local government laws, regulations and procurement policies and practices. Our compliance with such local government regulations or any applicable U.S. Government regulations (e.g., the Foreign Corrupt Practices Act and the International Traffic in Arms Regulations) may also be investigated or audited. We do not expect these audits and investigations to have a material adverse effect on our financial position, results of operations or liquidity, either individually or in the aggregate.

We are currently conducting a self-initiated internal review of certain of our international operations, focusing on compliance with the Foreign Corrupt Practices Act. In the course of the review, we have identified several possible areas of concern relating to payments made in connection with certain international operations related to a jurisdiction where we do business. We have voluntarily contacted the SEC and the Department of Justice to advise both agencies that an internal review is underway. Because the internal review is ongoing, we cannot predict the ultimate consequences of the review. Based on the information available to date, we do not believe that the results of this review will have a material adverse effect on our financial position, results of operations or liquidity.

In May 2006, international arbitration hearings commenced against us as the successor to the Hughes Electronics defense business, in connection with certain claims brought in 2004 by MBDA relating to an alleged 1995 Workshare Agreement. The asserted claims involve breach of contract, intellectual property infringement and other related matters. The arbitration panel stayed further proceedings, including the issuance of the liability decision on the non-IP claims presented during the May 2006 hearing, while the parties engaged in settlement efforts. The parties were unable to conclude an enforceable settlement, and in August 2009, the panel released its liability decision, rejecting some of MBDA's non-IP claims, while finding Raytheon liable for some other non-IP claims. We did not record any significant additional financial liability as a result of our estimate of the impact of the decision. The proceedings will now resume to determine liability for the asserted IP claims and to assess overall damages, if any. At this point, we are unable to estimate a range of potential loss, if any, because the IP claims are vague, discovery is in process, and any potential damages involve complex, technical matters subject to interpretation by the arbitration panel. We believe that we have meritorious defenses to the asserted IP claims and intend to continue to contest them vigorously; however, an adverse resolution of this matter could have a material effect on our financial position, results of operations or liquidity.

On July 22, 2010, Raytheon Systems Limited (RSL) was notified by the UK Border Agency that it had been terminated for cause on a program. The termination notice included allegations that RSL had failed to perform on certain key milestones and other matters in addition to claims to recover certain losses incurred and previous payments made to RSL.

We believe that RSL performed well and delivered substantial capabilities to the UK Border Agency under the program, which has been operating successfully and providing actionable information since live operations began in May 2009. On July 29, 2010, RSL filed a dispute notice on the grounds that the termination by the UK Border Agency was not valid. On August 18, 2010, the UK Border Agency initiated arbitration proceedings on this issue. We expect the arbitration procedures to commence in the first half of 2011. We intend to pursue vigorously the collection of receivables for the program and damages in connection with the termination and defend ourselves against the UK Border Agency's claims for losses and previous payments.

As a result of the termination notice, we adjusted our estimated amount of revenue and costs under the program in the second quarter of 2010. The adjustment was based on our determination that certain assets were no longer expected to be recovered and for estimated costs for certain exit cost obligations under the contract and the estimated settlement of expected future subcontractor claims. The impact of the adjustment reduced Intelligence and Information Systems' total net sales and operating income by $316 million and $395 million, respectively, for the year ended December 31, 2010. At December 31, 2010, we had approximately $80 million in letters of credit and approximately $70 million of receivables and other assets remaining under the program for technology and services delivered, which we believe, are probable of recovery in litigation or arbitration. No amounts have been drawn down on the letters of credit. We currently do not believe it is probable that we are liable for losses, previous payments or other claims asserted by the UK Border Agency. Due to the inherent uncertainties in litigation and arbitration as noted above, and the complexity and technical nature of potential claims and counterclaims, as well as the resolution of the related matters involving subcontractors, it is reasonably possible that the ultimate amount of any resolution of the termination could be less or greater than our estimate and at this time, we are unable to estimate a range of the potential difference in such amounts, if any. If we are unsuccessful in recovering amounts drawn on the letters of credit, if any, fail to collect the receivable balance, are required to make payments against claims or other losses asserted by the UK Border Agency or pay subcontractor claims in excess of our estimates made in connection with the adjustment in the second quarter of 2010 described above, it could have a material adverse effect on our financial position, results of operations or liquidity.

In addition, various other claims and legal proceedings generally incidental to the normal course of business are pending or threatened against us. We do not expect any additional liability from these proceedings to have a material adverse effect on our financial position, results of operations or liquidity.

ACCOUNTING STANDARDS

In January 2010, we adopted the required new accounting standards which amend the accounting and disclosure requirements for transfers of financial assets and consolidation of Variable Interest Entities (VIEs). Among other things, these accounting standards eliminate the concept of a qualifying special purpose entity (QSPE) and the related exception for applying the consolidation guidance. As a result, on January 1, 2010 we consolidated General Aviation Receivables Corporation (GARC), which did not have a material impact on our consolidated financial statements and resulted in:

- The removal of our $67 million investment in the GARC previously reported in other assets, net, and
- The addition of long and short-term notes receivable, net of $68 million, current and long-term notes payable of $2 million, and an increase in retained earnings of less than $1 million, net of tax.

Further, the new accounting standard related to consolidation of VIEs requires an enterprise to perform a qualitative analysis when determining whether or not it must consolidate a VIE. It also requires an enterprise to continuously reassess whether it must consolidate a VIE. Additionally, it requires enhanced disclosures about an enterprise's involvement with VIEs and any significant change in risk exposure due to that involvement, as well as how its involvement with VIEs impacts the enterprise's financial statements. Finally, an enterprise is required to disclose significant judgments and assumptions used to determine whether or not to consolidate a VIE. With the exception of GARC described above, the adoption of this accounting standard did not change any of our previous consolidation conclusions and thus did not have an effect on our financial position, results of operations or liquidity.

Other new pronouncements issued but not effective until after December 31, 2010, are not expected to have a material impact on our financial position, results of operations or liquidity.

ITEM 7A. QUANTITATIVE AND QUALITATIVE DISCLOSURES ABOUT MARKET RISK

Our primary market exposures are to interest rates and foreign exchange rates.

We meet our working capital requirements with a combination of variable-rate short-term and fixed-rate long-term financing. We enter into foreign currency forward contracts with commercial banks to fix the foreign currency exchange rates on specific commitments and payments to vendors and customer receipts. We may enter into interest rate swap agreements with commercial and investment banks to manage interest rates associated with our financing arrangements. The market-risk sensitive instruments we use for hedging are entered into with commercial and investment banks and are directly related to a particular asset, liability or transaction for which a firm commitment is in place.

The following tables provide information as of December 31, 2010 and December 31, 2009 about our market risk exposure associated with changing interest and exchange rates. For long-term debt obligations, the table presents principal cash flows by maturity date and average interest rates related to outstanding obligations. There were no interest rate swaps outstanding at December 31, 2010 and December 31, 2009.

As of December 31, 2010
Principal Payments and Interest Rate Detail by Contractual Maturity Dates
(In millions, except percentages)

Long—Term Debt	**2011**	**2012**	**2013**	**2014**	**2015**	**Thereafter**	**Total**	**Fair Value**
Fixed-rate debt	$—	$—	$—	$—	400	$ 3,258	$ 3,658	$ 3,783
Average interest rate	—	—	—	—	1.625%	4.962%	4.60%	

As of December 31, 2009
Principal Payments and Interest Rate Detail by Contractual Maturity Dates
(In millions, except percentages)

Long—Term Debt	2010	2011	2012	2013	2014	Thereafter	Total	Fair Value
Fixed-rate debt	$—	$—	$ 333	$ 345	$—	$1,658	$2,336	$2,581
Average interest rate	—	—	5.50%	5.38%	—	6.10%	5.91%	

The notional amounts of outstanding foreign exchange forward contracts consisted of the following at:

	December 31, 2010		December 31, 2009	
(In millions)	**Buy**	**Sell**	Buy	Sell
British Pounds	$370	$296	$407	$498
Canadian Dollars	220	51	212	46
Euros	165	32	190	35
All other	85	39	176	53
Total	$840	$418	$985	$632

Unrealized gains of $45 million and $69 million were included in non-current assets and unrealized losses of $41 million and $33 million were included in current liabilities at December 31, 2010 and December 31, 2009, respectively. For foreign currency forward contracts designated and qualifying for hedge accounting, we record the effective portion of the gain or loss on the derivative in accumulated other comprehensive loss, net of tax, and reclassify it into earnings in the same period or periods during which the hedged revenue or cost of sales transaction affects earnings. Realized gains and losses resulting from these cash flow hedges offset the foreign currency exchange gains and losses on the underlying assets or liabilities being hedged. We believe our exposure due to changes in foreign currency rates is not material due to our hedging policy.

ITEM 8. FINANCIAL STATEMENTS AND SUPPLEMENTARY DATA

COMPANY RESPONSIBILITY FOR FINANCIAL STATEMENTS

The financial statements and related information contained in this Annual Report have been prepared by and are the responsibility of our management. Our financial statements have been prepared in conformity with accounting principles generally accepted in the United States of America and reflect judgments and estimates as to the expected effects of transactions and events currently being reported. Our management is responsible for the integrity and objectivity of the financial statements and other financial information included in this Annual Report. To meet this responsibility, we maintain a system of internal control over financial reporting to provide reasonable assurance that assets are safeguarded and that transactions are properly executed and recorded. The system includes policies and procedures, internal audits and our officers' reviews.

Our Audit Committee of our Board of Directors is composed solely of directors who are independent under applicable SEC and New York Stock Exchange rules. Our Audit Committee meets periodically and, when appropriate, separately with representatives of the independent registered public accounting firm, our officers and the internal auditors to monitor the activities of each.

PricewaterhouseCoopers LLP, an independent registered public accounting firm, was appointed by our Audit Committee to audit our financial statements and our internal control over financial reporting and their report follows. Our stockholders ratified the appointment of PricewaterhouseCoopers LLP at the 2010 Annual Meeting of Stockholders.

MANAGEMENT'S REPORT ON INTERNAL CONTROL OVER FINANCIAL REPORTING

Management is responsible for establishing and maintaining adequate internal control over financial reporting for the Company. In order to evaluate the effectiveness of internal control over financial reporting, as required by Section 404 of the Sarbanes-Oxley Act, management has conducted an assessment, including testing, using the criteria in Internal Control – Integrated Framework, issued by the Committee of Sponsoring Organizations of the Treadway Commission (COSO). The Company's system of internal control over financial reporting is designed to provide reasonable assurance regarding the reliability of financial reporting and the preparation of financial statements for external purposes in accordance with accounting principles generally accepted in the United States of America. Because of its inherent limitations, internal control over financial reporting may not prevent or detect misstatements. Also, projections of any evaluation of effectiveness to future periods are subject to the risk that controls may become inadequate because of changes in conditions, or that the degree of compliance with the policies or procedures may deteriorate.

Based on its assessment, management has concluded that the Company maintained effective internal control over financial reporting as of December 31, 2010, based on criteria in Internal Control – Integrated Framework, issued by the COSO. The effectiveness of the Company's internal control over financial reporting as of December 31, 2010, has been audited by PricewaterhouseCoopers LLP, an independent registered public accounting firm, as stated in their report which is included below.

/s/ William H. Swanson
William H. Swanson
Chairman and Chief Executive Officer

/s/ David C. Wajsgras
David C. Wajsgras
Senior Vice President and Chief Financial Officer

REPORT OF INDEPENDENT REGISTERED PUBLIC ACCOUNTING FIRM

To the Board of Directors and Shareholders of Raytheon Company:

In our opinion, the accompanying consolidated balance sheets and the related consolidated statements of operations, of equity, and of cash flows present fairly, in all material respects, the financial position of Raytheon Company and its subsidiaries at December 31, 2010 and 2009, and the results of their operations and their cash flows for each of the three years in the period ended December 31, 2010 in conformity with accounting principles generally accepted in the United States of America. Also in our opinion, the Company maintained, in all material respects, effective internal control over financial reporting as of December 31, 2010, based on criteria established in *Internal Control—Integrated Framework* issued by the Committee of Sponsoring Organizations of the Treadway Commission (COSO). The Company's management is responsible for these financial statements, for maintaining effective internal control over financial reporting and for its assessment of the effectiveness of internal control over financial reporting, included in the accompanying Management's Report on Internal Control over Financial Reporting. Our responsibility is to express opinions on these financial statements and on the Company's internal control over financial reporting based on our integrated audits. We conducted our audits in accordance with the standards of the Public Company Accounting Oversight Board (United States). Those standards require that we plan and perform the audits to obtain reasonable assurance about whether the financial statements are free of material misstatement and whether effective internal control over financial reporting was maintained in all material respects. Our audits of the financial statements included examining, on a test basis, evidence supporting the amounts and disclosures in the financial statements, assessing the accounting principles used and significant estimates made by management, and evaluating the overall financial statement presentation. Our audit of internal control over financial reporting included obtaining an understanding of internal control over financial reporting, assessing the risk that a material weakness exists, and testing and evaluating the design and operating effectiveness of internal control based on the assessed risk. Our audits also included performing such other procedures as we considered necessary in the circumstances. We believe that our audits provide a reasonable basis for our opinions.

As discussed in Note 12 to the consolidated financial statements, in 2008, the Company changed the manner in which it accounts for obligations associated with certain life insurance agreements.

A company's internal control over financial reporting is a process designed to provide reasonable assurance regarding the reliability of financial reporting and the preparation of financial statements for external purposes in accordance with generally accepted accounting principles. A company's internal control over financial reporting includes those policies and procedures that (i) pertain to the maintenance of records that, in reasonable detail, accurately and fairly reflect the transactions and dispositions of the assets of the company; (ii) provide reasonable assurance that transactions are recorded as necessary to permit preparation of financial statements in accordance with generally accepted accounting principles, and that receipts and expenditures of the company are being made only in accordance with authorizations of management and directors of the company; and (iii) provide reasonable assurance regarding prevention or timely detection of unauthorized acquisition, use, or disposition of the company's assets that could have a material effect on the financial statements.

Because of its inherent limitations, internal control over financial reporting may not prevent or detect misstatements. Also, projections of any evaluation of effectiveness to future periods are subject to the risk that controls may become inadequate because of changes in conditions, or that the degree of compliance with the policies or procedures may deteriorate.

/s/ PricewaterhouseCoopers LLP
Boston, Massachusetts
February 23, 2011

RAYTHEON COMPANY

CONSOLIDATED BALANCE SHEETS

(In millions, except per share amount) December 31:	2010	2009
Assets		
Current assets		
Cash and cash equivalents	$ 3,638	$ 2,642
Contracts in process, net	4,414	4,493
Inventories	363	344
Deferred taxes	266	273
Prepaid expenses and other current assets	141	116
Total current assets	8,822	7,868
Property, plant and equipment, net	2,003	2,001
Deferred taxes	106	436
Goodwill	12,045	11,922
Other assets, net	1,446	1,380
Total assets	$24,422	$23,607
Liabilities and Equity		
Current liabilities		
Advance payments and billings in excess of costs incurred	$ 2,201	$ 2,224
Accounts payable	1,538	1,397
Accrued employee compensation	901	868
Other accrued expenses	1,320	1,034
Total current liabilities	5,960	5,523
Accrued retiree benefits and other long-term liabilities	4,815	5,793
Deferred taxes	147	23
Long-term debt	3,610	2,329
Commitments and contingencies (note 11)		
Equity		
Raytheon Company stockholders' equity		
Common stock, par value, $0.01 per share, 1,450 shares authorized, 359 and 378 shares outstanding at 2010 and 2009, respectively after deducting 136 and 107 treasury shares at 2010 and 2009, respectively.	4	4
Additional paid-in capital	11,406	10,991
Accumulated other comprehensive loss	(5,146)	(4,824)
Treasury stock, at cost	(6,900)	(5,446)
Retained earnings	10,390	9,102
Total Raytheon Company stockholders' equity	9,754	9,827
Noncontrolling interests in subsidiaries	136	112
Total equity	9,890	9,939
Total liabilities and equity	$24,422	$23,607

The accompanying notes are an integral part of the consolidated financial statements.

RAYTHEON COMPANY

CONSOLIDATED STATEMENTS OF OPERATIONS

(In millions, except per share amounts) Years Ended December 31:	2010	2009	2008
Net sales			
Products	$21,386	$21,761	$20,923
Services	3,797	3,120	2,251
Total net sales	25,183	24,881	23,174
Operating expenses			
Cost of sales—products	17,022	17,071	16,570
Cost of sales—services	3,281	2,676	1,919
Administrative and selling expenses	1,648	1,527	1,548
Research and development expenses	625	565	517
Total operating expenses	22,576	21,839	20,554
Operating income	2,607	3,042	2,620
Interest expense	126	123	129
Interest income	(16)	(14)	(64)
Other (income) expense	65	3	33
Non-operating (income) expense, net	175	112	98
Income from continuing operations before taxes	2,432	2,930	2,522
Federal and foreign income taxes	589	953	824
Income from continuing operations	1,843	1,977	1,698
Income (loss) from discontinued operations, net of tax	36	(1)	(2)
Net income	1,879	1,976	1,696
Less: Net Income (loss) attributable to noncontrolling interests in subsidiaries	39	41	24
Net income attributable to Raytheon Company	$ 1,840	$ 1,935	$ 1,672
Basic earnings (loss) per share attributable to Raytheon Company common stockholders:			
Income from continuing operations	$ 4.84	$ 4.96	$ 4.01
Income (loss) from discontinued operations, net of tax	0.10	—	(0.01)
Net income	4.94	4.96	4.01
Diluted earnings (loss) per share attributable to Raytheon Company common stockholders:			
Income from continuing operations	$ 4.79	$ 4.89	$ 3.93
Income (loss) from discontinued operations, net of tax	0.10	—	(0.01)
Net income	4.88	4.89	3.92
Amounts attributable to Raytheon Company common stockholders:			
Income from continuing operations	$ 1,804	$ 1,936	$ 1,674
Income (loss) from discontinued operations, net of tax	36	(1)	(2)
Net income	$ 1,840	$ 1,935	$ 1,672

The accompanying notes are an integral part of the consolidated financial statements.

RAYTHEON COMPANY

CONSOLIDATED STATEMENTS OF EQUITY

Years Ended December 31, 2010, 2009 and 2008 (In millions, except per share amounts)	Common stock	Additional paid-in capital	Accumulated other comprehensive (loss)	Treasury stock	Retained earnings	Total Raytheon Company stockholders' equity	Noncontrolling interests in subsidiaries	Total equity
Balance at December 31, 2007	$4	$10,544	$(1,956)	$(2,502)	$ 6,452	$12,542	$ 87	$12,629
Net income					1,672	1,672	24	1,696
Other comprehensive income (loss)								
Amortization of unfunded projected benefit obligation			182			182		182
Impact to revalue unfunded projected benefit obligation			(3,208)			(3,208)		(3,208)
Foreign exchange translation			(160)			(160)		(160)
Cash flow hedges			(40)			(40)		(40)
Comprehensive (loss) income						(1,554)	24	(1,530)
Dividends declared					(462)	(462)		(462)
Impact to adopt new accounting standard (Note 12)					(16)	(16)		(16)
Distributions and other activity related to noncontrolling interests							(10)	(10)
Common stock plans activity		329				329		329
Treasury stock activity				(1,752)		(1,752)		(1,752)
Balance at December 31, 2008	4	10,873	(5,182)	(4,254)	7,646	9,087	101	9,188
Net income					1,935	1,935	41	1,976
Other comprehensive income (loss)								
Amortization of unfunded projected benefit obligation			255			255		255
Impact to revalue unfunded projected benefit obligation			(24)			(24)		(24)
Foreign exchange translation			88			88		88
Cash flow hedges			40			40		40
Unrealized gain on investments			(1)			(1)		(1)
Comprehensive income						2,293	41	2,334
Dividends declared					(479)	(479)		(479)
Distributions and other activity related to noncontrolling interests							(30)	(30)
Common stock plans activity		118				118		118
Treasury stock activity				(1,192)		(1,192)		(1,192)
Balance at December 31, 2009	4	10,991	(4,824)	(5,446)	9,102	9,827	112	9,939
Net income					1,840	1,840	39	1,879
Other comprehensive income (loss)								
Amortization of unfunded projected benefit obligation			372			372		372
Impact to revalue unfunded projected benefit obligation			(647)			(647)		(647)
Foreign exchange translation			(18)			(18)		(18)
Cash flow hedges			(27)			(27)		(27)
Unrealized gain on investments			(2)			(2)		(2)
Comprehensive income						1,518	39	1,557
Dividends declared					(552)	(552)		(552)
Distributions and other activity related to noncontrolling interests							(15)	(15)
Common stock plans activity		165				165		165
Warrants exercised		250				250		250
Treasury stock activity				(1,454)		(1,454)		(1,454)
Balance at December 31, 2010	$4	$11,406	$(5,146)	$(6,900)	$10,390	$ 9,754	$136	$ 9,890

The accompanying notes are an integral part of the consolidated financial statements.

RAYTHEON COMPANY

CONSOLIDATED STATEMENTS OF CASH FLOWS

(In millions) Years Ended December 31:	2010	2009	2008
Cash flows from operating activities			
Net income	$ 1,879	$ 1,976	$ 1,696
(Income) loss from discontinued operations, net of tax	(36)	1	2
Income from continuing operations	1,843	1,977	1,698
Adjustments to reconcile to net cash provided by (used in) operating activities from continuing operations, net of the effect of acquisitions and divestitures			
Depreciation and amortization	420	402	390
Stock-based compensation	128	127	122
Deferred income taxes	345	269	574
Collection of financing receivables	36	46	68
Tax benefit from stock-based awards	(21)	(13)	(53)
Changes in assets and liabilities			
Contracts in process, net and advance payments and billings in excess of costs incurred	52	(225)	155
Inventories	(10)	(6)	62
Prepaid expenses and other current assets	(25)	(36)	60
Accounts payable	139	198	(24)
Income taxes receivable/payable	419	494	(351)
Accrued employee compensation	27	(56)	(9)
Other accrued expenses	175	78	3
Pension and other, net	(1,597)	(510)	(659)
Net cash provided by (used in) operating activities from continuing operations	1,931	2,745	2,036
Net cash provided by (used in) operating activities from discontinued operations	11	(20)	(21)
Net cash provided by (used in) operating activities	1,942	2,725	2,015
Cash flows from investing activities			
Additions to property, plant and equipment	(319)	(280)	(304)
Proceeds from sales of property, plant and equipment	4	1	14
Additions to capitalized internal use software	(67)	(67)	(74)
Change in other assets	(1)	(12)	(8)
Proceeds from sales of discontinued operations, net	—	—	9
Payments for purchases of acquired companies, net of cash received	(152)	(334)	(54)
Net cash provided by (used in) investing activities	(535)	(692)	(417)
Cash flows from financing activities			
Dividends paid	(536)	(473)	(460)
Issuance of long-term debt, net of offering costs	1,975	496	—
Repayments of long-term debt	(678)	(474)	—
Repurchases of common stock	(1,450)	(1,200)	(1,700)
Proceeds from warrants exercised	250	—	—
Activity under common stock plans	22	1	113
Tax benefit from stock-based awards	21	13	53
Other	(15)	(13)	—
Net cash provided by (used in) financing activities	(411)	(1,650)	(1,994)
Net increase (decrease) in cash and cash equivalents	996	383	(396)
Cash and cash equivalents at beginning of year	2,642	2,259	2,655
Cash and cash equivalents at end of year	$ 3,638	$ 2,642	$ 2,259

The accompanying notes are an integral part of the consolidated financial statements.

NOTES TO CONSOLIDATED FINANCIAL STATEMENTS

Note 1: Summary of Significant Accounting Policies

Consolidation and Classification—The consolidated financial statements include the accounts of Raytheon Company, and all wholly-owned and majority-owned domestic and otherwise controlled foreign subsidiaries. All intercompany transactions have been eliminated. For classification of certain current assets and liabilities, we use the duration of the related contract or program as our operating cycle, which is generally longer than one year. In addition, certain prior year amounts have been reclassified to conform with the current year presentation. As used in these notes, the terms "we", "us", "our", "Raytheon" and the "Company" mean Raytheon Company and its subsidiaries, unless the context indicates another meaning.

Use of Estimates—Our consolidated financial statements are based on the application of U.S. Generally Accepted Accounting Principles (GAAP), which require us to make estimates and assumptions about future events that affect the amounts reported in our consolidated financial statements and the accompanying notes. Future events and their effects cannot be determined with certainty. Therefore, the determination of estimates requires the exercise of judgment. Actual results could differ from those estimates, and any such differences may be material to our consolidated financial statements.

Revenue Recognition—We account for our long-term contracts associated with the design, development, manufacture, or modification of complex aerospace or electronic equipment and related services, such as certain cost-plus service contracts, using the percentage-of-completion accounting method. Under this method, revenue is recognized based on the extent of progress towards completion of the long-term contract. We combine closely related contracts when all the applicable criteria under GAAP are met. Similarly, we may segment a project, which may consist of a single contract or a group of contracts, with varying rates of profitability, only if all the applicable criteria under GAAP are met.

We generally use the cost-to-cost measure of progress for all of our long-term contracts unless we believe another method more clearly measures progress towards completion of the contract. Under the cost-to-cost measure of progress, the extent of progress towards completion is measured based on the ratio of costs incurred-to-date to the total estimated costs at completion of the contract. Revenues, including estimated earned fees or profits, are recorded as costs are incurred. Incentive and award fees are generally awarded at the discretion of the customer or upon achievement of certain program milestones or cost targets. Incentive and award fees, as well as penalties related to contract performance, are considered in estimating profit rates. Estimates of award fees are based on actual awards and anticipated performance, which may include the performance of subcontractors or partners depending upon the individual contract requirements. Incentive provisions that increase or decrease earnings based solely on a single significant event are generally not recognized until the event occurs. Such incentives and penalties are recorded when there is sufficient information for us to assess anticipated performance. Our claims on contracts are recorded only if it is probable the claim will result in additional contract revenue and the amounts can be reliably estimated.

Changes in estimates of net sales, costs of sales and the related impact to operating income are recognized using a cumulative catch-up, which recognizes in the current period the cumulative effect of the changes on current and prior periods. A significant change in one or more of these estimates could affect the profitability of one or more of our contracts. When estimates of total costs to be incurred on a contract exceed total estimates of revenue to be earned, a provision for the entire loss on the contract is recorded in the period the loss is determined.

To a much lesser extent, we enter into contracts that are not associated with the design, development, manufacture, or modification of complex aerospace or electronic equipment and related services. Revenue under such contracts is generally recognized upon delivery or as the service is performed. Revenue on contracts to sell software is recognized when evidence of an arrangement exists, the software has been delivered and accepted by the customer, the fee is fixed or determinable and collection is probable. Revenue from non-software license fees is recognized over the expected life of the continued involvement with the customer. Royalty revenue is recognized when earned. Revenue generated from fixed-price service contracts not associated with the design, development, manufacture, or modification of complex aerospace or electronic equipment is recognized as services are rendered once persuasive evidence of an arrangement exists, our price is fixed or determinable, and we have determined collectability is reasonably assured.

We apply the separation guidance under GAAP for contracts with multiple deliverables. Revenue arrangements with multiple deliverables are evaluated to determine if the deliverables should be divided into more than one unit of accounting. For contracts with more than one unit of accounting, we recognize revenue for each deliverable based on the revenue recognition policies described above.

Research and Development Expenses—Expenditures for Company-sponsored research and development projects and bid and proposal costs are expensed as incurred. Customer-sponsored research and development projects performed under contracts are accounted for as contract costs as the work is performed and included in contracts in process in our consolidated balance sheets. Bid and proposal costs were between 40% and 50% of total research and development expenses in 2010, 2009 and 2008.

Federal, Foreign and State Income Taxes—The Company and its domestic subsidiaries provide for federal income taxes on pretax accounting income at rates in effect under existing tax law. Foreign subsidiaries record provisions for income taxes at applicable foreign tax rates in a similar manner. Such provisions differ from the amounts currently payable because certain items of income and expense are recognized in different time periods for financial reporting purposes than for income tax purposes. The payments made for state income taxes are included in administrative and selling expenses as these costs can generally be recovered through the pricing of products and services to the U.S. Government in the period in which the tax is payable. Accordingly, the state income tax provision (benefit) is allocated to contracts in future periods as described below in Deferred Contract Costs.

Other (Income) Expense—Other (income) expense consists primarily of gains and losses from our investments held in rabbi trusts used to fund certain of our non-qualified deferred compensation plans, gains and losses on the early repurchase of long-term debt and certain financing fees.

Cash and Cash Equivalents—Cash and cash equivalents consist of cash and short-term, highly liquid investments with original maturities of 90 days or less at the date of purchase.

Contracts in Process—Contracts in process are stated at cost plus estimated profit, but not in excess of estimated realizable value. Included in contracts in process is accounts receivables, which includes amounts billed and due from customers. We maintain an allowance for doubtful accounts to provide for the estimated amount of accounts receivable that will not be collected. The allowance is based upon an assessment of customer credit-worthiness, historical payment experience, the age of outstanding receivables and collateral to the extent applicable.

Deferred Contract Costs—Included in contracts in process are certain costs incurred in the performance of our U.S. Government contracts which are required to be recorded under GAAP but are not currently allocable to contracts. Such costs are deferred and primarily include a portion of our environmental expenses, asset retirement obligations, certain restructuring costs, deferred state income taxes, workers' compensation and other accruals. At December 31, 2010 and December 31, 2009, net deferred contract costs were approximately $340 million and $305 million, respectively. These costs are allocated to contracts when they are paid or otherwise agreed. We regularly assess the probability of recovery of these costs. This assessment requires us to make assumptions about the extent of cost recovery under our contracts and the amount of future contract activity. If the level of backlog in the future does not support the continued deferral of these costs, the profitability of our remaining contracts could be adversely affected.

Pension and other postretirement benefit costs are allocated to our contracts as allowed costs based upon the U.S. Government cost accounting standards (CAS). The CAS requirements for pension and other postretirement benefit costs differ from the financial accounting standards (FAS) requirements under GAAP. Given the inability to match with reasonable certainty individual expense and income items between the CAS and FAS requirements to determine specific recoverability, we have not estimated the incremental FAS income or expense to be recoverable under our expected future contract activity, and therefore did not defer any FAS expense for pension and other postretirement benefit plans in 2008-2010. This resulted in $230 million of expense, $27 million of income and $123 million of expense in 2010, 2009 and 2008, respectively, reflected in our consolidated results of operations for the difference between CAS and FAS requirements for our pension plans in those years.

Inventories—Inventories are stated at cost (first-in, first-out or average cost), but not in excess of realizable value. A write down for excess or inactive inventory is recorded based upon an analysis that considers current inventory levels, historical usage patterns, future sales expectations and salvage value.

Inventories consisted of the following at December 31:

(In millions)	**2010**	2009
Materials and purchased parts	$ 63	$ 60
Work in process	278	257
Finished goods	22	27
Total	$363	$344

We capitalize costs incurred in advance of contract award or funding in inventories, precontract costs, if we determine contract award or funding is probable, excluding any start-up costs. We included capitalized precontract and other deferred costs of $116 million and $88 million in inventories as work in process at December 31, 2010 and December 31, 2009, respectively.

Property, Plant and Equipment, Net—Property, plant and equipment, net are stated at cost less accumulated depreciation. Major improvements are capitalized while expenditures for maintenance, repairs and minor improvements are expensed. We include gains and losses on the sales of plant and equipment that are allocable to our contracts in overhead as we can generally recover these costs through the pricing of products and services to the U.S. Government. For all other sales or asset retirements, the assets and related accumulated depreciation and amortization are eliminated from the accounts and any resulting gain or loss is reflected in income.

Provisions for depreciation are generally computed using a combination of accelerated and straight-line methods and are based on estimated useful lives as follows:

	Years
Machinery and equipment	3-10
Equipment leased to others	5-10
Buildings	20-45

Leasehold improvements are amortized over the lesser of the remaining life of the lease or the estimated useful life of the improvement.

Impairment of Goodwill and Long-lived Assets—We evaluate our goodwill for impairment annually or whenever events or circumstances indicate the carrying value of that goodwill may not be recoverable. We perform our annual impairment test on the first day of the fourth quarter utilizing a two-step methodology that requires us to first identify potential goodwill impairment and then measure the amount of the related goodwill impairment loss, if any. We have identified our operating segments as reporting units under the impairment test assessment criteria outlined in GAAP. In performing our annual impairment test in the fourth quarter of 2010 and 2009, we did not identify any goodwill impairment.

We determine whether long-lived assets are to be held for use or disposal. Upon indication of possible impairment of long-lived assets held for use, we evaluate the recoverability of such assets by measuring the carrying amount of the assets against the related estimated undiscounted future cash flows. When an evaluation indicates that the future undiscounted cash flows are not sufficient to recover the carrying value of the asset, the asset is adjusted to its estimated fair value. In order for long-lived assets to be considered held for disposal, we must have committed to a plan to dispose of the assets. Once deemed held for disposal, the assets are stated at the lower of the carrying amount or fair value.

Computer Software, Net—Internal use computer software, net, included in other assets, net, which consists primarily of an integrated financial software package used across the Company, is stated at cost less accumulated amortization and is amortized using the straight-line method over its estimated useful life, generally ten years.

Advance Payments and Billings in Excess of Costs Incurred—We receive advances, performance-based payments and progress payments from customers that may exceed costs incurred on certain contracts. We classify advance payments and billings in excess of costs incurred, other than those reflected as a reduction of contracts in process, as current liabilities.

Comprehensive Income—Comprehensive income and its components are presented in the consolidated statements of equity.

Accumulated other comprehensive loss (AOCL) consisted of the following at December 31:

(In millions)	**2010**	2009
Unfunded projected benefit obligation	$(5,167)	$(4,892)
Foreign exchange translation	28	46
Cash flow hedges	3	22
Unrealized gains on investments	—	2
Interest rate lock	(10)	(2)
Total	$(5,146)	$(4,824)

The unfunded projected benefit obligation is shown net of tax benefits of $2,764 million and $2,634 million at December 31, 2010 and December 31, 2009, respectively. The cash flow hedges are shown net of tax liability of $2 million and net of tax liability of $11 million at December 31, 2010 and December 31, 2009, respectively. The unrealized gains on investments are shown net of tax liabilities of less than $1 million and $1 million at December 31, 2010 and December 31, 2009, respectively. The interest rate locks are shown net of tax benefits of $6 million and $1 million at December 31, 2010 and December 31, 2009, respectively. We expect approximately $4 million of after-tax net unrealized gains on our cash flow hedges at December 31, 2010, to be reclassified into earnings at then-current values over the next twelve months as the underlying hedged transactions occur.

Translation of Foreign Currencies—Assets and liabilities of foreign subsidiaries are translated at current exchange rates and the effects of these translation adjustments are reported as a component of AOCL in stockholders' equity. Deferred taxes are not recognized for translation related temporary differences of foreign subsidiaries as their undistributed earnings are considered to be indefinitely reinvested. Income and expenses in foreign currencies are translated at the average exchange rate during the period. Foreign exchange transaction gains and losses in 2010, 2009 and 2008 were not material.

Treasury Stock—We account for treasury stock under the cost method. When shares are reissued or retired from treasury stock they are accounted for at average price. Upon retirement the excess over par value is charged against additional paid-in capital. The remaining treasury stock activity primarily relates to stock-based compensation awards and the related shares withheld to settle employee tax obligations.

Pension Costs—We have pension plans covering the majority of our employees, including certain employees in foreign countries. We must calculate our pension costs as required under GAAP and the calculations and assumptions utilized require judgment. GAAP outlines the methodology used to determine pension expense or income for financial reporting purposes.

For purposes of determining pension expense under GAAP, investment gains and losses are spread over 3 years to develop a market-related value of the assets.

We recognize the funded status of a postretirement benefit plan (defined benefit pension and other benefits) as an asset or liability on our consolidated balance sheets. Funded status represents the difference between the projected benefit obligation of the plan and the market value of the plan's assets. Previously unrecognized deferred amounts such as demographic or asset gains or losses and the impact of historical plan changes are included in AOCL. Changes in these amounts in future years will be reflected through AOCL and amortized in future pension expense over the average employee service period.

Derivative Financial Instruments—We enter into foreign currency forward contracts with commercial banks to fix the foreign currency exchange rates on specific commitments and payments to vendors, and customer receipts. Our foreign currency forward contracts are transaction driven and directly relate to a particular asset, liability or transaction for which commitments are in place. For foreign currency forward contracts designated and qualified for cash flow hedge accounting, we record the effective portion of the gain or loss on the derivative in AOCL, net of tax, and reclassify it into earnings in the same period or periods during which the hedged revenue or cost of sales transaction affects earnings.

We recognize all derivative financial instruments as either assets or liabilities at fair value in our consolidated balance sheets. We measure and record the impact of counterparty credit risk into our valuation and the impact was less than $1 million as of December 31, 2010. We designate most foreign currency forward contracts as cash flow hedges of forecasted purchases and sales denominated in foreign currencies, and interest rate swaps as fair value hedges of our fixed-rate financing obligations. We classify the cash flows from these instruments in the same category as the cash flows from the hedged items. We do not hold or issue derivative financial instruments for trading or speculative purposes.

Realized gains and losses resulting from these cash flow hedges offset the foreign exchange gains and losses on the underlying transactions being hedged. Gains and losses on derivatives not designated for hedge accounting or representing either hedge ineffectiveness or hedge components excluded from the assessment of effectiveness are recognized currently in cost of sales or net sales.

We also periodically enter into pay-variable, receive-fixed interest rate swaps to manage interest rate risk associated with our fixed-rate financing obligations. We account for our interest rate swaps as fair value hedges of a portion of our fixed-rate financing obligations, and accordingly record gains and losses from changes in the fair value of these swaps in interest expense, along with the offsetting gains and losses on the fair value adjustment of the hedged portion of our fixed-rate financing obligations. We also record in interest expense the net amount paid or received under the swap for the period and the amortization of gain or loss from the early termination of interest rate swaps. For a discussion of the impacts of our hedging activities on our results, see page 86 of this Form 10-K.

Fair Values—The accounting standard for fair value measurements provides a framework for measuring fair value and requires expanded disclosures regarding fair value measurements. Fair value is defined as the price that would be received for an asset or the exit price that would be paid to transfer a liability in the principal or most advantageous market in an orderly transaction between market participants on the measurement date. This accounting standard established a fair value hierarchy, which requires an entity to maximize the use of observable inputs, where available. The following summarizes the three levels of inputs required, as well as the assets and liabilities that we value using those levels of inputs.

Level 1: Quoted prices in active markets for identical assets or liabilities. Our Level 1 assets are investments in marketable securities held in rabbi trusts that we use to pay benefits under certain of our non-qualified deferred compensation plans, which we include in other assets, net. Our Level 1 liabilities include our obligations to pay certain non-qualified deferred compensation plan benefits, which we include in accrued retiree benefits and other long-term liabilities. Under these non-qualified deferred compensation plans, participants designate investment options (primarily mutual funds) to serve as the basis for measurement of the notional value of their accounts. We also include foreign currency forward contracts that we trade in an active exchange market in our Level 1 assets and liabilities.

Level 2: Observable inputs, other than Level 1 prices, such as quoted prices for similar assets or liabilities; quoted prices in markets that are not active; or other inputs that are observable or that we corroborate with observable market data for substantially the full term of the related assets or liabilities. We did not have any Level 2 assets or liabilities at December 31, 2010 and December 31, 2009.

Level 3: Unobservable inputs supported by little or no market activity that are significant to the fair value of the assets or liabilities. We did not have any Level 3 assets or liabilities at December 31, 2010.

Earnings per Share—We compute basic EPS attributable to Raytheon Company common stockholders by dividing income from continuing operations attributable to Raytheon Company common stockholders, income (loss) from discontinued operations attributable to Raytheon Company common stockholders and net income attributable to Raytheon Company, by our weighted-average common shares outstanding, including participating securities outstanding, as described below, during the period. Diluted EPS reflects the potential dilution beyond shares for basic EPS that could occur if securities or other contracts to issue common stock were exercised, converted into common stock or resulted in the issuance of common stock that would have shared in our earnings. We compute basic and diluted EPS using actual income from continuing operations attributable to Raytheon Company common stockholders, income (loss) from discontinued operations attributable to Raytheon Company common stockholders, net income attributable to Raytheon Company, and our actual weighted-average shares and participating securities outstanding rather than the numbers presented within our consolidated financial statements, which are rounded to the nearest million. As a result, it may not be possible to recalculate EPS as presented in our consolidated financial statements. Furthermore, it may not be possible to recalculate EPS attributable to Raytheon Company common stockholders by adjusting EPS from continuing operations by EPS from discontinued operations.

We include all unvested stock awards that contain non-forfeitable rights to dividends or dividend equivalents, whether paid or unpaid, in the number of shares outstanding in our basic and diluted EPS calculations. As a result, we have included all of our outstanding unvested restricted stock and LTPP awards that meet the retirement eligible criteria in our calculation of basic and diluted EPS. We disclose EPS for common stock and unvested share-based payment awards, and separately disclose distributed and undistributed earnings. Distributed earnings represent common stock dividends and dividends earned on unvested share-based payment awards of retirement eligible employees. Undistributed earnings represent earnings that were available for distribution but were not distributed. Common stock and unvested share-based payment awards earn dividends equally, as shown in the table below.

Employee Stock Plans—Stock-based compensation cost is measured at the grant date based on the calculated fair value of the award. The expense is recognized over the employees' requisite service period, generally the vesting period of the award. The expense is amortized over the service period using the graded vesting method for our restricted stock and restricted stock units and the straight line amortization method for our Long-Term Performance Plan (LTPP). The related gross excess tax benefit received upon exercise of stock options or vesting of a stock-based award, if any, is reflected in the consolidated statements of cash flows as a financing activity rather than an operating activity.

Risks and Uncertainties—We provide a wide range of technologically advanced products, services and solutions for principally governmental customers in the U.S. and abroad, and are subject to certain business risks specific to that industry. Total sales to the U.S. Government, including foreign military sales, were 88% of total net sales in 2010 and

2009 and 87% of total net sales in 2008. Total sales to customers outside the U.S., including foreign military sales through the U.S. Government, were 23%, 21% and 20% of total net sales in 2010, 2009 and 2008, respectively. Sales to the government may be affected by changes in procurement policies, budget considerations, changing concepts of national defense, political developments abroad and other factors.

Note 2: Accounting Standards

As described in Note 7: Other Assets, in January 2010, we adopted the required new accounting standards which amend the accounting and disclosure requirements for transfers of financial assets and consolidation of variable interest entities (VIEs). These accounting standards eliminate the concept of a qualifying special-purpose entity (QSPE) and the related exception for applying the consolidation guidance. As a result, on January 1, 2010 we consolidated our QSPE, General Aviation Receivables Corporation (GARC), which did not have a material impact on our consolidated financial statements and resulted in:

- The removal of our $67 million investment in GARC, previously reported in other assets, net, and
- The addition of long and short-term notes receivable, net, of $68 million; current notes payable of $2 million, and an increase in retained earnings of less than $1 million, net of tax.

Further, the new accounting standard related to consolidation of VIEs requires an enterprise to perform a qualitative analysis when determining whether or not it must consolidate a VIE. It also requires an enterprise to continuously reassess whether it must consolidate a VIE. Additionally, it requires enhanced disclosures about an enterprise's involvement with VIEs and any significant change in risk exposure due to that involvement, as well as how its involvement with VIEs impacts the enterprise's financial statements. Finally, an enterprise is required to disclose significant judgments and assumptions used to determine whether or not to consolidate a VIE. With the exception of GARC described above, the adoption of this accounting standard did not change any of our previous consolidation conclusions and thus did not have an effect on our financial position, results of operations or liquidity.

Other new pronouncements issued but not effective until after December 31, 2010, are not expected to have a material impact on our financial position, results of operations or liquidity.

Note 3: Acquisitions

In pursuing our business strategies, we acquire and make investments in certain businesses that meet strategic and financial criteria.

In 2010, we acquired Trusted Computer Solutions Inc., Technology Associates Inc. and substantially all of the assets of an Australian company, Compucat Research Pty. Ltd, for a total amount for all three of $152 million in cash, net of cash acquired. These acquisitions enhance our cybersecurity and information assurance capabilities at Intelligence and Information Systems (IIS). In connection with these acquisitions, we recorded $125 million of goodwill, primarily related to expected synergies from combining operations and the value of the existing workforce, and $28 million of intangible assets, primarily related to technology, trade names and customer relationships with a weighted-average life of five years.

In 2009, we acquired BBN Technologies Corp. and related entities (BBN) which enhances our advanced networking, speech and language technologies, information technologies, sensor systems and cybersecurity at Network Centric Systems (NCS) for $334 million in cash, net of $22 million of cash acquired, exclusive of retention and management incentive payments. In connection with this acquisition, we recorded $254 million of goodwill, primarily related to expected synergies from combining operations and the value of the workforce, and $70 million in intangible assets, primarily related to technology, contractual backlog and trade name with a weighted-average life of eight years.

In 2008, we acquired Telemus Solutions, Inc. and SI Government Solutions at IIS for a total of $52 million in cash. In connection with these acquisitions, we recorded $39 million of goodwill and $9 million in intangible assets.

Pro forma financial information has not been provided for these acquisitions as they are not material either individually or in the aggregate.

We funded each of the above acquisitions using cash on hand. The operating results of these businesses have been included with our consolidated results as of the respective closing dates of the acquisitions. The purchase price of these businesses has been allocated to the estimated fair value of net tangible and intangible assets acquired, with any excess purchase price recorded as goodwill. We completed these acquisitions to enhance our technology and cybersecurity portfolio. Tax deductible goodwill related to these acquisitions totaled $76 million.

A rollforward of goodwill by segment was as follows:

(In millions)	Integrated Defense Systems	Intelligence and Information Systems	Missile Systems	Network Centric Systems	Space and Airborne Systems	Technical Services	Total
Balance at December 31, 2008	$765	$1,575	$3,431	$2,362	$2,664	$865	$11,662
Adjustment for acquisitions	—	—	—	254	—	—	254
Effect of foreign exchange rates and other	2	—	1	—	(1)	4	6
Balance at December 31, 2009	767	1,575	3,432	2,616	2,663	869	11,922
Adjustment for acquisitions	—	125	—	—	—	—	125
Effect of foreign exchange rates and other	(2)	(2)	—	—	—	2	(2)
Balance at December 31, 2010	$765	$1,698	$3,432	$2,616	$2,663	$871	$12,045

Note 4: Discontinued Operations

In pursuing our business strategies we have divested certain non-core businesses, investments and assets when appropriate. All residual activity relating to our previously-disposed businesses appears in discontinued operations.

We retained certain assets and liabilities of our previously disposed businesses. At December 31, 2010 and December 31, 2009, we had $41 million and $71 million, respectively, of assets primarily related to our retained interest in general aviation finance receivables previously sold by Raytheon Aircraft Company (Raytheon Aircraft). At December 31, 2010 and December 31, 2009, we had $113 million and $57 million, respectively, of liabilities primarily related to non-income tax obligations, certain environmental and product liabilities, various contract obligations and aircraft lease obligations. We also have certain income tax obligations relating to these disposed businesses, which we include in our income tax disclosures. In the fourth quarter of 2010, IRS appeals proceedings failed to resolve the federal excise tax dispute related to the treatment of monthly management fees, and as a result, the IRS assessed Flight Options for excise taxes. In the divestiture of Flight Options, Raytheon agreed to indemnify Flight Options in the event Flight Options was assessed and paid these excise taxes. This indemnification obligation gave rise to our retained non-income tax obligation. In 2011, Flight Options paid the assessment and we indemnified Flight Options given our indemnification obligation. As a result, in the fourth quarter of 2010 we recorded a $39 million, net of the federal tax benefit, in discontinued operations. On behalf of Flight Options, we intend to vigorously contest the matter through litigation and, if successful, we would be entitled to recover substantially all of the amounts paid. We also retained certain U.K. pension assets and obligations for a limited number of U.K. pension plan participants as part of the Raytheon Aircraft sale, which we include in our pension disclosures.

As further described in Note 15: Income Taxes, during the year ended December 31, 2010, we recorded a $280 million reduction in our unrecognized tax benefits, which included a decrease of $89 million in tax expense from discontinued operations, including interest, primarily related to our previous disposition of Raytheon Engineers and Constructors (RE&C).

Note 5: Contracts in Process, Net

Contracts in process, net consisted of the following at December 31:

	Cost-Type		Fixed-Price		Total	
(In millions)	**2010**	2009	**2010**	2009	**2010**	2009
U.S. Government end-use contracts:						
Billed	$ 428	$ 570	$ 271	$ 291	$ 699	$ 861
Unbilled	1,050	960	9,074	8,431	10,124	9,391
Progress payments	—	—	(7,739)	(6,905)	(7,739)	(6,905)
	1,478	1,530	1,606	1,817	3,084	3,347
Other customers:						
Billed	14	6	621	642	635	648
Unbilled	12	13	1,426	1,082	1,438	1,095
Progress payments	—	—	(735)	(588)	(735)	(588)
Total contracts in process	26	19	1,312	1,136	1,338	1,155
Allowance for doubtful accounts	—	—	(8)	(9)	(8)	(9)
Total contracts in process, net	$1,504	$1,549	$ 2,910	$ 2,944	$ 4,414	$ 4,493

The U.S. Government has title to the assets related to unbilled amounts on contracts that provide progress payments. Unbilled amounts are recorded under the percentage-of-completion method and are recoverable from the customer upon shipment of the product, presentation of billings or completion of the contract. Included in unbilled at December 31, 2010 was $172 million which is expected to be collected outside of one year.

Billed and unbilled contracts in process include retentions arising from contractual provisions. At December 31, 2010, retentions were $50 million. We anticipate collecting $36 million of these retentions in 2011 and the balance thereafter.

Note 6: Property, Plant and Equipment, Net

Property, plant and equipment, net consisted of the following at December 31:

(In millions)	**2010**	2009
Land	$ 93	$ 93
Buildings and leasehold improvements	2,394	2,293
Machinery and equipment	3,286	3,187
Equipment leased to others	71	82
	5,844	5,655
Accumulated depreciation and amortization	(3,841)	(3,654)
Total	$ 2,003	$ 2,001

Depreciation and amortization expense of property, plant and equipment, net was $304 million, $299 million and $292 million in 2010, 2009 and 2008, respectively. Accumulated depreciation on equipment leased to others was $34 million at December 31, 2010 and December 31, 2009.

Note 7: Other Assets, Net

Other assets, net consisted of the following at December 31:

(In millions)	2010	2009
Long-term receivables		
Due from customers in installments to 2015	$ 46	$ 23
Other	21	23
Computer software, net	372	392
Investments	82	67
Prepaid retiree benefits	105	111
Other noncurrent assets, net	820	764
Total	$1,446	$1,380

We previously sold undivided interests in general aviation finance receivables, while retaining subordinated interests in and servicing rights to the receivables. At December 31, 2009, the outstanding balance of securitized accounts receivable held by the third party conduit totaled $73 million, of which our subordinated retained interest, which is included in other noncurrent assets, net in the table above, was $67 million. The underlying aircraft serve as collateral for these accounts receivable.

As previously described in Note 2: Accounting Standards, in January 2010, we consolidated our QSPE, GARC, which did not have a material impact on our consolidated financial statements and resulted in:

- The removal of our $67 million investment in GARC, previously reported in other assets, net, and
- The addition of long and short-term notes receivable, net, of $68 million, current notes payable of $2 million, and an increase in retained earnings of less than $1 million, net of tax.

The notes payable were paid off in the first quarter of 2010.

Computer software, net consisted of the following at December 31:

(In millions)	2010	2009
Computer software	$1,040	$ 970
Accumulated amortization	(668)	(578)
Total	$ 372	$ 392

Computer software amortization expense was $88 million in 2010, $86 million in 2009 and $79 million in 2008.

Other intangible assets, net, included in the table above in other noncurrent assets, net, consisted of the following at December 31:

(In millions)	2010	2009
Other intangible assets	$ 247	$217
Accumulated amortization	(108)	(80)
Total	$ 139	$137

Other intangible assets consisted primarily of drawings and intellectual property, which are included in other noncurrent assets, net. Amortization expense for these intangible assets was $28 million in 2010, $17 million in 2009 and $19 million in 2008.

Computer software and other intangible asset amortization expense is expected to approximate $100 million for each of the next five years.

Investments, which are included in other assets, net consisted of the following at December 31:

(In millions, except percentages)	Ownership %	**2010**	2009
Equity method investments			
Thales-Raytheon Systems Co. Ltd. (TRS)	50	$69	$56
Other investments	Various	13	11
Total		$82	$67

In 2001, we formed a joint venture, TRS, which we account for using the equity method. TRS is a system of systems integrator and provides fully customized solutions through the integration of command and control centers, radars and communication networks. We record our share of the TRS income or loss and other comprehensive income (loss) as a component of cost of sales and AOCL, respectively. We only record losses beyond the carrying amount of the investment when we guarantee obligations of the investee or commit to provide the investee further financial support.

TRS has two major operating subsidiaries, one of which, Thales-Raytheon Systems Co. LLC (TRS LLC), we control and consolidate and is a component of our NCS segment, and the other one, Thales-Raytheon Systems Company S.A.S. (TRS SAS), which we account for using the equity method through our investment in TRS. Of the $69 million investment in TRS, $58 million represents undistributed earnings at December 31, 2010. Our consolidated statements of operations includes net income, which represents net income attributable to Raytheon Company and net income attributable to noncontrolling interests in subsidiaries. Our primary noncontrolling interest relates to TRS LLC. TRS LLC formed a joint venture with TRS SAS called Air Command Systems International S.A.S. (ACSI), for which TRS LLC performs work. TRS LLC had $82 million of receivables due from ACSI.

In addition, we have entered into certain joint ventures formed specifically to facilitate a teaming arrangement between two contractors for the benefit of the customer, generally the U.S. Government, whereby we receive a subcontract from the joint venture in the joint venture's capacity as prime contractor. Accordingly, we record the work we perform for the joint venture as an operating activity.

Periodically we enter into other equity method investments which are not related to our core operations. We record the income or loss from these investments as a component of other (income) expense. We only record losses beyond the carrying amount of the investment when we guarantee obligations of the investee or commit to provide the investee further financial support.

Note 8: Derivative Financial Instruments

Our primary market exposures are to interest rates and foreign exchange rates and we use certain derivative financial instruments to help manage these exposures. We execute these instruments with financial institutions we judge to be credit-worthy, and the majority of our foreign currency forward contracts are denominated in currencies of major industrial countries.

The fair value amounts of asset derivatives included in other assets, net and liability derivatives included in other accrued expenses in our consolidated balance sheets related to foreign currency forward contracts consisted of the following at December 31:

	Asset Derivatives		Liability Derivatives	
(In millions)	**2010**	2009	**2010**	2009
Derivatives designated as hedging instruments	$32	$56	$28	$23
Derivatives not designated as hedging instruments	13	13	13	10
Total	$45	$69	$41	$33

We recognized the following pretax gains (losses) related to foreign currency forward contracts designated as cash flow hedges:

(In millions)	2010	2009
Effective Portion		
Gain (loss) recognized in AOCL	$ 4	$55
Gain (loss) reclassified from AOCL to net sales	1	(7)
Gain (loss) reclassified from AOCL to cost of sales	31	—
Amount excluded from effectiveness assessment and ineffective portion		
Gain (loss) recognized in cost of sales	$—	$—

We recognized the following pretax gains (losses) related to foreign currency forward contracts not designated as cash flow hedges:

(In millions)	2010	2009
Gain (loss) recognized in net sales	$(1)	$—
Gain (loss) recognized in cost of sales	(4)	4

In October 2010, we issued $2.0 billion of fixed rate long-term debt with maturities ranging from 5 to 30 years. In conjunction with the debt issuance, we entered into interest rate lock agreements with a total notional value of $1,550 million to manage interest rate risk, which resulted in an increase to AOCL of $8 million to be amortized over the term of the debt issued. As of December 31, 2010, the above referenced interest rate locks were closed out.

In the fourth quarter of 2010, we exercised our right to call and repurchased $678 million of our long-term debt due in 2012 and 2013 that was previously hedged with the interest rate swaps, described below. The remaining unamortized gain resulting from the early termination of the interest rate swaps of $15 million was recorded as a reduction to interest expense. In the first quarter of 2009 we terminated our interest rate swaps and collected cash of $37 million related to the early termination. In 2009, we recorded $16 million of income as a reduction to interest expense related to the amortization of the gain on the termination of our interest rate swaps, including $6 million of accelerated amortization related to the 4.85% Notes due 2011 which we repurchased in the fourth quarter of 2009. There were no interest rate swaps outstanding at December 31, 2010 and December 31, 2009.

The notional amounts of outstanding foreign currency forward contracts consisted of the following at:

	December 31, 2010		December 31, 2009	
(In millions)	Buy	Sell	Buy	Sell
British Pounds	$370	$296	$407	$498
Canadian Dollars	220	51	212	46
Euros	165	32	190	35
All other	85	39	176	53
Total	$840	$418	$985	$632

Buy amounts represent the U.S. Dollar equivalent of commitments to purchase foreign currencies and sell amounts represent the U.S. Dollar equivalent of commitments to sell foreign currencies. Foreign currency forward contracts that do not involve U.S. Dollars have been converted to U.S. Dollars for disclosure purposes.

Foreign currency forward contracts, used to fix the dollar value of specific commitments and payments to international vendors and the value of foreign currency denominated receipts, have maturities at various dates through 2020 as follows: $791 million in 2011, $274 million in 2012, $94 million in 2013, $40 million in 2014 and $59 million thereafter.

Our foreign currency forward contracts contain off-set, or netting provisions, to mitigate credit risk in the event of counterparty default, including payment default and cross default. At December 31, 2010 and December 31, 2009, these netting provisions effectively reduced our exposure to approximately $4 million and $35 million, respectively, which is spread across numerous highly rated counterparties.

Note 9: Fair Value Measurements

The estimated fair value of certain financial instruments, including cash and cash equivalents, approximates the carrying value due to their short maturities. The estimated fair value of notes receivable approximates the carrying value based principally on their underlying interest rates and terms, maturities, collateral and credit status of the receivables. The carrying value of long-term debt of $3,610 million and $2,329 million at December 31, 2010 and December 31, 2009, respectively, was recorded at amortized cost. The estimated fair value of long-term debt of approximately $3,783 million and $2,581 million at December 31, 2010 and December 31, 2009, respectively, was based on quoted market prices.

We did not have any significant nonfinancial assets or nonfinancial liabilities that would be recognized or disclosed at fair value on a recurring basis as of December 31, 2010 and December 31, 2009.

We did not have any transfers of assets and liabilities between Level 1 and Level 2 of the fair value measurement hierarchy during the year ended December 31, 2010 and December 31, 2009.

The following tables set forth the financial assets and liabilities that we measured at fair value on a recurring basis by level within the fair value hierarchy. We classify assets and liabilities measured at fair value in their entirety based on the lowest level of input that is significant to their fair value measurement.

Assets and liabilities measured at fair value on a recurring basis consisted of the following at December 31:

(In millions)	Level 1	Level 2	Level 3	Total 2010
Assets				
Marketable securities	$344	$—	$—	$344
Foreign currency forward contracts	45	—	—	45
Liabilities				
Deferred compensation	215	—	—	215
Foreign currency forward contracts	41	—	—	41

(In millions)	Level 1	Level 2	Level 3	Total 2009
Assets				
Marketable securities	$296	$—	$—	$296
Foreign currency forward contracts	69	—	—	69
Retained Interest	—	—	67	67
Liabilities				
Deferred compensation	192	—	—	192
Foreign currency forward contracts	33	—	—	33

Activity related to our Retained Interest, which is reflected in discontinued operations, was as follows:

(In millions)	2010	2009
Balance at beginning of period	$ 67	$66
Total gains (realized/unrealized):		
Included in other comprehensive income (loss)	—	1
Transfers out	(67)	—
Balance at end of period	$ —	$67

As described in Note 2: Accounting Standards, we adopted new accounting standards in January 2010 resulting in the consolidation of our QSPE, GARC. As a result, we removed our retained interest in general aviation finance receivables from our balance sheet resulting in the elimination of the Level 3 measure noted above.

Note 10: Notes Payable and Long-term Debt

Notes payable and long-term debt consisted of the following at December 31:

(In millions, except percentages)	2010	2009
Notes due 2012, 5.50%	$ —	$ 332
Notes due 2013, 5.375%	—	364
Notes due 2015, 1.625%	396	—
Debentures due 2018, 6.75%	251	250
Debentures due 2018, 6.40%	338	338
Notes due 2020, 4.40%	496	496
Notes due 2020, 3.125%	988	—
Debentures due 2027, 7.20%	366	365
Debentures due 2028, 7.00%	184	184
Notes due 2040, 4.875%	591	—
Total debt issued and outstanding	$3,610	$2,329

The notes and debentures are redeemable by the Company at any time at redemption prices based on U.S. Treasury rates.

In the fourth quarter of 2010, we received proceeds of $1,975 million for the issuance of $2.0 billion fixed rate long-term debt and exercised our call rights to repurchase, at prices based on fixed spreads to U.S. Treasuries, $678 million of our long-term debt due in 2012 and 2013 at a loss of $73 million pretax, $47 million after-tax, which is included in other (income) expense.

In the fourth quarter of 2009, we received proceeds of $496 million for the issuance of $500 million fixed rate long-term debt and exercised our call rights to repurchase, at prices based on fixed spreads to U.S. Treasuries, $474 million of our long-term debt due 2011 at a loss of $22 million pretax, $14 million after-tax, which is included in other (income) expense.

We periodically enter into various interest rate swaps that correspond to a portion of our fixed-rate debt in order to effectively hedge interest rate risk. In the fourth quarter of 2010, as a result of the repurchase of debt described above, we recorded $15 million of income as a reduction to interest expense resulting from the accelerated amortization of the interest rate swaps terminated in 2009, described below. In the first quarter of 2009, we terminated our interest rate swaps and collected cash of $37 million related to the early termination. In 2009, we recorded $16 million of income as a reduction to interest expense related to the amortization of the gain on the termination of our interest rate swaps, including $6 million of accelerated amortization related to the 4.85% Notes due 2011 which we repurchased in the fourth quarter of 2009.

The adjustments to the principal amounts of long-term debt were as follows at December 31:

(In millions)	**2010**	2009
Principal	$3,658	$2,336
Interest rate swaps	—	21
Unamortized issue discounts	(35)	(14)
Unamortized interest rate hedging costs	(13)	(14)
Total	$3,610	$2,329

The aggregate amounts of principal payments due on long-term debt for the next five years are:

(In millions)	
2011	$ —
2012	—
2013	—
2014	—
2015	400

In November 2010, we entered into a $500 million revolving credit facility maturing in 2012, replacing the previous $500 million 364-day facility, which matured in November 2010. Under the facility we can borrow and backstop commercial paper.

We also have a $1.0 billion facility maturing in November 2012, $150 million of which is available to Raytheon United Kingdom Limited, our U.K. subsidiary. Under the facility we can borrow, issue letters of credit and backstop commercial paper.

Borrowings under these facilities bear interest at various rate options, including LIBOR plus a margin based on our credit default swap spread, with minimum and maximum margins that are adjusted for our credit ratings. Based on our credit ratings at December 31, 2010, borrowings under the $1.0 billion and $500 million facilities would bear interest at LIBOR plus 100 basis points and 75 basis points, respectively, the minimum margin. The credit facilities are comprised of commitments from approximately 25 separate highly rated lenders, each committing no more than 10% of the aggregate of the facilities. As of December 31, 2010 and December 31, 2009, there were no borrowings outstanding under these credit facilities or our previous credit facilities. However, we had $3 million and $21 million of outstanding letters of credit at December 31, 2010 and December 31, 2009, respectively, which effectively reduced our borrowing capacity under these credit facilities and our previous credit facility by those same amounts.

Under the current and previous credit facilities, we must comply with certain covenants, including a ratio of total debt to total capitalization of no more than 50% and a ratio of consolidated earnings attributable to Raytheon Company before interest, taxes, depreciation and amortization to consolidated net interest expense, for any period of four consecutive fiscal quarters, of no less than 3 to 1. We were in compliance with these covenants during 2010 and 2009. Our ratio of total debt to total capitalization, as defined in the current and previous credit facilities, was 26.7% and 19.0% at December 31, 2010 and December 31, 2009, respectively. We are providing these ratios, which are financial covenants under our current credit facilities, as these metrics are used by our lenders to monitor the Company's leverage and debt service capacity and are also thresholds that limit our ability to utilize these two facilities.

Certain of our foreign subsidiaries maintain revolving bank lines of credit to provide them with a limited amount of short-term liquidity, including the $150 million Raytheon United Kingdom Limited facility described above. In addition, other uncommitted bank lines totaled approximately $2 million and $15 million at December 31, 2010 and December 31, 2009, respectively. There were no amounts outstanding under these lines of credit at December 31, 2010 and December 31, 2009. Compensating balance arrangements are not material.

Total cash paid for interest on notes payable and long-term debt was $134 million, $147 million and $142 million in 2010, 2009 and 2008, respectively.

Note 11: Commitments and Contingencies

At December 31, 2010, we had commitments under long-term leases requiring annual rentals on a net lease basis as follows:

(In millions)	
2011	$254
2012	207
2013	156
2014	118
2015	96
Thereafter	385

Rent expense was $307 million, $290 million and $285 million in 2010, 2009 and 2008, respectively. In the normal course of business, we lease equipment, office buildings and other facilities under leases that include standard escalation clauses for adjusting rent payments to reflect changes in price indices, as well as renewal options.

At December 31, 2010, we had commitments under agreements to outsource a portion of our information technology function, which have no minimum annual payments.

Insurance is purchased from third parties to cover aggregate liability exposure up to $1.5 billion.

Environmental Matters—We are involved in various stages of investigation and cleanup related to remediation of various environmental sites. Our estimate of the liability of total environmental remediation costs includes the use of a discount rate and considers that a portion of these costs is eligible for future recovery through the pricing of our products and services to the U.S. Government. We consider such recovery probable based on government contracting regulations and our long history of receiving reimbursement for such costs and accordingly have recorded the estimated future recovery of these costs from the U.S. Government within contracts in process. Our estimates of total remediation costs, weighted average risk-free rate, total remediation costs—discounted and recoverable portion were as follows at December 31:

(In millions, except percentages)	**2010**	2009
Total remediation costs—undiscounted	$225	$208
Weighted average risk-free rate	5.6%	5.7%
Total remediation costs—discounted	$152	$139
Recoverable portion	107	97

We also lease certain government-owned properties and are generally not liable for remediation of preexisting environmental contamination at these sites; as a result, we generally do not reflect the provision for these costs in our consolidated financial statements.

Due to the complexity of environmental laws and regulations, the varying costs and effectiveness of alternative cleanup methods and technologies, the uncertainty of insurance coverage and the unresolved extent of our responsibility, it is difficult to determine the ultimate outcome of environmental matters; however, we do not expect any additional liability to have a material adverse effect on our financial position, results of operations or liquidity.

Environmental remediation costs expected to be incurred are:

(In millions)	
2011	$ 48
2012	23
2013	19
2014	14
2015	12
Thereafter	109

Financing Arrangements and Other—We issue guarantees and banks and surety companies issue, on our behalf, letters of credit and surety bonds to meet various bid, performance, warranty, retention and advance payment obligations of us or our affiliates. These instruments expire on various dates through 2020. Additional guarantees of project performance for which there is no stated value also remain outstanding. The stated values outstanding consisted of the following at December 31, 2010 and December 31, 2009:

(In millions)	**2010**	2009
Guarantees	$ 281	$ 227
Letters of Credit	1,067	898
Surety Bonds	213	203

Included in guarantees and letters of credit described above were $134 million and $256 million, respectively, at December 31, 2010, and $80 million and $206 million, respectively, at December 31, 2009, related to our joint venture in TRS. We provide these guarantees and letters of credit to TRS and other affiliates to assist these entities in obtaining financing on more favorable terms, making bids on contracts and performing their contractual obligations. While we expect these entities to satisfy their loans, project performance and other contractual obligations, their failure to do so may result in a future obligation to us. At December 31, 2010 and December 31, 2009, we had an estimated liability of $9 million and $6 million, respectively, related to these guarantees and letters of credit. We periodically evaluate the risk of TRS and other affiliates failing to satisfy their loans, project performance and meet other contractual obligations described above. At December 31, 2010, we believe the risk that TRS and other affiliates will not be able to perform or meet their obligations is minimal for the foreseeable future based on their current financial condition. All obligations were current at December 31, 2010.

Our residual turbo-prop commuter aircraft portfolio has exposure to outstanding financing arrangements with the aircraft serving as collateral. We have sold and leased commuter aircraft globally to thinly capitalized companies, whose financial condition could be significantly affected by a number of factors, including fuel and other costs, the availability of credit, industry consolidation, declining commercial aviation market conditions and the U.S. Government budget for the Essential Air Service program. Based on recent economic trends, including tightening credit markets and volatile fuel costs, these companies may increasingly experience difficulties meeting their financial commitments. At December 31, 2010 and December 31, 2009, our exposure on commuter aircraft assets held as inventory, collateral on notes or as leased assets, was approximately $68 million relating to 77 aircraft and approximately $109 million relating to 106 aircraft, respectively. The carrying value of our commuter aircraft portfolio assumes an orderly disposition of these assets, consistent with our historical experience and strategy. The tightening of credit markets and economic conditions have reduced the number of potential buyers who are able to obtain financing and have negatively impacted the ability of existing customers to refinance their aircraft through a third party. If the long-term market prospects for these aircraft were to significantly erode or cease, our valuation of these assets would likely be less than the carrying value. We periodically evaluate potential alternative strategies for the disposal of these assets. If we were to dispose of these assets in an other than orderly manner or sell the portfolio in its entirety, the value realized would likely be less than the carrying value.

In 1997, we provided a first loss guarantee of $133 million on $1.3 billion of U.S. Export-Import Bank loans (maturing in 2015) to the Brazilian Government related to Network Centric Systems' System for the Vigilance of the Amazon (SIVAM) program. Loan repayments by the Brazilian Government were current at December 31, 2010.

We have entered into industrial cooperation agreements, sometimes referred to as offset agreements, as a condition to obtaining orders for our products and services from certain customers in foreign countries. These agreements are designed to enhance the social and economic environment of the foreign country by requiring the contractor to promote investment in the country. Offset agreements may be satisfied through activities that do not require us to use cash, including transferring technology, providing manufacturing and other consulting support to in-country projects, and the purchase by third parties (*e.g.*, our vendors) of supplies from in-country vendors. These agreements may also be satisfied through our use of cash for such activities as purchasing supplies from in-country vendors, providing financial support for in-country projects, building or leasing facilities for in-country operations and making investments in local ventures. We typically do not commit to offset agreements until orders for our products or services are definitive. The amounts ultimately applied against our offset agreements are based on negotiations with the customer and typically require cash outlays that represent only a fraction of the original amount in the offset agreement. Offset programs usually extend over several years and may provide for penalties in the event we fail to perform in accordance with offset requirements. We have historically not been required to pay any such penalties.

Government contractors are subject to many levels of audit and investigation. Agencies that oversee contract performance include: the Defense Contract Audit Agency, the Defense Contract Management Agency, the Inspector General of the Department of Defense and other departments and agencies, the Government Accountability Office, the Department of Justice and Congressional Committees. The Department of Justice has, from time to time, convened grand juries to investigate possible irregularities by us. We also provide products and services to customers outside of the U.S. and those sales are subject to local government laws, regulations and procurement policies and practices. Our compliance with such local government regulations or any applicable U.S. Government regulations (e.g., the Foreign Corrupt Practices Act and the International Traffic in Arms Regulations) may also be investigated or audited. We do not expect these audits and investigations to have a material adverse effect on our financial position, results of operations or liquidity, either individually or in the aggregate.

We are currently conducting a self-initiated internal review of certain of our international operations, focusing on compliance with the Foreign Corrupt Practices Act. In the course of the review, we have identified several possible areas of concern relating to payments made in connection with certain international operations related to a jurisdiction where we do business. We have voluntarily contacted the SEC and the Department of Justice to advise both agencies that an internal review is underway. Because the internal review is ongoing, we cannot predict the ultimate consequences of the review. Based on the information available to date, we do not believe that the results of this review will have a material adverse effect on our financial position, results of operations or liquidity.

In May 2006, international arbitration hearings commenced against us as the successor to the Hughes Electronics defense business, in connection with certain claims brought in 2004 by MBDA relating to an alleged 1995 Workshare Agreement. The asserted claims involve breach of contract, intellectual property infringement and other related matters. The arbitration panel stayed further proceedings, including the issuance of the liability decision on the non-IP claims presented during the May 2006 hearing, while the parties engaged in settlement efforts. The parties were unable to conclude an enforceable settlement, and in August 2009, the panel released its liability decision, rejecting some of MBDA's non-IP claims, while finding Raytheon liable for some other non-IP claims. We did not record any significant additional financial liability as a result of our estimate of the impact of the decision. The proceedings will now resume to determine liability for the asserted IP claims and to assess overall damages, if any. At this point, we are unable to estimate a range of potential loss, if any, because the IP claims are vague, discovery is in process, and any potential damages involve complex, technical matters subject to interpretation by the arbitration panel. We believe that we have meritorious defenses to the asserted IP claims and intend to continue to contest them vigorously; however, an adverse resolution of this matter could have a material effect on our financial position, results of operations or liquidity.

On July 22, 2010, Raytheon Systems Limited ("RSL") was notified by the UK Border Agency that it had been terminated for cause on a program. The termination notice included allegations that RSL had failed to perform on certain key milestones and other matters in addition to claims to recover certain losses incurred and previous payments made to RSL. We believe that RSL performed well and delivered substantial capabilities to the UK Border Agency under the program, which has been operating successfully and providing actionable information since live operations began in May 2009. On July 29, 2010, RSL filed a dispute notice on the grounds that the termination by the UK Border Agency was not valid. On August 18, 2010, the UK Border Agency initiated arbitration proceedings on this issue. We expect the arbitration procedures to commence in the first half of 2011. We intend to pursue vigorously the collection of receivables for the program and damages in connection with the termination and defend ourselves against the UK Border Agency's claims for losses and previous payments.

As a result of the termination notice, we adjusted our estimated amount of revenue and costs under the program in the second quarter of 2010. The adjustment was based on our determination that certain assets were no longer expected to be recovered and for estimated costs for certain exit cost obligations under the contract and the estimated settlement of expected future subcontractor claims. The impact of the adjustment reduced Intelligence and Information Systems' total net sales and operating income by $316 million and $395 million, respectively, for the year ended December 31, 2010. At December 31, 2010, we had approximately $80 million in letters of credit and approximately $70 million of receivables and other assets remaining under the program for technology and services delivered, which we believe, are probable of recovery in litigation or arbitration. No amounts have been drawn down on the letters of credit. We currently do not believe it is probable that we are liable for losses, previous payments or other claims asserted by the UK Border Agency. Due to the inherent uncertainties in litigation and arbitration as noted above, and the complexity and technical nature of potential claims and counterclaims, as well as the resolution of the related matters involving subcontractors, it is reasonably possible that the ultimate amount of any resolution of the termination could be less or greater than our estimate and at this time, we are unable to estimate a range of the potential difference in such amounts, if any. If we are unsuccessful in recovering amounts drawn on the letters of credit, if any, fail to collect the receivable balance, are required to make payments against claims or other losses asserted by the UK Border Agency or pay subcontractor claims in excess of our estimates made in connection with the adjustment in the second quarter of 2010 described above, it could have a material adverse effect on our financial position, results of operations or liquidity.

In addition, various other claims and legal proceedings generally incidental to the normal course of business are pending or threatened against us. We do not expect any additional liability from these proceedings to have a material adverse effect on our financial position, results of operations or liquidity.

Product Warranty—We provide for product warranties in conjunction with certain product sales for which we recognize revenue upon delivery.

Activity related to product warranty accruals was as follows:

(In millions)	
Balance at December 31, 2007	$ 47
Provisions for warranties	5
Warranty services provided	(13)
Balance at December 31, 2008	39
Provisions for warranties	7
Warranty services provided	(7)
Balance at December 31, 2009	39
Provisions for warranties	14
Warranty services provided	(10)
Balance at December 31, 2010	$ 43

We account for warranty provision costs incurred under our long-term contracts using the cost-to-cost measure of progress as contracts costs, as the estimation of these costs is integral in determining the price of the related long-term contracts. The table above excludes these costs.

Note 12: Stockholders' Equity

The changes in shares of our common stock outstanding were as follows:

(In millions)	
Balance at December 31, 2007	426.2
Common stock plans activity	5.5
Treasury stock activity	(31.6)
Balance at December 31, 2008	400.1
Common stock plans activity	3.7
Treasury stock activity	(25.9)
Balance at December 31, 2009	377.9
Warrants exercised	6.7
Common stock plans activity	4.6
Treasury stock activity	(29.8)
Balance at December 31, 2010	359.4

On May 27, 2010, our stockholders approved the Raytheon 2010 Stock Plan pursuant to which we may grant restricted stock awards, restricted stock units, stock grants, stock options and stock appreciation rights.

Our repurchases of our common stock under our stock repurchase programs were as follows:

(In millions)	**2010**	2009	2008
Amount of stock repurchased	$1,450	$1,200	$1,700
Shares of stock repurchased	29.0	25.8	30.7

In March 2010, our Board of Directors authorized the repurchase of up to an additional $2.0 billion of our outstanding common stock. At December 31, 2010, we had approximately $1.4 billion remaining under this repurchase program. All previous repurchase programs had been completed as of December 31, 2010. Share repurchases will take place from time to time at management's discretion depending on market conditions.

Included in treasury shares at December 31, 2010 were 149,916 shares with a cost basis of $5.7 million which are held in a rabbi trust related to the Company's non-qualified deferred compensation plans.

Our Board of Directors declared cash dividends of $1.50, $1.24 and $1.12 per share in 2010, 2009 and 2008, respectively.

Earnings Per Share (EPS)

EPS from continuing operations attributable to Raytheon Company common stockholders and unvested share-based payment awards was as follows:

	2010	2009	2008
Basic EPS attributable to Raytheon Company common stockholders:			
Distributed earnings	$1.48	$1.23	$1.11
Undistributed earnings	3.36	3.73	2.90
Total	$4.84	$4.96	$4.01

	2010	2009	2008
Diluted EPS attributable to Raytheon Company common stockholders:			
Distributed earnings	$1.47	$1.21	$1.09
Undistributed earnings	3.32	3.68	2.84
Total	$4.79	$4.89	$3.93

Basic and diluted EPS from discontinued operations attributable to Raytheon Company common stockholders and unvested share-based payment awards was income of $0.10, a loss of less than $0.01 and a loss of $0.01 for 2010, 2009 and 2008, respectively . Earnings from discontinued operations were deemed undistributed for all periods presented.

The amount of income from continuing operations attributable to participating securities was $29 million for 2010 and 2009 and $23 million in 2008. The amount of income (loss) from discontinued operations attributable to participating securities was income of $1 million for 2010, and a loss of less than $1 million for 2009 and 2008. The amount of net income attributable to participating securities was $29 million for 2010 and 2009 and $23 million for 2008.

The weighted-average shares outstanding for basic and diluted EPS were as follows:

(In millions)	2010	2009	2008
Shares for basic EPS (including 5.9 participating securities for 2010 and 2009 and 5.7 for 2008)	372.7	390.4	417.2
Dilutive effect of stock options and LTPP	2.4	3.1	5.1
Dilutive effect of warrants	1.9	2.2	4.2
Shares for diluted EPS	377.0	395.7	426.5

Stock options to purchase the following number of shares of common stock had exercise prices that were either less than the average market price (dilutive) or greater than the average market price (anti-dilutive) of our common stock and were either included or excluded in our calculations of diluted EPS:

(In millions)	2010	2009	2008
Stock options included in the calculation of EPS (dilutive)	6.5	8.7	10.1
Stock options excluded from the calculation of EPS (anti-dilutive)	—	—	2.4

Our Board of Directors is authorized to issue up to 200 million shares of preferred stock, $0.01 par value per share, in multiple series with terms as determined by our Board of Directors. There were no shares of preferred stock outstanding at December 31, 2010 and December 31, 2009.

Warrants to purchase 5.3 million, 12.0 million and 12.0 million shares of our common stock that expire in June 2011, with an exercise price of $37.50 per share, were outstanding and included in our calculations of diluted EPS at December 31, 2010, December, 31, 2009 and December 31, 2008, respectively.

In 2008, we adopted the required new accounting standards that require us to recognize liabilities for the existing postretirement benefit aspects of our current split-dollar life insurance arrangements. The cumulative effect of adopting these new standards resulted in a $16 million charge to retained earnings as of January 1, 2008. We did not grant any new or expanded benefits as a result of this change.

Note 13: Stock-based Compensation Plans

We recorded $128 million, $127 million and $122 million of expense related to stock-based compensation in 2010, 2009 and 2008, respectively. We recorded $43 million, $42 million and $43 million as a tax benefit related to stock-based compensation in 2010, 2009 and 2008, respectively. At December 31, 2010, there was $160 million of compensation expense related to nonvested awards not yet recognized which is expected to be recognized over a weighted-average period of 1.6 years.

At December 31, 2010, we had stock-based compensation awards outstanding under a number of stock plans, including our 2010 Stock Plan. Future grants of awards will be made from the 2010 Stock Plan and not from our prior plans.

Shares issued as a result of stock awards, stock option exercises or conversion of restricted stock unit awards will be funded through treasury stock or the issuance of new shares. Of the 41.8 million shares authorized under our stock plans, there were 11.9 million shares available for awards under such plans as of December 31, 2010.

Restricted Stock

The 2010 Stock Plan provides for the award of restricted stock awards, restricted stock units and stock appreciation rights to our employees, officers, nonemployee directors and consultants. Awards of restricted stock awards, restricted stock units and stock appreciation rights generally are made by the Management Development and Compensation Committee of our Board of Directors (MDCC) and are compensatory in nature. These awards vest over a specified period of time as determined by the MDCC, generally four years for employee awards and one year for nonemployee directors. Restricted stock awards entitle the recipient to full dividend and voting rights beginning on the date of grant. Non-vested shares are restricted as to disposition and subject to forfeiture under certain circumstances. At the date of award each share of restricted stock is credited to common stock at par value. The fair value of restricted stock, calculated under the intrinsic value method at the date of award, is charged to income as compensation expense over the vesting period with a corresponding credit to additional paid-in capital.

Restricted stock activity was as follows:

(Share amounts in thousands)	Shares	Weighted-Average Grant Date Fair Value
Outstanding at December 31, 2007	5,251	$46.45
Granted	1,725	63.00
Vested	(1,703)	41.78
Forfeited	(281)	49.29
Outstanding at December 31, 2008	4,992	53.60
Granted	2,514	44.83
Vested	(1,666)	46.57
Forfeited	(247)	53.10
Outstanding at December 31, 2009	5,593	51.78
Granted	1,932	52.37
Vested	(1,697)	54.02
Forfeited	(385)	51.62
Outstanding at December 31, 2010	5,443	$51.30

Long-Term Performance Plan

In 2004, we established the LTPP, which provides for restricted stock unit awards granted from our stock plans to our senior leadership. These awards vest at the end of a three-year performance cycle based upon the achievement of specific pre-established levels of performance.

The performance goals for the three outstanding performance cycles at December 31, 2010, which are independent of each other, are based on three metrics as defined in the award agreements: return on invested capital (ROIC), weighted at 50%, total shareholder return (TSR) relative to a peer group, weighted at 25%; and cumulative free cash flow (CFCF), weighted at 25%.

The ultimate award, which is determined at the end of each of the three-year performance cycles, can range from zero to 200% of the target award and also includes dividend equivalents, which are not included in the table below. Compensation expense for the awards is recognized over the performance period based upon the value determined under the intrinsic value method for the CFCF and ROIC portions of the award and the Monte Carlo simulation method for the TSR portion of the award using historic volatility. Compensation expense for the CFCF and ROIC portions of the awards will be adjusted based upon the expected achievement of those performance goals.

LTPP activity related to the expected units was as follows:

(Unit amounts in thousands)	Units	Weighted-Average Grant Date Fair Value
Outstanding at December 31, 2007	1,407	$ 45.99
Granted	365	74.80
Increase	664	55.24
Vested	(359)	38.33
Forfeited	(43)	59.60
Outstanding at December 31, 2008	2,034	55.24
Granted	495	46.04
Decrease	(21)	(11.60)
Vested	(811)	46.04
Forfeited	(36)	63.07
Outstanding at December 31, 2009	1,661	57.65
Granted	439	55.74
Decrease	(194)	56.21
Vested	(746)	53.33
Forfeited	(88)	53.39
Outstanding at December 31, 2010	1,072	$ 50.34

The increase (decrease) above relates to changes in the amount of expected awards as achievement is measured against performance goals.

Stock Options

In 2004, we changed the primary form of our broad-based equity compensation from stock options to restricted stock. There have been no stock options granted since 2005.

Stock option activity was as follows:

(Share amounts in thousands)	Shares	Weighted-Average Option Price	Weighted-Average Remaining Contractual Term (In years)	Aggregate Intrinsic Value (In millions)
Outstanding at December 31, 2007	17,118	$42.45	3.3	$312
Exercised	(3,684)	43.01		
Forfeited or expired	(900)	58.08		
Outstanding at December 31, 2008	12,534	41.16	2.7	124
Exercised	(1,353)	30.21		
Forfeited or expired	(2,449)	68.17		
Outstanding at December 31, 2009	8,732	35.28	2.3	142
Exercised	(2,167)	30.15		
Forfeited or expired	(115)	24.40		
Outstanding at December 31, 2010	6,450	$37.23	1.5	$ 59
Exercisable at December 31, 2010	6,450	$37.23	1.5	$ 59

The total intrinsic value of options exercised in the years ended December 31, 2010, 2009 and 2008 was $51 million, $24 million and $71 million, respectively.

As of December 31, 2010 and December 31, 2009 all outstanding options were fully vested and exercisable. There were no options vested during the years ended December 31, 2009 and December 31, 2010.

The following table summarizes information about stock options outstanding and exercisable at December 31, 2010:

(Share amounts in thousands)	Options Outstanding and Exercisable		
Exercise Price Range	Shares	Weighted- Average Remaining Contractual Life (In Years)	Weighted-Average Exercise Price
$19.38 to $29.78	1,372	1.0	$29.47
$30.00 to $39.21	2,074	2.4	$31.99
$40.13 to $44.45	3,004	1.4	$44.41
Total	6,450	1.5	$37.23

Shares exercisable at the corresponding weighted-average exercise price at December 31, 2010, 2009 and 2008, were 6.5 million at $37.23, 8.7 million at $35.28 and 12.5 million at $41.16, respectively.

Note 14: Pension and Other Employee Benefits

We have pension plans covering the majority of our employees, including certain employees in foreign countries (Pension Benefits). Our primary pension obligations relate to our domestic IRS qualified pension plans. We also provide certain health care and life insurance benefits to retired employees and to eligible employees upon retirement through other postretirement benefit plans (Other Benefits).

The fair value of plan assets for our domestic and foreign Pension Benefit plans was $14,502 million and $597 million at December 31, 2010, respectively, and $12,294 million and $545 million at December 31, 2009, respectively.

We maintain a defined contribution plan that includes a 401(k) plan. Covered employees hired or rehired after January 1, 2007, are eligible for a Company contribution based on age and service, instead of participating in our pension plans. These and other covered employees are eligible to contribute up to a specific percentage of their pay to the 401(k) plan. The Company matches the employee's contribution, generally up to 3% or 4% of the employee's pay, which is invested in the same way as employee contributions. Total expense for the Company match was $275 million, $269 million and $238 million in 2010, 2009 and 2008, respectively.

At December 31, 2010 and December 31, 2009, there was $11.2 billion and $10.3 billion invested in our defined contribution plan, respectively. At December 31, 2010 and December 31, 2009, $1.1 billion and $1.4 billion of this was invested in the Company stock fund, respectively.

We also maintain additional contractual pension benefits agreements for certain of our executive officers. The liability was $32 million and $31 million at December 31, 2010 and December 31, 2009, respectively.

Contributions and Benefit Payments

We make both discretionary and required contributions to our pension plans. Required contributions were primarily determined under the ERISA and are affected by the actual return on plan assets and plan funded status through December 31, 2010.

We made required contributions of $1,183 million, $1,160 million and $542 million in 2010, 2009 and 2008, respectively, to our pension and other postretirement benefit plans. We expect to make required contributions of $1,073 million and $21 million to our pension and other postretirement benefit plans, respectively, in 2011. We made discretionary contributions of $750 million in 2010 and $660 million in 2008. We did not make any discretionary contributions in 2009. We will continue to periodically evaluate whether to make additional discretionary contributions.

The table below reflects the total Pension Benefits expected to be paid from the plans or from our assets, including both our share of the benefit cost and the participants' share of the cost, which is funded by participant contributions. Other Benefit payments reflect our portion only.

(In millions)	Pension Benefits	Other Benefits
2011	$1,163	$ 64
2012	1,152	63
2013	1,200	63
2014	1,234	63
2015	1,262	63
Thereafter	7,141	308

Defined-Benefit Retirement Plan Summary Financial Information

The tables below outline the components of net periodic benefit cost and related actuarial assumptions of our domestic and foreign Pension Benefits and Other Benefits plans.

Components of Net Periodic Benefit Cost	Pension Benefits		
(In millions)	**2010**	2009	2008
Service cost	$ 442	$ 401	$ 396
Interest cost	1,058	1,031	1,013
Expected return on plan assets	(1,215)	(1,221)	(1,213)
Amounts reflected in net funded status	285	211	196
Amortization of prior service credit	13	13	14
Recognized net actuarial loss	596	422	313
Loss due to curtailments/settlements	2	—	1
Amounts reclassified during the year	611	435	328
Net periodic benefit cost	$ 896	$ 646	$ 524

Net periodic benefit cost also includes expense from foreign Pension Benefits plans of $21 million, $19 million and $20 million in 2010, 2009 and 2008, respectively.

Components of Net Periodic Benefit Credit	Other Benefits		
(In millions)	**2010**	2009	2008
Service cost	$ 9	$ 9	$ 10
Interest cost	48	53	55
Expected return on plan assets	(32)	(30)	(44)
Amounts reflected in net funded status	25	32	21
Amortization of transition obligation	4	4	4
Amortization of prior service credit	(45)	(52)	(52)
Recognized net actuarial loss	5	5	1
Amounts reclassified during the year	(36)	(43)	(47)
Net periodic benefit credit	$(11)	$(11)	$(26)

Funded Status – Amounts Recognized on the Balance Sheets	Pension Benefits		Other Benefits	
(In millions) December 31:	**2010**	2009	**2010**	2009
Noncurrent assets	$ 103	$ 111	$ —	$ —
Current liabilities	(48)	(45)	(16)	(18)
Noncurrent liabilities	(4,093)	(4,668)	(339)	(421)
Net amount recognized on the balance sheets	$(4,038)	$(4,602)	$(355)	$(439)

Reconciliation of Amounts Recognized on the Balance Sheets	Pension Benefits		Other Benefits	
(In millions) December 31:	**2010**	2009	2010	2009
Accumulated other comprehensive loss:				
Initial net obligation	$ —	$ —	$ (5)	$ (9)
Prior service (cost) credit	(85)	(83)	20	65
Net loss	(7,794)	(7,351)	(67)	(148)
Accumulated other comprehensive loss	(7,879)	(7,434)	(52)	(92)
Accumulated contributions in excess (below) net periodic benefit or cost	3,841	2,832	(303)	(347)
Net amount recognized on the balance sheets	$(4,038)	$(4,602)	$(355)	$(439)

Sources of Change in Accumulated Other Comprehensive Loss	Pension Benefits		Other Benefits	
(In millions) December 31:	**2010**	2009	**2010**	2009
Amortization of initial net obligation	$ —	$ —	$ 4	$ 4
Net change initial net obligation	—	—	4	4
Prior service cost arising during period	(15)	(1)	—	—
Amortization of prior service cost (credit) included in net income	13	13	(45)	(52)
Net change in prior service cost (credit) not recognized in net income during that period	(2)	12	(45)	(52)
Actuarial (loss) gain arising during period	(1,044)	(44)	76	18
Amortization of net actuarial loss included in net income	596	422	5	5
Net change in actuarial gain (loss) not included in net income during the period	(448)	378	81	23
Effect of exchange rates	5	(8)	—	—
Total change in accumulated other comprehensive loss during period	$ (445)	$382	$ 40	$(25)

The amounts in accumulated other comprehensive loss at December 31, 2010 expected to be recognized as components of net periodic benefit cost in 2011 are as follows:

Adjustment to Accumulated Other Comprehensive Loss	Pension Benefits	Other Benefits
(In millions) December 31:	**2010**	**2010**
Net loss	$(796)	$(3)
Transition obligation	—	(4)
Prior service (cost) credit	(14)	10
Total	$(810)	$ 3

For our domestic qualified pension plans the projected benefit obligation (PBO), accumulated benefit obligation (ABO) and asset values for these plans were $17,847 million, $15,997 million, and $14,502 million, respectively, as of December 31, 2010 and $16,260 million, $14,599 million, and $12,294 million, respectively, as of December 31, 2009. The PBO represents the present value of Pension Benefits earned through the end of the year, with allowance for future salary increases. The ABO is similar to the PBO, but does not provide for future salary increases.

The PBO and fair value of plan assets for Pension Benefits plans with PBOs in excess of plan assets were $17,897 million and $13,756 million, respectively, at December 31, 2010, and $16,270 million and $11,558 million, respectively, at December 31, 2009.

The ABO and fair value of plan assets for Pension Benefits plans with ABOs in excess of plan assets were $15,920 million and $13,710 million, respectively, at December 31, 2010 and $14,511 million and $11,525 million, respectively, at December 31, 2009. The ABO for all Pension Benefits plans was $17,170 million and $15,675 million at December 31, 2010 and December 31, 2009, respectively.

The tables below provide a reconciliation of benefit obligations, plan assets, funded status and related actuarial assumptions of our domestic and foreign Pension Benefits and Other Benefits plans.

Change in Projected Benefit Obligation	Pension Benefits		Other Benefits	
(In millions) December 31:	**2010**	2009	**2010**	2009
Projected benefit obligation at beginning of year	$17,441	$16,361	$846	$ 834
Service cost	442	401	9	9
Interest cost	1,058	1,031	48	53
Plan participants' contributions	21	21	45	46
Amendments	15	1	—	—
Actuarial loss (gain)	1,340	708	(64)	8
Foreign exchange loss (gain)	(27)	54	—	—
Benefits paid	(1,152)	(1,142)	(96)	(104)
Net transfer in	—	6	—	—
Projected benefit obligation at end of year	$19,138	$17,441	$788	$ 846

The PBO for our domestic and foreign Pension Benefits plans was $18,407 million and $731 million, respectively at December 31, 2010 and $16,748 million and $693 million, respectively, at December 31, 2009.

Change in Plan Assets	Pension Benefits		Other Benefits	
(In millions) December 31:	**2010**	2009	**2010**	2009
Fair value of plan assets at beginning of year	$12,839	$10,907	$407	$ 365
Actual return (loss) on plan assets	1,508	1,885	45	55
Company contributions	1,902	1,115	32	45
Plan participants' contributions	21	21	45	46
Foreign exchange gain (loss)	(19)	49	—	—
Benefits paid	(1,152)	(1,142)	(96)	(104)
Net transfer in	—	4	—	—
Fair value of plan assets at end of year	$15,099	$12,839	$433	$ 407

Retirement Plan Assumptions

Weighted-Average Net Periodic Benefit Cost Assumptions	Pension Benefits		
	2010	2009	2008
Discount rate	6.23%	6.50%	6.46%
Expected return on plan assets	8.68%	8.62%	8.64%
Rate of compensation increase			
Range	2.00% -7.00%	2.00% -7.00%	2.00% -7.00%
Average	4.51%	4.48%	4.50%

Weighted-Average Net Periodic Benefit Cost Assumptions	Other Benefits		
	2010	2009	2008
Discount rate	6.00%	6.75%	6.50%
Expected Long-term rate of return on plan assets	8.25%	8.75%	8.75%
Rate of compensation increase			
Range	2.00% -7.00%	2.00% -7.00%	2.00% -7.00%
Average	4.50%	4.50%	4.50%
Health care trend rate in the next year	7.00%	7.40%	8.50%
Gradually declining to an ultimate trend rate	4.00%	4.00%	5.00%
Year that the rate reaches ultimate trend rate	2027	2029	2015

Weighted-Average Year-End Benefit Obligation Assumptions	Pension Benefits		Other Benefits	
December 31:	**2010**	2009	**2010**	2009
Discount rate	5.73%	6.23%	5.50%	6.00%
Rate of compensation increase				
Range	2.00% -7.00%	2.00% -7.00%	2.00% - 7.00%	2.00% - 7.00%
Average	4.50%	4.51%	4.50%	4.50%
Health care trend rate in the next year			4.00%	7.00%
Gradually declining to an ultimate trend rate of			4.00%	4.00%
Year that the rate reaches the ultimate trend rate			2010	2027

The discount rate for our domestic Pension Benefits plans was 5.75% and 6.25% at December 31, 2010 and December 31, 2009, respectively. Our foreign Pension Benefits plan assumptions have been included in the Pension Benefits assumptions in the table above.

The long-term rate of return on plan assets (ROA) represents the average rate of earnings expected over the long term on the assets invested to provide for anticipated future benefit payment obligations. The Company employs a "building block" approach in determining the long-term ROA assumption. Historical markets are studied and long-term relationships between equities and fixed income are assessed. Current market factors such as inflation and interest rates are evaluated before long-term capital market assumptions are determined. The long-term ROA assumption is also established giving consideration to investment diversification, rebalancing and active management of the investment portfolio. Peer data and historical returns are reviewed periodically to assess reasonableness and appropriateness.

In validating the 2010 long-term ROA assumption, we reviewed our pension plan asset performance since 1986. Our average actual annual rate of return since 1986 has exceeded our estimated 8.75% assumed return. Based upon these analyses and our internal investing targets, we determined our long-term ROA assumption for our domestic pension plans in 2010 was 8.75%, consistent with our 2009 assumption. Our domestic pension plans' actual rates of return were approximately 11%, 17% and (26%) for 2010, 2009 and 2008, respectively. The difference between the actual rate of return and our long-term ROA assumption is included in deferred losses. If we significantly change our long-term investment allocation or strategy, then our long-term ROA assumption could change.

The long-term ROA assumptions for foreign Pension Benefits plans are based on the asset allocations and the economic environment prevailing in the locations where the Pension Benefits plans reside. Foreign pension assets do not make up a significant portion of the total assets for all of our Pension Benefits plans.

The effect of a 1% increase or (decrease) in the assumed health care trend rate for each future year for the aggregate of service cost and interest cost is $1 million or ($1) million, respectively, and for the accumulated postretirement benefit obligation is $11 million or ($10) million, respectively.

Plan Assets

Substantially all our domestic Pension Benefit Plan (plan) assets, which consists of investments in equity securities, fixed-income securities, cash and cash equivalents, public real estate securities, private real estate funds and hedge funds and other assets such as investments in private equity funds, are held in a master trust, which was established for the investment of assets of our Company sponsored retirement plans. The assets of the master trust are overseen by the Company's Investment Committee comprised of members of senior management drawn from appropriate diversified levels of the executive management team.

The Investment Committee is responsible for setting the policy that provides the framework for management of the Plan assets. In accordance with its responsibilities and charter, the Investment Committee meets on a regular basis to review the performance of the Plan assets and compliance with the investment policy. The policy sets forth an investment structure for managing Plan assets, including setting the asset allocation ranges, which are expected to provide an appropriate level of overall diversification and total investment return over the long term while maintaining sufficient liquidity to pay the benefits of the Plan. Asset allocation ranges are set to produce the highest return on investment taking into account investment risks that are prudent and reasonable given prevailing market conditions. In developing the asset allocation ranges, third party asset allocation studies are periodically performed that consider the current and expected positions of the plan assets and funded status. Based on this study and other appropriate information, the Investment Committee establishes asset allocation ranges taking into account acceptable risk targets and associated returns.

The investment policy asset allocation ranges for the Plan, as set by the Investment Committee, for the year ended December 31, 2010 were as follows:

Asset Category	
U.S. equities	25% - 40%
International equities	15% - 30%
Fixed-income securities	25% - 40%
Cash and cash equivalents	3% - 15%
Other (including private equity and real estate)	0% - 20%

The Investment Committee appoints the investment fiduciary, who is responsible for making investment decisions within the framework of the Investment Policy and for supervising the internal pension investment team. The pension investment team is comprised of experienced financial managers, who are all employees of the Company. The investment fiduciary reports back to the Investment Committee. During times of unusual market conditions, the investment fiduciary may seek authorization from the Investment Committee to change the investing allocation ranges to prevent excessive volatility or other undesirable consequences.

Taking into account the asset allocation ranges, the investment fiduciary determines the specific allocation of the Plan's investments within various asset classes. The Plan utilizes select investment strategies which are executed through separate account or fund structures with external investment managers who demonstrate experience and expertise in the appropriate asset classes and styles. The selection of investment managers is done with careful evaluation of all aspects of performance and risk, due diligence of internal operations and controls, reputation, systems evaluation and a review of investment manager's policies and processes. The Plan also utilizes unleveraged exchange traded funds that track an index and highly liquid short term instruments. Investment performance is monitored frequently against appropriate benchmarks and tracked to compliance guidelines with the assistance of third party performance evaluation tools and metrics.

Consistent with the objective of maximizing return while minimizing risk, multiple investment strategies are employed to diversify risk such that no single investment or manager holding presents a significant exposure to the total investment portfolio. Plan assets are invested in numerous diversified strategies with the intent to minimize correlations. This allows for diversification of returns. As of December 31, 2010, no individual investment strategy represented more than 5% of the total assets of the Plan. Further, within each strategy, guidelines are established which set forth the list of authorized investments, the typical portfolio characteristics and diversification required by limiting the amount that can be invested by sector, country and issuer. As a result, the Plan is not significantly exposed to any single entity, investment manager, sector or international location.

The Plan's investments are stated at fair value. Investments in equity securities (common and preferred) are valued at the last reported sales price when an active market exists. Investments in fixed-income securities are generally valued using methods based upon market transactions for comparable securities and various relationships between securities which are generally recognized by institutional traders. Investments in private equity funds, hedge funds and private real estate funds are estimated at fair market value which primarily utilizes net asset values reported by the investment manager. The pension investment team reviews independently appraised values, audited financial statements and additional pricing information to evaluate the net asset values. For the very limited group of securities and other assets for which market quotations are not readily available or for which the above valuation procedures are deemed not to reflect fair value, additional information is obtained from the investment manager and evaluated internally to determine whether any adjustments are required to reflect fair value.

The fair value of the Company's Plan assets by asset category and by level (as described in Note 1: Summary of Significant Accounting Policies) at December 31, 2010 and December 31, 2009 were as follows:

Fair Value Measurements at December 31, 2010

(In millions)	Total	Level 1	Level 2	Level 3
U.S. equities				
All capitalization[1]	$ 4,520	$4,510	$ 10	$ —
U.S. equity hedge funds[2]	27	—	5	22
International equities				
Developed markets[1]	1,837	1,687	150	—
Emerging markets[1]	1,121	889	232	—
International equity hedge funds[2]	30	—	30	—
Fixed-income securities				
U.S. Government bonds or treasuries	388	388	—	—
U.S. Agency securities	16	—	16	—
Corporate bonds				
Investment grade bonds[3]	1,583	24	1,559	—
Non-investment grade bonds[3]	573	212	361	—
Emerging market debt	260	20	240	—
Core fixed income[4]	352	352	—	—
Global multi-sector fixed income[5]	504	269	235	—
Fixed income hedge funds[2]	495	—	403	92
Cash and cash equivalents[6]	1,102	401	701	—
Other funds				
Commodity	95	—	95	—
Currency	73	—	73	—
Multi-asset class[7]	393	187	206	—
Private equity funds[8]	252	—	—	252
Private real estate funds	156	—	—	156
Hedge funds[2]	734	—	713	21
Insurance contracts	23	—	—	23
Payable for securities lending collateral[9]	(95)	—	(95)	—
Other[10]	63	2	—	61
Total	$14,502	$8,941	$4,934	$627

Fair Value Measurements at December 31, 2009

(In millions)	Total	Level 1	Level 2	Level 3
U.S. equities				
All capitalization[1]	$ 3,281	$3,122	$ 159	$ —
U.S. equity hedge funds[2]	145	—	126	19
International equities				
Developed markets[1]	1,452	1,435	17	—
Emerging markets[1]	748	622	126	—
International equity hedge funds[2]	71	—	71	—
Fixed-income securities				
U.S. Government bonds or treasuries	750	750	—	—
U.S. Agency securities	43	—	43	—
Corporate bonds				
Investment grade bonds[3]	1,935	29	1,906	—
Non-investment grade bonds[3]	325	—	276	49
Emerging market debt	214	—	214	—
Global multi-sector fixed income[5]	109	—	109	—
Fixed income hedge funds[2]	472	—	265	207
Cash and cash equivalents[6]	2,042	987	1,055	—
Other funds				
Commodity	67	—	67	—
Currency	104	—	104	—
Private equity funds[8]	242	—	—	242
Private real estate funds	125	—	—	125
Hedge funds[2]	293	—	293	—
Insurance contracts	22	—	—	22
Payable for securities lending collateral[9]	(233)	—	(233)	—
Other[10]	87	21	—	66
Total	$12,294	$6,966	$4,598	$730

(1) U.S. and International equity securities primarily include investments across the capitalization spectrum of large, medium and small market capitalization stocks.

(2) Hedge funds can employ numerous strategies and seek to hedge some of the risk inherent in their investments by using a variety of methods, including short selling and derivative instruments.

(3) Investment grade bonds are fixed-income securities with a rating equivalent to a Standard & Poors rating of BBB- or better. Non-investment grade bonds have an equivalent rating of BB+ or less.

(4) Core fixed income investments are strategies that invest primarily in intermediate-term high quality domestic bonds.

(5) Global multi-sector fixed income investments are strategies that invest globally among several sectors including governments, investment grade corporate bonds, high yield corporate bonds and emerging market bonds.

(6) As of December 31, 2010, cash and cash equivalents were invested in a highly liquid money market fund and other short term instruments, including treasuries, agencies, commercial paper and certificates of deposit. As of December 31, 2009, cash and cash equivalents were predominantly held in a highly liquid short term investment fund. Fund investments at December 31, 2009 were primarily short term direct treasury instruments, including treasuries, agencies, treasury backed commercial paper and treasury collateralized overnight repurchase agreements. Included in cash and cash equivalents is excess cash in investment manager accounts. This cash is available for immediate use and is used to fund daily operations and execute the investment policy. This amount is not considered to be part of the cash target allocation set forth in the investment policy.

(7) Multi-asset class investments are long-only balanced strategies that invest across multiple asset classes including equities, fixed income and commodities utilizing a risk-balanced approach.

(8) Investments in private equity funds are predominantly invested in U.S. and Western Europe private equity funds.

(9) The Plan participates in a securities lending program with the Trustee. The program allows the Trustee to loan securities, which are assets of the Plan, to approved brokers (the "Borrowers"). The Trustee requires Borrowers, pursuant to a security loan agreement, to deliver collateral to secure each loan. The Plan bears the risk of loss with respect to the unfavorable change in fair value of the invested cash collateral. The market value of securities on loan is reflected in the various asset categories above. Loaned securities were predominantly U.S. equities, International equities, corporate bonds and U.S. Government bonds or treasuries. Cash collateral obligations of $95 million and $233 million were received for securities on loan as of December 31, 2010 and December 31, 2009, respectively. Cash collateral was invested in a separately maintained and managed cash collateral investment account, which was primarily invested in investment grade bonds and is reflected in the assets above.

(10) As of December 31, 2010 and December 31, 2009, this category included $2 million and $21 million of cash on deposit with a broker for future margin requirements and $61 million and $66 million of net receivables and payables which consisted primarily of pending trades, interest, dividends and other payable expenses.

Fair Value Measurements Using Significant Unobservable Inputs (Level 3)

(In millions)	Beginning Balance at December 31, 2009	Actual return on plan assets[1]	Purchases, issuances, settlements	Transfers in and/or out of Level 3	Ending Balance at December 31, 2010
U.S. equity					
U.S. equity hedge funds	$ 19	$ 3	$ —	$—	$ 22
Fixed-income securities					
Non-investment grade bonds	49	(11)	(38)	—	—
Fixed-income hedge funds	207	7	(122)	—	92
Other funds					
Private equity funds	242	21	(11)	—	252
Private real estate funds	125	17	14	—	156
Hedge funds	—	1	20	—	21
Insurance contracts	22	—	1	—	23
Other	66	—	(5)	—	61
Total	$730	$ 38	$(141)	$—	$627

(In millions)	Beginning Balance at December 31, 2008	Actual return on plan assets[1]	Purchases, issuances, settlements	Transfers in and/or out of Level 3	Ending Balance at December 31, 2009
U.S. equities					
All capitalization	$ 2	$ (2)	$ —	$—	$ —
U.S. equity hedge funds	15	4	—	—	19
Fixed-income securities					
Non-investment grade bonds	53	(29)	25	—	49
Fixed-income hedge funds	301	60	(154)	—	207
Other funds					
Private equity funds	272	(23)	(7)	—	242
Private real estate funds	185	(70)	10	—	125
Hedge funds	51	16	(67)	—	—
Insurance contracts	24	2	(4)	—	22
Other	86	—	(20)	—	66
Total	$989	$(42)	$(217)	$—	$730

(1) The actual return on plan assets for assets still held at December 31, 2010 and December 31, 2009 was $52 million and $14 million, respectively.

The Plan limits the use of derivatives through direct or separate account investments such that the derivatives used are liquid and able to be readily valued in the market. Derivative usage in separate account structures is limited to hedging purposes or to gain market exposure in a non-speculative manner. The fair market value of the Plan's derivatives through direct or separate account investments was less than $1 million and $2 million as of December 31, 2010 and December 31, 2009, respectively.

In addition, assets are held in trust for non-U.S. Pension Benefits plans, primarily in the U.K. and Canada which are governed locally in accordance with specific jurisdictional requirements. These assets are overseen by local management in Canada and by trustees with a combination of members representing plan participants and local management in the U.K. Investments in the non-U.S. Pension Benefits plans consist primarily of fixed-income securities and equity securities and had a fair market value of $597 million and $545 million at December 31, 2010 and December 31, 2009, respectively.

These investments are valued using quoted prices in active markets (Level 1) as well as significant observable inputs (Level 2). Investments with significant unobservable inputs (Level 3) are immaterial in the non-U.S. Pension Benefits plans.

The fair market value of assets related to our Other Benefits was $433 million and $407 million as of December 31, 2010 and December 31, 2009, respectively. These assets included $186 million and $171 million at December 31, 2010 and December 31, 2009, respectively, that were invested in the master trust described above and are therefore invested in the same assets described above. The remaining investments are held within Voluntary Employees' Beneficiary Association (VEBA) trusts. The assets of the VEBAs are also overseen by the Investment Committee and managed by the same investment fiduciary that manages the master trust's investments with a separate team. These assets are generally invested in domestic fixed-income securities as well as U.S. equities. These investments are valued primarily using quoted prices in active markets (Level 1) as well as significant observable inputs (Level 2). There were no Level 3 investments in the VEBAs at December 31, 2010 or December 31, 2009.

The table below details assets by category for our Other Benefits plans. These assets consist primarily of publicly-traded equity securities and publicly-traded fixed-income securities.

Other Benefits Asset Information	Percent of Plan Assets at December 31:	
Asset category	**2010**	2009
Fixed-income securities	51%	55%
U.S. equities	32%	31%
International equities	11%	8%
Cash and cash equivalents	6%	6%
Total	100%	100%

Note 15: Income Taxes

The provision for federal and foreign income taxes consisted of the following:

(In millions)	**2010**	2009	2008
Current income tax expense			
Federal	$ 205	$669	$206
Foreign	39	15	44
Deferred income tax expense (benefit)			
Federal	465	257	568
Foreign	(120)	12	6
Total	$ 589	$953	$824

The expense for income taxes differs from the U.S. statutory rate due to the following:

	2010	2009	2008
Statutory tax rate	35.0%	35.0%	35.0%
Research and development tax credit	-1.1%	-0.9%	-1.0%
Tax settlements and refund claims	-8.0%	-0.9%	-0.5%
Domestic manufacturing deduction benefit	-1.7%	-0.9%	-0.5%
Foreign income tax rate differential	0.8%	0.1%	-0.4%
Other, net	-0.8%	0.1%	0.1%
Effective tax rate	24.2%	32.5%	32.7%

We are subject to income taxes in the U.S. and numerous foreign jurisdictions. IRS examinations of our tax returns have been completed through 2005 and the IRS is currently examining the 2006-2008 tax years. Additionally, we are under audit by multiple state and foreign tax authorities. State tax liabilities are routinely adjusted to account for any changes in federal taxable income.

Domestic income from continuing operations before taxes was $2,699 million, $2,806 million and $2,360 million in 2010, 2009 and 2008, respectively, and foreign income (loss) from continuing operations before taxes was ($267) million, $124 million and $162 million in 2010, 2009 and 2008, respectively. No provision has been made for deferred taxes on undistributed earnings of non-U.S. subsidiaries as these earnings have been indefinitely reinvested. Determination of the amount of unrecognized deferred tax liability on these undistributed earnings is not practicable. Total federal and foreign tax payments, net of refunds and credits, were $337 million, $208 million and $448 million in 2010, 2009 and 2008, respectively.

We believe that our income tax reserves are adequate; however, amounts asserted by taxing authorities could be greater or less than amounts accrued and reflected in our consolidated balance sheets. Accordingly, we could record adjustments to the amounts for federal, foreign and state tax-related liabilities in the future as we revise estimates or we settle or otherwise resolve the underlying matters.

The balance of unrecognized tax benefits at December 31, 2010, exclusive of interest, was $188 million which would affect earnings if recognized. The balance of unrecognized tax benefits at December 31, 2009, exclusive of interest, was $469 million, of which $364 million would affect earnings if recognized.

In 2010, we received final approval from the IRS and the U.S. Congressional Joint Committee on Taxation of the IRS' examination of our tax returns for the 1998-2005 tax years (Tax Settlement). As a result, we recorded a reduction in our unrecognized tax benefits from continuing and discontinued operations of $280 million, which decreased our tax expense by $259 million, including $170 million from continuing operations and $89 million from discontinued operations. The decrease in tax expense included $56 million related to interest.

In addition, we filed an accounting method change related to the timing of certain compensation deductions with the IRS. As a result, we recorded a reduction in our unrecognized tax benefits from continuing operations of $104 million, which decreased tax expense by $13 million related to interest.

We accrue interest related to unrecognized tax benefits in tax expense. Primarily as a result of the Tax Settlement in 2010, we recorded $90 million of income related to interest which, net of the federal tax expense was $57 million. In the twelve months ended December 31, 2009 and December 31, 2008, respectively, we recorded $27 million and $26 million of interest which, net of the federal tax benefit was $17 million in 2009 and 2008, respectively. At December 31, 2010 and December 31, 2009, we had $33 million and $123 million, respectively, of interest accrued related to unrecognized tax benefits, which, net of the federal tax benefit, was approximately $23 million and $80 million, respectively. In the ordinary course of business, we may take new tax positions that could increase or decrease our unrecognized tax benefits in future periods.

A rollforward of our unrecognized tax benefits was as follows:

(In millions)	**2010**	2009	2008
Unrecognized tax benefits, beginning of year	$469	$415	$342
Additions based on current year tax positions	14	20	36
Additions based on prior year tax positions	32	34	38
Reductions based on prior year tax positions	(317)	—	—
Settlements with taxation authorities	(10)	—	(1)
Unrecognized tax benefits, end of year	$188	$469	$415

We generally account for our state income tax expense as a deferred contract cost, as we can generally recover this expense through the pricing of our products and services to the U.S. Government. We include this deferred contract cost in contracts in process until allocated to our contracts, which generally occurs upon payment or when otherwise agreed as allocable with the U.S. Government. Net state income tax expense allocated to our contracts was $59 million, $25 million and $122 million in 2010, 2009 and 2008, respectively. We include state income tax expense allocated to our contracts in administrative and selling expenses.

The American Jobs Creation Act of 2004 provides a deduction for income derived from qualifying domestic production activities (the Domestic Manufacturing Deduction under Section 199 of the Internal Revenue Code (IRC)) that is phased in over the 2005–2010 period. The deduction was equal to 9% of qualified income in 2010, and 6% in 2009 and 2008.

In December 2010, the Tax Relief, Unemployment Insurance Reauthorization, and Job Creation Act of 2010 was enacted. This legislation retroactively reinstated the research and development tax credit for 2010 and extended it through December 31, 2011. As a result, we recorded a benefit of approximately $26 million in the fourth quarter of 2010 representing the benefit of the research and development tax credit for the full year.

Deferred income taxes consisted of the following at December 31:

(In millions)	**2010**	2009
Current deferred tax assets (liabilities)		
Other accrued expenses and reserves	$ 167	$ 166
Accrued employee compensation and benefits	241	196
Contracts in process and inventories	(142)	(89)
Deferred income taxes-current	$ 266	$ 273
Noncurrent deferred tax assets (liabilities)		
Net operating loss and tax credit carryforwards	$ 159	$ 32
Pension benefits	1,158	1,384
Other retiree benefits	122	123
Depreciation and amortization	(1,337)	(1,194)
Other	(143)	68
Deferred income taxes-noncurrent	$ (41)	$ 413

As of December 31, 2010, we had foreign net operating loss carryforwards of approximately $450 million, of which $440 million was generated in the United Kingdom. We believe that we will have sufficient taxable income to realize this deferred tax asset, as any net operating loss generated in the United Kingdom may be carried forward indefinitely.

The federal tax (benefit) expense related to discontinued operations was ($110) million, $1 million and $7 million in 2010, 2009 and 2008, respectively.

Note 16: Business Segment Reporting

Our reportable segments, organized based on capabilities and technologies, are: Integrated Defense Systems, Intelligence and Information Systems, Missile Systems, Network Centric Systems, Space and Airborne Systems and Technical Services.

Integrated Defense Systems (IDS) is a leader in global capabilities integration, providing affordable, integrated solutions to a broad international and domestic customer base. IDS leverages its core domain knowledge and capabilities in sensors, command, control and communication (C3), persistent surveillance/ISR, effects and mission support, to provide integrated naval, air and missile defense and civil security response solutions.

Intelligence and Information Systems (IIS) is a leader in intelligence, surveillance and reconnaissance (ISR), advanced cyber solutions, weather and environmental solutions, and information-based solutions for law enforcement and homeland security.

Missile Systems (MS) is a premier developer and producer of missile systems for the armed forces of the U.S. and other allied nations. Leveraging its key capabilities in advanced airframes, guidance and navigation systems, high-resolution sensors, targeting, and netted systems, MS develops and supports a broad range of cutting-edge weapon systems, including missiles, smart munitions, close-in weapon systems, projectiles, kinetic kill vehicles and directed energy effectors.

Network Centric Systems (NCS) is a leading provider of net-centric mission solutions for federal, state and local government and civil customers. NCS leverages its capabilities in networking, sensors, command and control, and communications to develop and produce solutions for customers in key markets such as U.S. Army modernization, international and domestic homeland security, civil communications, and transportation solutions.

Space and Airborne Systems (SAS) is a leader in the design and development of integrated systems and solutions for advanced missions, including traditional and non-traditional intelligence, surveillance and reconnaissance (ISR), precision engagement, unmanned aerial operations and space. Leveraging advanced concepts, state-of-the-art technologies and mission systems knowledge, SAS provides electro-optical/infrared sensors, airborne radars for surveillance and fire control applications, lasers, precision guidance systems, processors, electronic warfare systems and space-qualified systems for civil and military applications.

Technical Services (TS) provides a full spectrum of technical, scientific and professional services to defense, federal, international and commercial customers worldwide. It specializes in training, logistics, engineering services and solutions, product support and operational support services. TS provides solutions for mission support, homeland security, space, civil aviation, counterproliferation and counterterrorism markets.

Segment total net sales and operating income generally include intersegment sales and profit recorded at cost plus a specified fee, which may differ from what the selling entity would be able to obtain on sales to external customers. Corporate and Eliminations includes corporate expenses and intersegment sales and profit eliminations. Corporate expenses represent unallocated costs and certain other corporate costs not considered part of management's evaluation of reportable segment operating performance, including the net costs associated with our residual turbo-prop commuter aircraft portfolio.

Segment financial results were as follows:

Total Net Sales (In millions)	**2010**	2009	2008
Integrated Defense Systems	$ 5,470	$ 5,525	$ 5,148
Intelligence and Information Systems	2,757	3,204	3,132
Missile Systems	5,732	5,561	5,408
Network Centric Systems	4,918	4,822	4,510
Space and Airborne Systems	4,830	4,582	4,280
Technical Services	3,472	3,161	2,601
Corporate and Eliminations	(1,996)	(1,974)	(1,905)
Total	$25,183	$24,881	$23,174

Intersegment Sales (In millions)	**2010**	2009	2008
Integrated Defense Systems	$ 88	$ 126	$ 162
Intelligence and Information Systems	14	19	22
Missile Systems	94	57	26
Network Centric Systems	502	481	379
Space and Airborne Systems	586	611	595
Technical Services	739	710	700
Total	$2,023	$2,004	$1,884

Operating Income (In millions)	**2010**	2009	2008
Integrated Defense Systems	$ 879	$ 859	$ 870
Intelligence and Information Systems	(150)	259	253
Missile Systems	654	604	584
Network Centric Systems	701	674	575
Space and Airborne Systems	686	647	569
Technical Services	300	215	174
FAS/CAS Pension Adjustment	(230)	27	(123)
Corporate and Eliminations	(233)	(243)	(282)
Total	$2,607	$3,042	$2,620

We must calculate our pension costs under both FAS requirements under GAAP and CAS. GAAP outlines the methodology used to determine pension expense or income for financial reporting purposes, which is not indicative of the funding requirements for pension plans that we determine by other factors. CAS prescribes the allocation to and recovery of pension costs on U.S. Government contracts. The results of each segment only include pension expense as determined under CAS. The CAS requirements for pension costs and its calculation methodology differ from the FAS requirements and calculation methodology. As a result, while both FAS and CAS use long-term assumptions in their calculation methodologies, each method results in different calculated amounts of pension cost. The FAS/CAS Pension Adjustment, which we report as a separate line item in our segment results above, represents the difference between our pension expense or income under FAS requirements under GAAP and our pension expense under CAS.

The components of operating income related to Corporate and Eliminations were as follows:

(In millions)	**2010**	2009	2008
Intersegment profit eliminations	$(189)	$(173)	$(166)
Corporate	(44)	(70)	(116)
Total	$(233)	$(243)	$(282)

Intersegment Operating Income (In millions)	**2010**	2009	2008
Integrated Defense Systems	$ 6	$ 8	$ 9
Intelligence and Information Systems	1	2	4
Missile Systems	14	7	2
Network Centric Systems	43	41	31
Space and Airborne Systems	56	52	56
Technical Services	69	63	64
Total	$ 189	$ 173	$ 166

The following table reconciles operating income to income from continuing operations before taxes:

(In millions)	2010	2009	2008
Operating income	$2,607	$3,042	$2,620
Non-operating expense, net	(175)	(112)	(98)
Income from continuing operations before taxes	$2,432	$2,930	$2,522

Capital Expenditures (In millions)	2010	2009	2008
Integrated Defense Systems	$ 61	$ 52	$ 63
Intelligence and Information Systems	50	23	24
Missile Systems	41	49	52
Network Centric Systems	67	64	85
Space and Airborne Systems	78	60	58
Technical Services	11	5	12
Corporate	11	27	10
Total	$ 319	$ 280	$ 304

Depreciation and Amortization (In millions)	2010	2009	2008
Integrated Defense Systems	$ 75	$ 68	$ 65
Intelligence and Information Systems	45	43	45
Missile Systems	53	55	52
Network Centric Systems	85	77	68
Space and Airborne Systems	84	82	81
Technical Services	16	17	18
Corporate	62	60	61
Total	$ 420	$ 402	$ 390

Identifiable Assets (In millions)	2010	2009
Integrated Defense Systems	$ 1,849	$ 1,943
Intelligence and Information Systems	2,374	2,391
Missile Systems	4,921	4,858
Network Centric Systems	4,409	4,199
Space and Airborne Systems	4,232	4,236
Technical Services	1,376	1,340
Corporate	5,261	4,640
Total	$24,422	$23,607

Total Net Sales by Geographic Areas (In millions)	United States	Asia/ Pacific	MENA[1]	All Other (Principally Europe)	Total
2010	$19,400	$2,664	$1,854	$1,265	$25,183
2009	19,618	2,470	1,216	1,577	24,881
2008	18,596	2,086	482	2,010	23,174

(1) MENA is defined as the Middle East and North Africa.

The country of destination was used to attribute sales to either the United States or outside the United States (including foreign military sales through the U.S. Government of $3.3 billion, $2.8 billion and $1.8 billion in 2010, 2009 and 2008, respectively). Sales to our major customer, the U.S. Government, including foreign military sales in 2010, 2009 and 2008 were $22,294 million, $22,003 million and $20,170 million, respectively. Included in U.S. Government sales were sales to the U.S. Department of Defense of $21,333 million, $20,958 million and $19,231 million, in 2010, 2009 and 2008, respectively.

Long-lived Assets by Geographic Area (In millions)	United States	All Other (Principally Europe)	Total
December 31, 2010	$1,885	$118	$2,003
December 31, 2009	1,889	112	2,001

Note 17: Quarterly Operating Results (Unaudited)

(In millions, except per share amounts, stock prices and workdays)

2010	First	Second[3]	Third[4]	Fourth[5]
Total net sales	$6,053	$5,973	$6,272	$6,885
Gross margin	1,269	935	1,297	1,379
Income from continuing operations	461	219	649	514
Net income attributable to Raytheon Company	445	208	728	459
EPS from continuing operations attributable to Raytheon Company common stockholders[1]				
Basic	$ 1.20	$ 0.56	$ 1.72	$ 1.38
Diluted	1.18	0.56	1.71	1.37
EPS attributable to Raytheon Company common stockholders[1]				
Basic	1.18	0.55	1.96	1.26
Diluted	1.16	0.55	1.94	1.25
Cash dividends per share				
Declared	0.375	0.375	0.375	0.375
Paid	0.31	0.375	0.375	0.375
Common stock prices				
High	$57.29	$60.01	$50.59	$48.33
Low	50.73	50.38	43.21	44.45
Workdays[2]	60	64	63	62

2009	First	Second	Third	Fourth[6]
Total net sales	$5,884	$6,125	$6,205	$6,667
Gross margin	1,187	1,286	1,311	1,350
Income from continuing operations	457	504	499	517
Net income attributable to Raytheon Company	452	489	490	504
EPS from continuing operations attributable to Raytheon Company common stockholders[1]				
Basic	$ 1.12	$ 1.25	$ 1.27	$ 1.32
Diluted	1.11	1.24	1.25	1.30
EPS attributable to Raytheon Company common stockholders[1]				
Basic	1.13	1.24	1.26	1.32
Diluted	1.12	1.23	1.25	1.30
Cash dividends per share				
Declared	0.31	0.31	0.31	0.31
Paid	0.28	0.31	0.31	0.31
Common stock prices				
High	$53.00	$48.34	$48.64	$53.84
Low	33.20	38.00	41.90	45.02
Workdays[2]	61	64	63	61

(1) EPS is computed independently for each of the quarters presented; therefore, the sum of the quarterly earnings per share may not equal the total computed for each year.

(2) Number of workdays per our fiscal calendar, which excludes holidays and weekends.

(3) During the second quarter 2010, RSL was notified by the UK Border Agency that it had been terminated for default on a program. The impact of the adjustment reduced IIS total net sales and operating income by $316 million and $395 million in the second quarter and the six months ended June 27, 2010, respectively.

(4) During the third quarter 2010, we received final approval from the IRS and the U.S. Congressional Joint Committee on Taxation of the Tax Settlement. As a result, we recorded a reduction in our unrecognized tax benefits from continuing and discontinued operations of $280 million, which decreased our tax expense by $259 million, including $170 million from continuing operations and $89 million from discontinued operations. The decrease in tax expense included $56 million related to interest.

(5) During the fourth quarter of 2010, we received proceeds of $1,975 million for the issuance of $2.0 billion fixed rate long-term debt and exercised our call rights to repurchase, at prices based on fixed spreads to U.S. Treasuries, $678 million of our long-term debt due in 2012 and 2013 at a loss of $73 million pretax, $47 million after-tax, which is included in other (income) expense.

(6) During the fourth quarter of 2009, we received proceeds of $496 million for the issuance of $500 million fixed rate long-term debt and exercised our call rights to repurchase, at prices based on fixed spreads to U.S. Treasuries, $474 million of our long-term debt due in 2011 at a loss of $22 million pretax, $14 million after-tax, which is included in other (income) expense.

Note 18: Subsequent Events

We have evaluated subsequent events through the time of filing this Annual Report on Form 10-K with the SEC.

On January 31, 2011, we completed the acquisition of Applied Signal Technology, Inc. (AST), pursuant to a definitive agreement dated December 18, 2010. We paid $38.00 per share of AST for an aggregate purchase price of approximately $500 million, net of cash received. Following the acquisition, AST was renamed Raytheon Applied Signal Technology, Inc. and will be integrated into our SAS segment and is expected to enhance SAS's capabilities across the full spectrum of integrated sensor solutions for classified and other government customers.

ITEM 9. CHANGES IN AND DISAGREEMENTS WITH ACCOUNTANTS ON ACCOUNTING AND FINANCIAL DISCLOSURE

None.

ITEM 9A. CONTROLS AND PROCEDURES

Evaluation of Disclosure Controls and Procedures

Management has conducted an evaluation, under the supervision and with the participation of the Chief Executive Officer and Chief Financial Officer, of the effectiveness of the design and operation of our disclosure controls and procedures (as defined in Rules 13a–15(e) and 15d–15(e) of the Securities Exchange Act of 1934) as of December 31, 2010.

Conclusion of Evaluation—Based on this evaluation, the Chief Executive Officer and Chief Financial Officer concluded that our disclosure controls and procedures as of December 31, 2010 were effective.

Inherent Limitations on Effectiveness of Controls—In designing and evaluating our disclosure controls and procedures, management recognizes that any control, no matter how well designed and operated, can provide only reasonable, not absolute, assurance of achieving the desired control objectives. Due to the inherent limitations in all control systems, no evaluation of controls can provide absolute assurance that misstatements due to error or fraud will not occur or that all control issues and instances of fraud, if any, within the Company have been detected.

Evaluation of Internal Control Over Financial Reporting

Management's Report on Internal Control Over Financial Reporting—Management's Report on Internal Control Over Financial Reporting is set forth in Part II, Item 8 of this Annual Report on Form 10-K.

Attestation Report of the Independent Registered Public Accounting Firm—The effectiveness of our internal control over financial reporting as of December 31, 2010 has been audited by PricewaterhouseCoopers LLP, an independent registered public accounting firm, as stated in their report which is set forth in Part II, Item 8 of this Annual Report on Form 10-K.

Changes in Internal Control Over Financial Reporting—There were no changes in our internal control over financial reporting during the fourth quarter of 2010 that have materially affected or are reasonably likely to materially affect our internal control over financial reporting.

Subsequent to the fourth quarter of 2010, our Technical Services segment migrated to the Company's common Enterprise Resource Planning (ERP) systems.

ITEM 9B. OTHER INFORMATION

None.

PART III

ITEM 10. DIRECTORS, EXECUTIVE OFFICERS AND CORPORATE GOVERNANCE

Information regarding members of our Board of Directors is contained in our definitive proxy statement for the 2011 Annual Meeting of Stockholders under the caption "Election of Directors" and is incorporated herein by reference. Information regarding our executive officers is contained after Part I of this Form 10-K. Information regarding Section 16(a) compliance is contained in our definitive proxy statement under the caption "Section 16(a) Beneficial Ownership Reporting Compliance" and is incorporated herein by reference. Information regarding our Audit Committee and our Audit Committee Financial Expert is contained in our definitive proxy statement under the caption "The Board of Directors and Board Committees" and is incorporated herein by reference.

We have adopted a code of ethics that applies to all of our directors, officers, employees and representatives. Information regarding our code of ethics is contained in our definitive proxy statement for the 2011 Annual Meeting of Stockholders under the caption "Corporate Governance—Code of Ethics and Conflicts of Interest" and is incorporated herein by reference.

No material changes have been made to the procedures by which our stockholders may recommend nominees to our Board of Directors since we described the procedures in our definitive proxy statement for the 2007 Annual Meeting of Stockholders. Information regarding the procedures is contained in our definitive proxy statement for the 2011 Annual Meeting of Stockholders under the caption "Corporate Governance—Director Nomination Process."

ITEM 11. EXECUTIVE COMPENSATION

This information is contained in our definitive proxy statement for the 2011 Annual Meeting of Stockholders under the caption "Executive Compensation," "Director Compensation," and under the caption "The Board of Directors and Board Committees—Compensation Committee Interlocks and Insider Participation" and is incorporated herein by reference.

ITEM 12. SECURITY OWNERSHIP OF CERTAIN BENEFICIAL OWNERS AND MANAGEMENT AND RELATED STOCKHOLDER MATTERS

Information regarding security ownership of certain beneficial owners and for directors and executive officers is contained in our definitive proxy statement for the 2011 Annual Meeting of Stockholders under the caption "Stock Ownership" and is incorporated herein by reference. Information regarding securities authorized for issuance under our executive compensation plans is contained in Part II, Item 5 of this Annual Report on Form 10-K.

ITEM 13. CERTAIN RELATIONSHIPS AND RELATED TRANSACTIONS, AND DIRECTOR INDEPENDENCE

This information is contained in our definitive proxy statement for the 2011 Annual Meeting of Stockholders under the caption "Corporate Governance—Board Independence," "Corporate Governance—Transactions with Related Persons" and under the caption "Stock Ownership—Five Percent Stockholders" and is incorporated herein by reference.

ITEM 14. PRINCIPAL ACCOUNTANT FEES AND SERVICES

This information is contained in our definitive proxy statement for the 2011 Annual Meeting of Stockholders under the caption "Independent Auditors: Audit and Non-Audit Fees" and is incorporated herein by reference.

PART IV

ITEM 15. EXHIBITS AND FINANCIAL STATEMENT SCHEDULES

(a) Financial Statements and Schedules

(1) The following financial statements of Raytheon Company, supplemental information and report of independent registered public accounting firm are included in this Form 10-K:

Consolidated Balance Sheets at December 31, 2010 and 2009

Consolidated Statements of Operations for the Years Ended December 31, 2010, 2009 and 2008

Consolidated Statements of Equity for the Years Ended December 31, 2010, 2009 and 2008

Consolidated Statements of Cash Flows for the Years Ended December 31, 2010, 2009 and 2008

Notes to Consolidated Financial Statements

Five Year Statistical Summary (Unaudited)

Report of PricewaterhouseCoopers LLP dated February 23, 2011 on the Company's financial statements filed as a part hereof for the fiscal years ended December 31, 2010, 2009 and 2008 and on the Company's internal control over financial reporting as of December 31, 2010 is included in Part II, Item 8 of this Annual Report on Form 10-K. The independent registered public accounting firm's consent with respect to this report appears in Exhibit 23 of this Annual Report on Form 10-K.

(2) List of financial statement schedules:

All schedules have been omitted because they are not required, not applicable or the information is otherwise included.

(b) Exhibits:

The following list of exhibits includes exhibits submitted with this Form 10-K as filed with the SEC and those incorporated by reference to other filings.

3.1 Raytheon Company Restated Certificate of Incorporation, restated as of April 2, 2002, filed as an exhibit to the Company's Registration Statement on Form S-3, File No. 333-85648, is hereby incorporated by reference.

3.2 Certificate of Amendment of Restated Certificate of Incorporation of Raytheon Company, amended as of May 5, 2005, filed as an exhibit to the Company's Current Report on Form 8-K filed May 9, 2005, is hereby incorporated by reference.

3.3 Certificate of Amendment of Restated Certificate of Incorporation of Raytheon Company, as amended as of June 2, 2010, filed as an exhibit to the Company's Quarterly Report on Form 10-Q for the quarter ended June 27, 2010, is hereby incorporated by reference.

3.4 Raytheon Company Amended and Restated By-Laws, amended as of July 23, 2008, filed as an exhibit to the Company's Quarterly Report on Form 10-Q for the quarter ended September 28, 2008, is hereby incorporated by reference.

3.5 Raytheon Company Amended and Restated By-Laws, as amended as of May 27, 2010, filed as an exhibit to the Company's Current Report on Form 8-K filed June 2, 2010, is hereby incorporated by reference.

3.6 Raytheon Company Amended and Restated By-Laws, as amended as of September 23, 2010, filed as an exhibit to the Company's Current Report on Form 8-K filed September 27, 2010, is hereby incorporated by reference.

4.1 Indenture relating to Senior Debt Securities dated as of July 3, 1995 between Raytheon Company and The Bank of New York, Trustee, filed as an exhibit to the former Company's Registration Statement on Form S-3, File No. 33-59241, is hereby incorporated by reference.

4.2 Indenture relating to Subordinated Debt Securities dated as of July 3, 1995 between Raytheon Company and The Bank of New York, Trustee, filed as an exhibit to the former Company's Registration Statement on Form S-3, File No. 33-59241, is hereby incorporated by reference.

4.3 Supplemental Indenture dated as of December 17, 1997 between Raytheon Company and The Bank of New York, Trustee, filed as an exhibit to the Company's Annual Report on Form 10-K for the year ended December 31, 1997, is hereby incorporated by reference.

4.4 Second Supplemental Indenture, dated as of May 9, 2001, between Raytheon Company and The Bank of New York, Trustee, filed as an exhibit to the Company's Current Report on Form 8-K filed May 10, 2001, is hereby incorporated by reference.

4.5 Form of Senior Debt Securities, filed as an exhibit to the Company's Registration Statement on Form S-3, File No. 333-58474, is hereby incorporated by reference.

4.6 Form of Subordinated Debt Securities, filed as an exhibit to the Company's Registration Statement on Form S-3, File No. 333- 58474, is hereby incorporated by reference.

4.7 Certificate of Trust of RC Trust I, filed as an exhibit to the Company's Registration Statement on Form S-3, File No. 333-58474, is hereby incorporated by reference.

4.8 Amended and Restated Declaration of Trust of RC Trust I, dated as of May 9, 2001, among Raytheon Company, The Bank of New York as initial Property Trustee, The Bank of New York (Delaware) as initial Delaware Trustee, and the Regular Trustee including the Form of Preferred Security Attached as Exhibit A, filed as an exhibit to the Company's Current Report on Form 8-K filed May 10, 2001, is hereby incorporated by reference.

4.9 Agreement of Resignation, Appointment and Acceptance, dated April 1, 2005, between Raytheon Company and The Bank of New York appointing Successor Trustee, Paying Agent and Registrar in connection with certain securities originally authorized and issued under the Indenture dated as of July 3, 1995, filed as an exhibit to the Company's Quarterly Report on Form 10-Q for the quarter ended March 27, 2005, is hereby incorporated by reference.

4.10 Agreement of Resignation, Appointment and Acceptance, dated April 1, 2005, between Raytheon Company and The Bank of New York appointing Successor Trustee, Paying Agent and Registrar in connection with the 8.25% Equity Security Units originally authorized and issued under the Indenture dated as of July 3, 1995 and the Second Supplemental Indenture dated as of May 9, 2001, filed as an exhibit to the Company's Quarterly Report on Form 10-Q for the quarter ended March 27, 2005, is hereby incorporated by reference.

4.11 Warrant Agreement dated May 10, 2006 between Raytheon Company and American Stock Transfer & Trust Company, as warrant agent, filed as an exhibit to the Company's Current Report on Form 8-K filed June 9, 2006, is hereby incorporated by reference.

4.12 Form of 4.40% Notes due 2020, filed as an exhibit to the Company's Current Report on Form 8-K filed on November 19, 2009, is hereby incorporated by reference.

4.13 Form of 1.625% Notes due 2015, filed as an exhibit to the Company's Current Report on Form 8-K filed October 20, 2010, is hereby incorporated by reference.

4.14 Form of 3.125% Notes due 2020, filed as an exhibit to the Company's Current Report on Form 8-K filed October 20, 2010, is hereby incorporated by reference.

4.15 Form of 4.875% Notes due 2040, filed as an exhibit to the Company's Current Report on Form 8-K filed October 20, 2010, is hereby incorporated by reference.

No other instruments defining the rights of holders of long-term debt are filed since the total amount of securities authorized under any such instrument does not exceed 10% of the total assets of the Company on a consolidated basis. The Company agrees to furnish a copy of such instruments to the SEC upon request.

10.1 Raytheon Company 1991 Stock Plan, as amended on September 21, 2005, filed as an exhibit to the Company's Quarterly Report on Form 10-Q for the quarter ended September 25, 2005, is hereby incorporated by reference.

10.2 Raytheon Company 1995 Stock Option Plan, as amended on September 21, 2005, filed as an exhibit to the Company's Quarterly Report on Form 10-Q for the quarter ended September 25, 2005, is hereby incorporated by reference.

10.3 Raytheon Company 2001 Stock Plan, as amended on September 21, 2005, filed as an exhibit to the Company's Quarterly Report on Form 10-Q for the quarter ended September 25, 2005, is hereby incorporated by reference.

10.4 Raytheon 2010 Stock Plan, filed as Appendix B to the Company's definitive proxy statement filed on April 26, 2010, is hereby incorporated by reference.

10.5 Amendment No. 1 to Raytheon 2010 Stock Plan, filed as an exhibit to the Company's Quarterly Report on Form 10-Q for the quarter ended September 26, 2010, is hereby incorporated by reference.

10.6 Plan for Granting Stock Options in Substitution for Stock Options Granted by Texas Instruments Incorporated, filed as an exhibit to the Company's Registration Statement on Form S-8, File No. 333-45629, is hereby incorporated by reference.

10.7 Plan for Granting Stock Options in Substitution for Stock Options Granted by Hughes Electronics Corporation, filed as an exhibit to the Company's Registration Statement on Form S-8, File No. 333-45629, is hereby incorporated by reference.

10.8 Raytheon Company 1997 Nonemployee Directors Restricted Stock Plan, as amended on September 21, 2005, filed as an exhibit to the Company's Quarterly Report on Form 10-Q for the quarter ended September 25, 2005, is hereby incorporated by reference.

10.9 Raytheon Company Deferral Plan for Directors, filed as an exhibit to the former Company's Registration Statement on Form S-8, File No. 333-22969, is hereby incorporated by reference.

10.10 Raytheon Company Excess Savings Plan, filed as an exhibit to the Company's Registration Statement on Form S-8, File No. 333-56117, as amended by Post-Effective Amendment No. 1, File No. 333-52536, is hereby incorporated by reference.

10.11 Raytheon Company Excess Pension Plan, filed as an exhibit to the Company's Annual Report on Form 10-K for the year ended on December 31, 2004, is hereby incorporated by reference.

10.12 Raytheon Company Supplemental Executive Retirement Plan, filed as an exhibit to the Company's Annual Report on Form 10-K for the year ended December 31, 2004, is hereby incorporated by reference.

10.13 Raytheon Company Deferred Compensation Plan, as amended and restated effective as of January 1, 2009, filed as an exhibit to the Company's Annual Report on Form 10-K for the year ended December 31, 2008, is hereby incorporated by reference.

10.14 Form of Nonqualified Stock Option Agreement under the Raytheon Company 1995 Stock Option Plan, filed as an exhibit to the Company's Quarterly Report on Form 10-Q for the quarter ended September 26, 2004, is hereby incorporated by reference.

10.15 Form of Incentive Stock Option Agreement under the Raytheon Company 1995 Stock Option Plan, filed as an exhibit to the Company's Quarterly Report on Form 10-Q for the quarter ended September 26, 2004, is hereby incorporated by reference.

10.16 Form of Incentive Stock Option Agreement under the Raytheon Company 2001 Stock Plan, filed as an exhibit to the Company's Quarterly Report on Form 10-Q for the quarter ended September 26, 2004, is hereby incorporated by reference.

10.17 Form of Nonqualified Stock Option Agreement under the Raytheon Company 2001 Stock Plan, filed as an exhibit to the Company's Quarterly Report on Form 10-Q for the quarter ended September 26, 2004, is hereby incorporated by reference.

10.18 Form of Restricted Stock Agreement under the Raytheon 2011 Stock Plan, filed as an exhibit to the Company's Quarterly Report on Form 10-Q for the quarter ended September 26, 2010, is hereby incorporated by reference.

10.19 Form of Restricted Stock Unit Agreement under the Raytheon 2011 Stock Plan, filed as an exhibit to the Company's Quarterly Report on Form 10-Q for the quarter ended September 26, 2010, is hereby incorporated by reference.

10.20 Form of Performance Stock Unit Award Agreement under the Raytheon 2011 Stock Plan, filed as an exhibit to the Company's Quarterly Report on Form 10-Q for the quarter ended September 26, 2010, is hereby incorporated by reference.

10.21 Form of Restricted Stock Unit Agreement for U.K. employees under the Raytheon 2011 Stock Plan, filed as an exhibit to the Company's Quarterly Report on Form 10-Q for the quarter ended September 26, 2010, is hereby incorporated by reference.

10.22 Form of Restricted Stock Award Agreement under the 1997 Nonemployee Directors Restricted Stock Plan, filed as an exhibit to the Company's Current Report on Form 8-K filed May 9, 2005, is hereby incorporated by reference.

10.23 Form of Stock Award Agreement under the 1997 Nonemployee Directors Restricted Stock Plan, filed as an exhibit to the Company's Quarterly Report on Form 10-Q for the quarter ended June 29, 2008, is hereby incorporated by reference.

10.24 Form of Change in Control Severance Agreement between the Company and certain executive officers (providing for benefits in the event of a qualified termination upon a change in control of three times base salary and bonus), filed as an exhibit to the Company's Annual Report on Form 10-K for the year ended December 31, 2009, is hereby incorporated by reference.

10.25 Form of Change in Control Severance Agreement between the Company and certain executive officers (providing for benefits in the event of a qualified termination upon a change in control of two times base salary and bonus), filed as an exhibit to the Company's Annual Report on Form 10-K for the year ended December 31, 2009, is hereby incorporated by reference.

10.26 Form of Amendment to Change in Control Severance Agreement between the Company and its executive officers, filed as an exhibit to the Company's Annual Report on Form 10-K for the year ended December 31, 2009, is hereby incorporated by reference.

10.27 Summary of Executive Severance and Change in Control Guidelines, filed as an exhibit to the Company's Annual Report on Form 10-K for the year ended December 31, 2009, is hereby incorporated by reference.

10.28 Letter Agreement between Raytheon Company and William H. Swanson, filed as an exhibit to the Company's Current Report on Form 8-K filed April 24, 2003, is hereby incorporated by reference.

10.29 Employment Agreement between Raytheon Company and Keith J. Peden, filed as an exhibit to the Company's Annual Report on Form 10-K for the year ended December 31, 2001, is hereby incorporated by reference.

10.30 Amendment dated February 5, 2010 to Employee Agreement between Raytheon Company and Keith J. Peden, filed as an exhibit to the Company's Annual Report on Form 10-K for the year ended December 31, 2009, is hereby incorporated by reference.

10.31 Employment Agreement between Raytheon Company and Thomas M. Culligan, filed as an exhibit to the Company's Annual Report on Form 10-K for the year ended December 31, 2002, is hereby incorporated by reference.

10.32 Employment Agreement between Raytheon Company and Jay B. Stephens, filed as an exhibit to the Company's Annual Report on Form 10-K for the year ended December 31, 2002, is hereby incorporated by reference.

10.33 Amendment dated November 18, 2002 to Employment Agreement between Raytheon Company and Jay B. Stephens, filed as an exhibit to the Company's Annual Report on Form 10-K for the year ended December 31, 2004, is hereby incorporated by reference.

10.34 Amendment to Employment Agreement between Raytheon Company and Jay B. Stephens, filed as an exhibit to Raytheon's Quarterly Report on Form 10-Q for the quarter ended September 28, 2003, is hereby incorporated by reference.

10.35 Letter Agreement dated March 4, 2005 between Raytheon Company and Pamela A. Wickham, filed as an exhibit to the Company's Current Report on Form 8-K filed March 25, 2005, is hereby incorporated by reference.

10.36 Summary of Executive Perquisites Policy, filed as an exhibit to the Company's Annual Report on Form 10-K for the year ended December 31, 2005, is hereby incorporated by reference.

10.37 Summary of Key Employee Permanent Domestic Relocation Policy, filed as an exhibit to the Company's Annual Report on Form 10-K for the year ended December 31, 2009, is hereby incorporated by reference.

10.38 Summary of Non-Employee Director Compensation, filed as an exhibit to the Company's Current Report on Form 8-K filed November 1, 2005, is hereby incorporated by reference.

10.39 $2.2 Billion Five-Year Competitive Advance and Revolving Credit Facility dated as of March 24, 2005 among Raytheon Company, as the Borrower, the lenders named therein, Bank of America, N.A., as Syndication Agent, Citicorp USA, Inc. and Credit Suisse First Boston, as Documentation Agents, and JPMorgan Chase Bank, N.A., as Administrative Agent, filed as an exhibit to the Company's Current Report on Form 8-K filed March 29, 2005, is hereby incorporated by reference.

10.40 Guarantee Agreement, dated as of May 9, 2001, between Raytheon Company and The Bank of New York as initial Guarantee Trustee, filed as an exhibit to the Company's Current Report on Form 8-K filed May 10, 2001, is hereby incorporated by reference.

10.41 Settlement Agreement between Raytheon Company, Raytheon Engineers and Constructors International, Inc. and Washington Group International, Inc. dated January 23, 2002, filed as an exhibit to the Company's Annual Report on Form 10-K for the year ended December 31, 2002, is hereby incorporated by reference.

10.42 Fifth Amended and Restated Purchase and Sale Agreement between General Aviation Receivables Corporation, Raytheon Aircraft Receivables Corporation, Raytheon Aircraft Credit Corporation, Receivables Capital Corporation and Bank of America, N.A., dated September 1, 2003, filed as an exhibit to the Company's Annual Report on Form 10-K for the year ended December 31, 2003, is hereby incorporated by reference.

10.43 Letter Agreement dated February 21, 2006 between Raytheon Company and David C. Wajsgras, filed as an exhibit to the Company's Current Report on Form 8-K filed February 28, 2006, is hereby incorporated by reference.

10.44 Letter Agreement dated March 2, 2006 between Raytheon Company and Taylor W. Lawrence, filed as an exhibit to the Company's Current Report on Form 8-K filed March 6, 2006, is hereby incorporated by reference.

10.45 Summary of the Long-Term Performance Plan dated January 24, 2006, filed as an exhibit to the Company's Current Report on Form 8-K filed May 9, 2006, is hereby incorporated by reference.

10.46 Form of Raytheon Company Performance Share Award Agreement under the Long-Term Performance Plan, filed as an exhibit to the Company's Current Report on Form 8-K filed May 9, 2006, is hereby incorporated by reference.

10.47 Summary of the Raytheon Company Results-Based Incentive Program, filed as an exhibit to the Company's Current Report on Form 8-K filed December 14, 2006, is hereby incorporated by reference.

10.48 Summary of the Raytheon Company Long-Term Performance Plan, filed as an exhibit to the Company's Current Report on Form 8-K filed December 14, 2006, is hereby incorporated by reference.

10.49 Stock Purchase Agreement by and among, Hawker Beechcraft Corporation, Greenbulb Limited, Raytheon Company, Raytheon Aircraft Holdings, Inc. and Raytheon Aircraft Services Limited dated as of December 20, 2006, filed as an exhibit to the Company's Current Report on Form 8-K filed December 22, 2006, is hereby incorporated by reference.

10.50 Form of Performance Share Award with respect to the Long-Term Performance Plan, filed as an exhibit to the Company's Quarterly Report on Form 10-Q for the quarter ended March 25, 2007, is hereby incorporated by reference.

10.51 Form of Indemnification Agreement between the Company and each of its directors and executive officers, filed as an exhibit to the Company's Quarterly Report on Form 10-Q for the quarter ended September 23, 2007, is hereby incorporated by reference.

10.52 Three-Year Competitive Advance and Revolving Credit Facility by and among Raytheon Company, as the Borrower, Raytheon United Kingdom Limited, as the UK Borrower, the Lenders named therein, and the Syndication Agent, Documentation Agents and Administrative Agent named therein, dated as of November 18, 2009, filed as an exhibit to the Company's Current Report on Form 8-K filed November 24, 2009, is hereby incorporated by reference.

10.53 Two-Year and One-Day Competitive Advance and Revolving Credit Agreement by and among Raytheon Company, as the Borrower, the Lenders named therein, and the Syndication Agent, Documentation Agents and Administrative Agent named therein, dated as of November 17, 2010, filed as an exhibit to the Company's Current Report on Form 8-K filed November 23, 2010, is hereby incorporated by reference.

10.54 Form of Clawback Policy Acknowledgement, filed as an exhibit to the Company's Annual Report on Form 10-K for the year ended December 31, 2009, is hereby incorporated by reference.

10.55 Separation Agreement dated August 3, 2010 between Raytheon Company and Daniel L. Smith, filed as an exhibit to the Company's Quarterly Report on Form 10-Q for the quarter ended September 26, 2010, is hereby incorporated by reference.

12 Statement regarding Computation of Ratio of Earnings to Fixed Charges for the year ended December 31, 2010.*

21 Subsidiaries of Raytheon Company.*

23 Consent of Independent Registered Public Accounting Firm.*

31.1 Certification of William H. Swanson pursuant to Section 302 of the Sarbanes-Oxley Act of 2002.*

31.2 Certification of David C. Wajsgras pursuant to Section 302 of the Sarbanes-Oxley Act of 2002.*

32.1 Certificate of William H. Swanson pursuant to 18 U.S.C. Section 1350, as Adopted Pursuant to Section 906 of the Sarbanes-Oxley Act of 2002.**

32.2 Certificate of David C. Wajsgras pursuant to 18 U.S.C. Section 1350, as Adopted Pursuant to Section 906 of the Sarbanes-Oxley Act of 2002.**

101 The following materials from Raytheon Company's Annual Report on Form 10-K for the year ended December 31, 2010, formatted in XBRL (Extensible Business Reporting Language): (i) the Consolidated Balance Sheets, (ii) Consolidated Statements of Operations, (iii) Consolidated Statements of Equity, (iv) Consolidated Statements of Cash Flows, and (v) Notes to Consolidated Financial Statements.**

(Exhibits marked with an asterisk (*) are filed electronically herewith.)

(Exhibits marked with two asterisks (**) are deemed to be furnished and not filed.)

SIGNATURES

Pursuant to the requirements of Section 13 or 15(d) of the Securities Exchange Act of 1934, the Registrant has duly caused this report to be signed on its behalf by the undersigned, thereunto duly authorized.

RAYTHEON COMPANY

/s/ Michael J. Wood

Michael J. Wood
Vice President and Chief
Accounting Officer

Dated: February 23, 2011

Pursuant to the requirements of the Securities Exchange Act of 1934, this report has been signed below by the following persons on behalf of the Registrant and in the capacities and on the dates indicated.

SIGNATURES	TITLE	DATE
/s/ William H. Swanson William H. Swanson	Chairman and Chief Executive Officer (Principal Executive Officer)	February 23, 2011
/s/ David C. Wajsgras David C. Wajsgras	Senior Vice President and Chief Financial Officer (Principal Financial Officer)	February 23, 2011
/s/ Michael J. Wood Michael J. Wood	Vice President and Chief Accounting Officer (Principal Accounting Officer)	February 23, 2011
/s/ Vernon E. Clark Vernon E. Clark	Director	February 23, 2011
/s/ John M. Deutch John M. Deutch	Director	February 23, 2011
/s/ Stephen J. Hadley Stephen J. Hadley	Director	February 23, 2011
/s/ Frederic M. Poses Frederic M. Poses	Director	February 23, 2011
/s/ Michael C. Ruettgers Michael C. Ruettgers	Director	February 23, 2011
/s/ Ronald L. Skates Ronald L. Skates	Director	February 23, 2011
/s/ William R. Spivey William R. Spivey	Director	February 23, 2011
/s/ Linda G. Stuntz Linda G. Stuntz	Director	February 23, 2011

INVESTOR INFORMATION

GLOBAL HEADQUARTERS

Raytheon Company
870 Winter Street
Waltham, MA 02451
781.522.3000

COMMON STOCK SYMBOL

Raytheon Company common stock is listed on the New York Stock Exchange. The ticker symbol is RTN.

ANNUAL MEETING

The 2011 Annual Meeting of Stockholders will be held on Thursday, May 26, 2011, at 11:00 a.m.

The Ritz-Carlton, Pentagon City
1250 South Hayes Street
Arlington, VA 22202
703.415.5000

STOCK TRANSFER AGENT, REGISTRAR AND DIVIDEND DISBURSING AGENT

American Stock Transfer & Trust Company is Raytheon's transfer agent and registrar and maintains the company's stockholder records. Inquiries concerning dividend payments, name and address changes, lost stock certificate replacement, stock ownership transfers and Form 1099 questions should be directed to: Raytheon Company, c/o American Stock Transfer & Trust Company, 6201 15th Avenue, Brooklyn, NY 11219, at 800.360.4519.

DIVIDEND DISTRIBUTION/DIRECT DIVIDEND DEPOSIT

Common stock dividends are payable quarterly upon authorization of the Board of Directors, normally at the end of January, April, July and October. Direct Dividend Deposit (via ACH) is available to Raytheon stockholders. For enrollment information, call American Stock Transfer & Trust at 800.360.4519.

DIVIDEND REINVESTMENT

Raytheon Company has a Dividend Reinvestment Plan administered by American Stock Transfer & Trust Company. This plan gives stockholders the option of having their cash payments applied to the purchase of additional shares. For enrollment information about this plan, call 800.360.4519.

INVESTOR RELATIONS

Security analysts, shareholders and investment professionals with other inquiries regarding Raytheon Company should contact: Todd Ernst, vice president, Investor Relations, Raytheon Company, 870 Winter Street, Waltham, MA 02451, at 877.786.7070.

MEDIA RELATIONS

Members of the news media requesting information about Raytheon should contact: Jonathan Kasle, director, Media Relations, Raytheon Company, 870 Winter Street, Waltham, MA 02451, at 781.522.5110.

WEBSITE

Raytheon's website offers financial information and facts about the company, its products and services.

We periodically add additional news and information. Raytheon's website address is http://www.raytheon.com.

We make our website content available for informational purposes only. It should not be relied upon for investment purposes, nor is it incorporated by reference into this annual report.

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Raytheon is an equal opportunity employer.

COPIES OF REPORTS

Copies of the company's annual reports, latest SEC filings, quarterly earnings reports and other information may be requested through the company's website at http://www.raytheon.com or by calling 877.786.7070 (Option 1).

RETURN ON INVESTED CAPITAL CALCULATION (ROIC)

Dollars in millions	2010	2009	2008	2007	2006
Income from cont. ops.	$ 1,843	$ 1,977	$ 1,698	$ 1,719	$ 1,209
Adjustments:					
FAS/CAS pension adj., after-tax[1]	150	(18)	80	168	235
UK Border Agency program adj., after-tax[2]	284	–	–	–	–
Tax settlements	(170)	–	–	(219)	–
Early debt retirement make-whole charges, after-tax[1]	47	14	–	38	–
Unfavorable impact of pension returns on existing contracts, after-tax[1]	–	–	45	–	–
Subtotal	2,154	1,973	1,823	1,706	1,444
Net interest expense, after-tax[1]	72	71	42	21	128
Lease expense, after-tax[1]	67	66	66	63	63
Return	$ 2,293	$ 2,110	$ 1,931	$ 1,790	$ 1,635
Net debt[3]	$ (171)	$ (132)	$ (169)	$ 559	$ 2,367
Equity less invest. in disc. ops.	9,944	9,560	10,920	11,162	9,456
Lease exp. x 8 plus fin. guarantees	2,890	2,815	2,728	2,656	2,619
Pension liability, net of tax	3,049	3,612	2,650	1,844	1,762
Invested cap. from cont. ops.[4]	$15,712	$15,855	$16,129	$16,221	$16,204
ROIC	14.6%	13.3%	12.0%	11.0%	10.1%

[1] Calculated using the federal statutory tax rate of 35%
[2] Calculated using the UK statutory tax rate that was in effect in the second quarter of 28%
[3] Net debt is defined as total debt less cash and cash equivalents and is calculated using a 2 point average
[4] Calculated using a 2 point average

We define ROIC as income from continuing operations excluding the after-tax effect of the FAS/CAS Pension Adjustment and, from time to time, certain other items as set forth above in the calculation, plus after-tax net interest expense plus one-third of operating lease expense after-tax (estimate of interest portion of operating lease expense) divided by average invested capital after capitalizing operating leases (operating lease expense times a multiplier of 8), adding financial guarantees less net investment in Discontinued Operations, and adding back the liability for defined benefit pension plans, net of tax.

ADJUSTED EARNING PER SHARE (EPS) RECONCILIATION

	2010	2009	2008	2007	2006
Diluted EPS from cont. ops.	$ 4.79	$ 4.89	$ 3.93	$ 3.78	$ 2.62
FAS/CAS pension adj., after-tax[1]	0.40	(0.04)	0.19	0.37	0.52
UK Border Agency program adj., after-tax[2]	0.75	–	–	–	–
Tax settlements	(0.45)	–	–	(0.49)	–
Early debt retirement make-whole charges, after-tax[1]	0.13	0.04	–	0.08	–
Acceleration of deferred gains related to terminated interest rate swaps on retired debt, after tax[1]	(0.03)	(0.01)	–	–	–
Unfavorable impact of pension returns on existing contracts, after-tax[1]	–	–	0.11	–	–
Adjusted EPS	$ 5.58	$ 4.87	$ 4.22	$ 3.75	$ 3.13

[1] Calculated using the federal statutory tax rate of 35%
[2] Calculated using the UK statutory tax rate that was in effect in the second quarter of 28%

We define Adjusted EPS as diluted EPS from continuing operations attributable to Raytheon Company common stockholders excluding the EPS impact of the FAS/CAS Pension Adjustment and, from time to time, certain other items as set forth above in the reconciliation. Amounts may not recalculate due to rounding.

ADJUSTED INCOME RECONCILIATION

Dollars in millions	2010	2009	2008	2007	2006
Income from cont. ops. attributable to Raytheon Company common stockholders	$ 1,804	$ 1,936	$ 1,674	$ 1,693	$ 1,187
FAS/CAS pension adj., after-tax[1]	150	(18)	80	168	235
UK Border Agency program adj., after-tax[2]	284	–	–	–	–
Tax settlements	(170)	–	–	(219)	–
Early debt retirement make-whole charges, after-tax[1]	47	14	–	38	–
Acceleration of deferred gains related to terminated interest rate swaps on retired debt, after tax[1]	(10)	(4)	–	–	–
Unfavorable impact of pension returns on existing contracts, after-tax[1]	–	–	45	–	–
Adjusted income	$ 2,105	$ 1,928	$ 1,799	$ 1,680	$ 1,422

[1] Calculated using the federal statutory tax rate of 35%
[2] Calculated using the UK statutory tax rate that was in effect in the second quarter of 28%

We define Adjusted Income as income from continuing operations attributable to Raytheon Company common stockholders excluding the impact of the FAS/CAS Pension Adjustment and, from time to time, certain other items as set forth above in the reconciliation.

ROIC, Adjusted EPS and Adjusted Income are not measures of financial performance under generally accepted accounting principles (GAAP) and may not be defined and calculated by other companies in the same manner. The Company uses ROIC as a measure of the efficiency and effectiveness of its use of capital and as an element of management compensation. ROIC, Adjusted EPS and Adjusted Income should be considered supplemental to and not a substitute for financial information prepared in accordance with GAAP. We are providing these measures because management uses them for the purposes of evaluating and forecasting the Company's financial performance and believes that they provide additional insights into the Company's underlying business performance. We also believe that they allow investors to benefit from being able to assess our operating performance in the context of how our principal customer, the U.S. Government, allows us to recover pension costs and to better compare our operating performance to others in the industry on that same basis.

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BOARD OF DIRECTORS

WILLIAM H. SWANSON
Chairman and Chief Executive Officer
Raytheon Company

VERNON E. CLARK
Admiral
Chief of Naval Operations
U.S. Navy (Ret.)

JOHN M. DEUTCH
Institute Professor
Massachusetts Institute of Technology

STEPHEN J. HADLEY
Principal
The RiceHadley Group, LLC

FREDERIC M. POSES
Retired Chairman and
Chief Executive Officer
Trane, Inc.

MICHAEL C. RUETTGERS*
Retired Chairman and
Chief Executive Officer
EMC Corporation

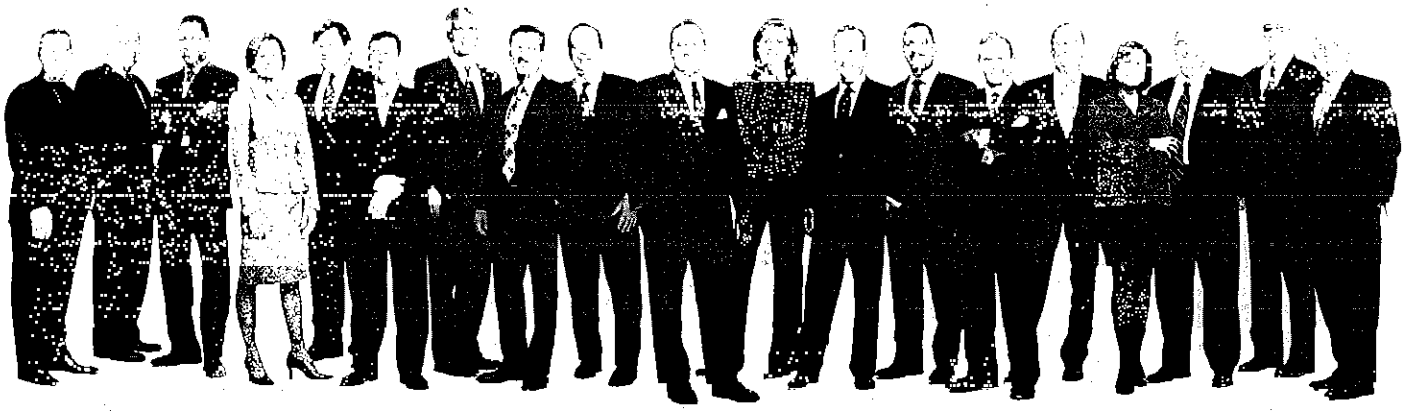
RONALD L. SKATES
Retired President and
Chief Executive Officer
Data General Corporation

WILLIAM R. SPIVEY
Retired President and
Chief Executive Officer
Luminent, Inc.

LINDA G. STUNTZ
Partner
Stuntz, Davis & Staffier, P.C.

*Lead Director

LEADERSHIP TEAM



FROM LEFT TO RIGHT: *C. Schottlaender, D. Smith, J. Harris, L. Dugle, K. Peden, D. Wajsgras, D. Crowley, T. Lawrence, T. Culligan, W. Swanson, P. Wickham, T. Kennedy, D. Wilkins, J. Stephens, R. Yuse, R. Rhoads, M. Russell, M. Hoeffler, L. Harrington*

WILLIAM H. SWANSON
Chairman and Chief Executive Officer
Raytheon Company

DANIEL J. CROWLEY
President
Network Centric Systems

THOMAS M. CULLIGAN
Senior Vice President
Business Development, RII
Raytheon Company

LYNN A. DUGLE
President
Intelligence and Information Systems

LAWRENCE J. HARRINGTON
Vice President
Internal Audit
Raytheon Company

JOHN D. HARRIS II
President
Technical Services

MICHAEL M. HOEFFLER
Vice President
Raytheon Company
Evaluation Team

JON C. JONES**
President
Space and Airborne Systems

THOMAS A. KENNEDY, PH.D.
President
Integrated Defense Systems

TAYLOR W. LAWRENCE, PH.D.
President
Missile Systems

KEITH J. PEDEN
Senior Vice President
Human Resources
Raytheon Company

REBECCA R. RHOADS
Vice President and
Chief Information Officer
Raytheon Company

MARK E. RUSSELL
Vice President
Engineering, Technology and
Mission Assurance
Raytheon Company

COLIN J.R. SCHOTTLAENDER*
President
Network Centric Systems

DANIEL L. SMITH*
President
Integrated Defense Systems

JAY B. STEPHENS
Senior Vice President
General Counsel and Secretary
Raytheon Company

DAVID C. WAJSGRAS
Senior Vice President and
Chief Financial Officer
Raytheon Company

PAMELA A. WICKHAM
Vice President
Corporate Affairs and Communications
Raytheon Company

M. DAVID WILKINS
Vice President
Contracts and Supply Chain
Raytheon Company

RICHARD R. YUSE
President
Space and Airborne Systems

* Retired in 2010

**On March 6, 2010 we were all saddened to hear of the sudden passing of Jon Jones, a Raytheon vice president who served as president of our Space and Airborne Systems business. Jon was a valued contributor to Raytheon for 33 years, and an outstanding leader within our company, industry and community.

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APPENDIX D. RAYTHEON MASTER SUBCONTRACTING PLAN

Master Subcontracting Plan for utilization of small, small disadvantaged, women owned small, veteran small and service disabled veteran owned small businesses, hub zone certified small businesses and historically black colleges / universities and minority institutions in government contracts and subcontracts (Except Department of Defense contracts and subcontracts)

This plan is prepared in accordance with Section 834 of Public Law 101-189 and is pursuant to Federal Acquisition Regulations (FAR) Subpart 19.7 and 52.219.9

Effective 1 October 2010 through 30 September 2013

Master Subcontracting Plan Administrator:

9/29/10

Benita Fortner — Date
Corporate Liaison Officer
Raytheon Supplier Diversity

Location: 870 Winter Street
Waltham, MA 02451

Telephone: 781.522.6337
bfortner@raytheon.com

The signature of the following authorized cognizant government representative evidences approval of this master subcontracting plan:

E. Ann Haase 9·30·10

E. Ann Haase — Date
Assistant Chief
Procurement Operations, GOES R/
Small Business Specialist
NASAs Goddard Space Flight Center

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RAYTHEON COMPANY
MASTER SUBCONTRACTING PLAN
For utilization of Small, Small Disadvantaged, Women-Owned Small Business, Veteran Owned Small Business, Service Disabled Veteran Owned Small Business, HUB Zone Certified Small Businesses and the utilization of Historically Black Colleges and Minority Institutions.

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I INTRODUCTION

The Chairman and Chief Executive Officer of Raytheon, has committed the Company's resources to further the government policy that Small Business (SB); Small Business Owned and Operated by Socially and Economically Disadvantaged Individuals (SDB); Historically Black Colleges and Universities (HBCU) and Minority Institutions (MI), Small Business Owned and Operated by Women (WOSB), Veteran Owned Small Business (VOSB), Service Disabled Veteran Owned Small Business (SDVOSB), and HUB Zone Certified Small Businesses (SBHZ) shall have the maximum practicable opportunity to compete for subcontract awards consistent with the efficient performance of all contracts.

II OVERVIEW

Company Overview

Raytheon is the fourth largest U.S. military contractor with over $25 billion dollars in annual sales. Raytheon is organized around six companies:

Raytheon Integrated Defense Systems

Raytheon Intelligence and Information Systems

Raytheon Missile Systems

Raytheon Network Centric Systems

Raytheon Space and Airborne Systems

Raytheon Technical Services

Raytheon has locations throughout the United States with primary facilities in Arizona, California, Colorado, Florida, Indiana, Maryland, Massachusetts, Texas and Virginia. Purchasing and supplier diversity personnel are located in each of these operating facilities and in the Corporate Headquarters located in Waltham Massachusetts

See Exhibit 1. Raytheon Company Organization Chart

Supplier Diversity Overview

This Master Subcontracting Plan defines how Raytheon will focus its resources and provide support to increase the quantity and quality of participation by SB, SDB, WOSBs, VOSB, SDVOSB, SBHZ, and HBCU/MIs in subcontracting opportunities. Goals will be established for each of these business categories for use in individual government and civilian agency contracts that meet the requirements for the implementation of an individual small business subcontracting plan. (Except contracts in support of the Department of Defense)

Management Commitment

Raytheon's Vice President of Contracts and Supply Chain, Mr. David Wilkins, serves as the Company's Supplier Diversity Executive and Chairs Raytheon's Supplier Diversity Council. Mr. Wilkins leads the company-wide supplier diversity efforts through the Supply Chain Leadership Team which is comprised of the vice presidents of supply chain for each of Raytheon's six businesses. These supply chain leaders serve as the Supplier Diversity Executive for their respective organizations and collectively make up the Raytheon Supplier Diversity Council.

See Exhibit 2, Raytheon Supply Chain Management Organization Chart.

The Supplier Diversity Executive has also designated the Director of Raytheon Supplier Diversity to serve as the Company Liaison Officer (CLO) for matters involving the utilization of small businesses in government contracts. The (CLO) leads a network of supplier diversity professionals in implementing Company Policy relative to the government's small business requirements and associated socioeconomic programs. The CLO serves on Raytheon Supplier Diversity Council, and serves as the Small Business Subcontracting Plan Administrator. A supplier diversity leader (Supplier Diversity Business Leader SDBL – SDBL) for each Raytheon business has been designated by the respective vice president of supply chain to assist Raytheon's

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Supplier Diversity Director in developing and implementing strategies to assure consistency and compliance with Raytheon's policies and procedures supporting the utilization of small businesses throughout Raytheon.

See Exhibit 3, Raytheon Supplier Diversity Organization Chart

The SDBLs serve as the Small Business Liaison Officers (SBLOs) for their respective businesses and have responsibility, through a network of Supplier Diversity Advocates (SDAs), for supplier diversity management and compliance within in the businesses. Supplier Diversity Advocates are assigned to major supply chain operations and together with the SDBLs concentrate on maximizing business opportunities for SB, SDB, WOSB, and SBHZ, VOSB, SDVOSB, and HBCU/MIs within their respective organizations. This support is provided by identifying and counseling small businesses through participation in procurement conference, seminars, other outreach events and investigating referrals made by government agencies. SDBLs also arrange for and provide counseling and assistance in engineering, quality, financial matters, procurement, and production management related issues to small business concerns.

Strategic procurement process

Supplier Diversity is addressed throughout the supply chain management process. Each supply chain management organization maintains a strategic sourcing process that includes source selection, cost evaluations and reduction measurements and alternate source development decisions. This process includes consideration for the participation of small business concerns, consistent with government contracting requirements and sound business practices, in the competition for procurement opportunities. Raytheon's strategic commodity management team (SCMT) managers serve as the supplier diversity advocate (SDA) for their respective commodities. These managers assure supplier diversity strategies are addressed and government regulations have been adhered to in developing procurement recommendations. In addition supplier diversity advocates from individual businesses are periodically assigned to strategic agreement and major procurement teams as a resource for identifying SB, SDB, WOSB, and SBHZ, VOSB, SDVOSB, and HBCU/MIs. SDAs from the businesses also use this forum to provide training and continuing education relative to supplier diversity issues.

Past Performance

Raytheon, through its legacy companies, has a history of supplier diversity success through the identification and creation of opportunities for all categories of small businesses. Best practices are continuously identified and implemented to keep Raytheon at the forefront of supplier diversity. A brief example of previous program success is listed below.

See Exhibit 4. Past Performance by Organization

- Multiple operating sites met or exceeded the 5% SDB goals
- Multiple operating sites met or exceeded government and civilian agency small business goals
- Recognition by local DCMA Organizations and other federal agencies for outstanding or exceptional accomplishments in supplier diversity and small business utilization
- Recipient of multiple NUNN-PERRY Mentor-Protégé Awards
- Department of Defense, OSDBU Director's Mentor-Protégé Award
- Successful nomination of multiple U.S. SBA Subcontractor of the Year Award Winners
- Recipient of Dwight D. Eisenhower Awards, in services and in manufacturing categories
- Raytheon named in the top 10 of Diversity Business. Com best companies for supplier diversity for the last three years
- Raytheon named Corporate Citizen of the year or Corporate Advocate of the year by the National Center for American Indian Enterprise Development for the last three years

Raytheon
Past Performance in the traditional Small Business Categories

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2007	SDB		WOSB		SB		HBCU/MI		LB		TB
RC TOTAL	$227,091,666	4.70%	$211,294,336	4.30%	$1,815,495,861	37.30%	$1,573,278	1.20%	$3,047,290,384	62.67%	$4,862,785,425
	Veteran		SDVE		HUBZONE		NonProfit				
	$205,443,818	4.20%	$32,354,417	0.66%	$58,646,691	1.20%	$25,767,694				
2008	SDB		WOSB		SB		HBCU/MI		LB		TB
RC TOTAL	$444,736,031	6.70%	$256,165,107	3.80%	$2,311,567,980	34.60%	$862,213	0.10%	$4,368,210,803	65.39%	$6,679,778,783
	Veteran		SDVE		HUBZONE		NonProfit				
	$374,009,873	5.60%	$118,608,334	1.80%	$62,953,125	0.90%	$41,182,110				
2009	SDB		WOSB		SB		HBCU/MI		LB		TB
RC TOTAL	$419,692,080	6.37%	$291,133,068	4.42%	$2,224,225,128	33.75%	$1,179,887	0.02%	$4,366,657,696	66.25%	$6,590,882,824
	Veteran		SDVE		HUBZONE		NonProfit				
	$373,194,446	5.66%	$131,269,349	1.99%	$60,844,025	0.92%	$35,196,092				
2010 (Q3)	SDB		WOSB		SB		HBCU/MI		LB		TB
RC TOTAL	$364,555,051	7.33%	$256,624,338	5.16%	$1,899,831,183	38.19%	$393,570		$3,075,021,903	61.81%	$4,974,853,086
	Veteran		SDVE		HUBZONE		NonProfit				
	$358,716,755	7.21%	$140,899,606	2.83%	$77,344,743	1.55%	$33,871,924				
2011 Projected	SDB		WOSB		SB		HBCU/MI		LB		TB
RC TOTAL	$323,446,876	5.39%	$217,488,26[illegible]	[illegible]	$1,821,417,678	30.36%	$390,544		$4,174,841,483	69.62%	$5,996,259,161
	Veteran		SDVE		HUBZONE		NonProfit				
	$236,239,741	3.94%	$65,658,589	1.09%	$62,917,701	1.05%	$35,103,283				

III COMPANY POLICY

It is the policy of Raytheon Company to comply with Public Law 100-180 and Section 8(d) of the Small Business Act and federal acquisition regulations in establishing Companywide goals. Written policies and procedures and purchase order terms and conditions support Raytheon's commitment to supplier diversity and the utilization of small businesses, small disadvantaged businesses, women owned small businesses, veteran owned small businesses, service disabled veteran owned businesses, HUB Zone certified small businesses, and historically black colleges and universities, and minority institutions to the maximum practicable opportunity in subcontracts in support of government and civilian agency contracts. This Master Subcontracting Plan provides functional directives for consistency and compliance with public laws and federal acquisition regulations in supply chain operations throughout Raytheon.

IV COMPANY-WIDE GOALS

Raytheon company wide goals are established in compliance with federal statutory goals for small businesses and their respective sub-categories. The following statutory goals will serve as a reference point in establishing Raytheon goals in contracts or subcontracts, for government or civilian agencies, that require individual small business subcontracting plans.

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Basis for Establishing Goals

The goals for awards of subcontracts to small, small disadvantaged, women owned small business, veteran owned small business, service disabled veteran owned business, HUB Zone Certified Small Businesses and historically black colleges and universities, and minority institutions are based on total volume of planned domestic subcontracting forecasted for the individual contract and in accordance with the guidelines of the specific government customer for which small business subcontracting plans are being prepared.. The statutory

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goals referenced above will be serve as the initial targets in consideration of establishing goals for individual small business subcontracting plans

Indirect and Overhead Costs
Indirect and overhead purchase projections are not included in the goals for individual subcontracting plans. However, they are included for overall companywide performance to the referenced goals and will be utilized in calculating the performance percentage on the company wide eSSR Report. The portion of indirect spend is allocated proportionally to percentage of the commitments for the respective government or civilian agency report.

Principal Products to be Subcontracted
As a large aerospace and defense electronics contractor, Raytheon places subcontracts for a wide variety of goods and services to support ongoing programs. The principal types of goods and services with high potential for subcontracting to SB, SDB, WOSB, VOSB, SDVOSB, SBHZ and HBCU/MI include but are not limited to the following:

- Electronic Components and Assemblies
- Raw Materials
- Semiconductors and Hybrid Components
- Microwave Components and Assemblies
- General Services and Supplies
- Software and Software Support Services
- Electro Mechanical devices and Assemblies
- Sheet Metal Parts and Assemblies
- Power Devices and related Hardware
- Electro-optical Devices
- Computer Products and Supplies
- MRO Products

V IMPLEMENTATION – MASTER SUBCONTRACTING PLAN

This Master Small Business Subcontracting Plan complies with the eleven elements set forth in paragraph (d) of the clause at FAR 52.219-9 entitled "Subcontracting with Small and Small Disadvantaged Business Concerns" as well as the requirement of the Federal Acquisition Regulations (FAR), Subpart 19.7.

This Master Plan shall apply to all government & civilian agency contracts requiring subcontracting plans (except contracts in support of the Department of Defense) during the period of performance under this plan. Electronic Individual Subcontracting Plan reports (ISR) will be submitted in accordance with FAR Clause 52.219-9. A Companywide summary subcontract report via eSRS will be submitted on an annual basis or as directed by the respective government or civilian agency wherein an individual subcontracting plan exists. (Per FAR 52.219-9 (1) (2) (D) a companywide summary subcontract report shall be submitted via eSRS on a semiannual basis for NASA and on an annual basis for all other Civilian agencies wherein an individual subcontracting plan exits. Subcontracts awarded to large businesses in support of government & civilian agency contracts will also require the adoption of a subcontracting plan similar to that mandated by the clause at 52.219.9.

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PLAN ADMINISTRATOR

Company Liaison Office

At the direction of executive management, the Company Liaison Officer, Ms. Benita Fortner, has responsibility for Raytheon supplier diversity and the development, implementation and management of the Companywide Master Subcontracting Plan. Raytheon reserves the right to substitute another qualified individual should the need arise.

The duties of the Master Subcontracting Plan Administrator include, but are not limited to:

a) Negotiate the Master Subcontracting Plan Format with the appropriate government contracting officer.
b) Manage and oversee the Company-wide network of supplier diversity advocates (Small Business Liaison Officers SBLOs) and promote supplier diversity objectives.
c) Coordinate the management and implementation of supplier diversity initiatives with the SDBLs.
d) Assure SBLO participation in major procurement team activity.
e) Coordinate preparation and submittal of supplier diversity statistical reports from all Raytheon businesses and assure Raytheon Company SF 295 reports are submitted in a timely manner.
f) Represent Raytheon at government, industry, and trade association sponsored procurement conferences and business opportunity fairs, so as to identify and counsel SB, SDB, WOSB, VOSB, SDVOSB, SBHZ and HBCU/MI, capable of competing for procurement opportunities.
g) Represent Raytheon as requested, at Supplier Diversity reviews; interface with reviewing agencies and performing organizations to assure compliance and resolve issues
h) Provide liaison to government and industry organizations relative to Raytheon Supplier Diversity issues and objectives.
i) Support the collection and maintenance of information on small businesses and ensure such information is included in the Company Supplier Directory on an annual basis.
j) Coordinate the annual Small Business Subcontractor of the Year Program, the National Minority Supplier of the Year Program, and other supplier recognition programs.
k) Oversee supplier diversity training efforts and Raytheon participation in government sponsored supplier diversity initiatives. (I.e., Mentor/Protégé Program, the Small Business Innovative Research Program etc.)
l) Advise executive and individual business management of matters that could impair accomplishment of actions specified in this subcontracting plan

PROGRAM ADMINISTRATORS

Supplier Diversity Business Leaders

Responsibility for the implementation and administration of this Master Subcontracting Plan and the Company's Supplier Diversity initiatives at the Operation level is vested in the supplier diversity business leaders assisted by the network of supplier diversity advocates. (Small Business Liaison Officers SBLOs). SBLOs provide guidance and support to the total Company effort in enhancing the utilization of SB, SDB, WOSB, VOSB, SDVOSB, SBHZ and HBCU/MI concerns.

(Exhibit 5 Supplier Diversity Network/Organization Listing)

The duties of Supplier diversity business leaders and supplier diversity advocates shall include, but not be limited to, the following:

a) Attend local government, industry, and trade association conferences and business opportunity fairs as a means of developing and counseling SB, SDB, WOSB, VOSB, SDVOSB, SBHZ and HBCU/MI sources.
b) Provide advocacy assistance for all small firms interested in doing business with Raytheon.
c) Provide counseling services to small businesses to ensure their understanding of Raytheon procurement systems and processes.
d) Assist in obtaining technical, management, quality, material and/or financial support where appropriate to facilitate small business competition in source selection decisions.
e) Assist in developing supplier diversity data to support government & civilian agency contracts.

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f) Ensure supplier diversity goals are communicated and that a good faith effort toward meeting those goals is executed.
g) Prepare and submit program reports and other pertinent information as requested by the Company Liaison Officer or government & civilian agency representatives.
h) Provide liaison between supply chain, program management, and other organizations to ensure supplier diversity goals are met.
i) Provide supplier diversity training throughout all organizations that impact supplier selection decisions to ensure SB, SDB, WOSB, VOSB, SDVOSB, SBHZ and HBCU/MI are afforded an equitable opportunity to compete.
j) Manage and facilitate all aspects of supplier diversity at the operations level including, structuring and formulating subcontracting plan goals, participating in mentor protégé relationships and the Small Business Innovative Research Program and the Small Business Technology Transfer Programs.
k) Bring to supply chain management's attention any matter that could impair the accomplishment of actions specified in this plan.

VI SOURCE IDENTIFICATION

Raytheon's Small Business Liaison Officers assist in identifying qualified and SB, SDB, WOSB, VOSB, SDVOSB, SBHZ and HBCU/MIs as potential sources for participation in procurement opportunities. Commonly used resources in this effort include:
a) Raytheon Supplier Diversity Portal
b) Small Business Administration's Dynamic Small Business Search System
c) The Center for Veterans Enterprise
d) Raytheon Enterprise Supplier Database
e) National and regional minority supplier diversity council lists
f) Women's Business Enterprise – WBENC Link
g) An inventory of the capabilities of HBCU/MI's
h) Other resource documents and representations

VII EFFORTS FOR ENSURING EQUITABLE PARTICIPATION

A special effort is made to identify and facilitate procurement opportunities, solicit, and fairly consider SB, SDB, WOSB, VOSB, SDVOSB, SBHZ and HBCU/MI concerns for subcontracting. To this end:
a) Solicitations, time periods for bidding and delivery schedules are set to enable known SB, SDB, WOSB, VOSB, SDVOSB, SBHZ and HBCU/MI to compete.
b) Requirements are reviewed for possible breakout for procurement from SB, SDB, WOSB, VOSB, SDVOSB, SBHZ and HBCU/MI concerns.
c) Make-or-buy deliberations include adequate and timely consideration of known SB, SDB, WOSB, VOSB, SDVOSB, SBHZ and HBCU/MI capabilities.
d) Development work, likely to lead to production, is examined for possible placement with SB, SDB, WOSB, VOSB, SDVOSB, SBHZ and HBCU/MI concerns.
e) Specifications, drawings, and other relevant data are made available so that qualified SB, SDB, WOSB VOSB, SDVOSB, SBHZ and HBCU/MI concerns may equitably compete and prepare bids.
f) To the extent possible and ethical, counseling or other forms of assistance is given to help SB, SDB, WOSB, VOSB, SDVOSB, SBHZ and HBCU/MI obtain awards for which they can qualify. Supportive relations are maintained with such suppliers throughout contract performance.
g) When appropriate, competition may be restricted to qualified SB, SDB, WOSB, VOSB, SDVOSB, SBHZ and HBCU/MI. Through the Supply Chain Management Process decisive efforts are taken to identify and facilitate opportunities, which enhance participation of SB, SDB, WOSB, VOSB, SDVOSB, SBHZ and HBCU/MI concerns to compete for procurement awards. Changes in the market place or conditions, which beset the Company, dictate the practical alternatives available in utilizing SB, SDB, WOSB, VOSB, SDVOSB, SBHZ and HBCU/MI firms.

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The following presents options for consideration:

a) Ensure that small business firms are considered fairly when manufacture or purchase decisions are made for components required in development or production of major subsystems.
b) Examine development work likely to lead to production and make available specifications, drawings, and other relevant data to assist qualified SB, SDB, WOSB, VOSB, SDVOSB, SBHZ and HBCU/MI firms in preparing bids.
c) Identify sole and single source items normally procured from large businesses and ascertain the feasibility of acquiring such items from SB, SDB, WOSB, VOSB, SDVOSB, SBHZ and HBCU/MI concerns via alternate source development procedures.
d) Evaluate products developed by SB, SDB, WOSB, VOSB, SDVOSB, SBHZ and HBCU/MI firms for possible application in systems designed and produced by the Company.
e) Make available to inquiring SB, SDB, WOSB, VOSB, SDVOSB, SBHZ and HBCU/MI firms in appropriate circumstances information about Company patents so that they may evaluate the market and business potential of entering into licensing agreements.
f) Sponsor on-premise product displays of materials developed by small firms so that the technical community may assess future application.
g) Consider progress or milestone payment provisions in subcontracts awarded to small concerns whenever they require a heavy investment in the performance of work scheduled over a prolonged period of time.
h) When appropriate, assist SB, SDB, WOSB, VOSB, SDVOSB, SBHZ and HBCU/MI firms confronted with difficult problems that threaten their ability to perform subcontracts as an effort to avoid potential termination proceedings.
i) When appropriate, provide Company-owned tooling and test equipment to SB, SDB, WOSB, VOSB, SDVOSB, SBHZ and HBCU/MI firms to enable them to perform work in accordance with engineering drawings and specifications.
j) Assist SB, SDB, WOSB VOSB, SDVOSB, SBHZ and HBCU/MI firms encountering difficulty in obtaining needed materials for the performance of subcontract work.
k) Establish SB, SDB, WOSB, VOSB, SDVOSB, SBHZ and HBCU/MI business commitment award goals for buyers or organizational entities based upon goals structured and allocated by the Corporate Liaison Officer to operating departments.
l) Actively participate with the U.S. Small Business Administration and the Department of Commerce in their National Subcontractor of the Year Programs so that SB, SDB, WOSB, VOSB, SDVOSB, SBHZ and HBCU/MI, firms may be properly acknowledged for their contributions to defense and other federal program efforts.

VIII SUPPLIER RECOGNITION

Supplier award recognition is taken very seriously throughout Raytheon. The Company utilizes its leadership role in TRIAD, the National Minority Supplier Development Council, the Women's Business Enterprise National Council, National Small Business Week and the MED Week Planning Committee to assure consistent efforts are directed to supplier recognition. SBLOs are encouraged to work with their SB, SDB, WOSB, VOSB, SDVOSB, SBHZ and HBCU/MI, suppliers to develop candidates that can be recommended for awards within these associations

Annual celebrations include: small business subcontractor of the year recognition - ceremonies in Washington DC with the Vice President of Supply Chain Management and other Company Executives; supplier of the year recognition through the regional minority supplier development councils; Star award recognition through the Women's Business Enterprise National Council; Supplier Excellence awards as a component of Raytheon supplier conferences. In addition the Corporate Supplier Diversity office hosts an annual Supplier Diversity Awards celebration for Raytheon employees who have made significant contributions to Raytheon's supplier diversity performance. This event is hosted by the Raytheon Supplier Diversity Executive and the "Chairman's"

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award is presented on behalf of Raytheon's Chairman and CEO by the reigning Raytheon Diversity Executive Champion.

IX RECORD KEEPING

Raytheon's supplier information system includes data, regarding solicitation, to business categories by the following size classifications SB, SDB, WOSB, VOSB, SDVOSB, SBHZ and HBCU/MI, Large, Foreign and Nonprofit Status. This information is available for all products and services purchased in direct support of government and civilian agency contracts. Supply chain organizations document specific efforts to identify and award subcontracts to SB, SDB, WOSB, VOSB, SDVOSB, SBHZ and HBCU/MI. Raytheon's supplier information system is available to all procurement, finance, and quality personnel. Raytheon Company will maintain the following procurement activity records:

a) All subcontract solicitations over $150,000 indicating on each solicitation whether SB, SDB, WOSB,VOSB, SDVOSB SBHZ and HBCU/MI were solicited and if not, why not, and reasons for the failure of responding Small Business to receive the subcontract award
b) Source lists including organizations contacted in an attempt to locate and identify sources that are small business, veteran-owned small business, service-disabled veteran-owned small business, HUB Zone small business, small disadvantaged business, or women-owned small business concerns
c) Records regarding the name, address, and size status of all Subcontractors
d) Records of outreach efforts to contact organizations and events to identify small business, veteran-owned small business, service-disabled veteran-owned small business, HUB Zone small business, small disadvantaged business, or women-owned small business concerns
e) Records of internal guidance and encouragement provided to buyers and source selections personnel through workshops, seminars, training, etc and efforts to monitor performance to evaluate compliance with the small business program requirements

X REPORTS

The CLO monitors and publishes each organizations achievement based on government business data accumulated on total procurements from SB, SDB, WOSB, VOSB, SDVOSB, SBHZ and HBCU/MI concerns. This consolidated information is reported quarterly to Raytheon management and the Supplier Diversity Council.

The CLO submits Company-wide Summary Subcontracting Plan Reports (ESSR) to the appropriate government and civilian agencies based on the respective agency requirements and instructions on the eSSR Form (see XIV, #5). Individual subcontracting plan reports (ISR) will be submitted by the respective business for each government or civilian agency contract requiring a small business subcontracting plan.

In addition to the standard reporting requirements, Raytheon agrees to cooperate in any studies or surveys as may be required by the contracting agency or the U.S. Small Business Administration in order to determine compliance with subcontracting plans.

XI FLOW-DOWN REQUIREMENTS

Raytheon incorporates the following provisions in all government subcontracts which offer further subcontracting possibilities and will require all subcontractors that receive subcontracts in excess of $1,500,000 in the case of a contract for the construction of any public facility, or in excess of $650,000 in the case of all other contracts, to adopt a subcontracting plan which meets the requirements of FAR 52.219-9. (except small business concerns). The following clauses are included in all subcontracts in support of government or civilian agencies: Federal Acquisition Regulation Clause 52.219-8 entitled "Utilization of Small Business Concerns", Federal Acquisition Regulation Clause 52.219-9 entitled "Small Business and Small Disadvantaged Business

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Subcontracting Plan. In addition, Raytheon will ensure subcontractors requiring subcontracting plans agree to submit the ISR (formerly SF294) and or the SSR; provide subcontractors with small business subcontracting plans Raytheon's prime contract number, DUNS number and e-mail address of the government or contractor official responsible for acknowledging or rejecting the reports so it can be entered into the eSRS when subcontractors are submitting their reports and require each subcontractor with a small business subcontracting plan provide the prime contract number, its own DUNS number and the e-mail address of the government or contractor office responsible for acknowledging or rejecting the reports to its subcontractors that are required to submit a small business subcontracting plan.

XII OUTREACH

Raytheon communicates the procurement process and prospective subcontract opportunities to the small business community by participating in procurement conferences, trade fairs, workshops, seminars and other related functions. Raytheon also supports organizations such as chambers of commerce, minority supplier development councils, small business development centers etc.

Raytheon's Company Liaison Officer and the network of Small Business Liaison Officers also represent the Company through nationwide outreach and advocacy activities. SBLOs represent the supplier diversity program and procurement issues for the entire Company during outreach events. This process provides for quality and consistency of information provided to the SB, SDB, WOSB, VOSB, SDVOSB, SBHZ and HBCU/MI concerns, and maximizes the use of the supplier diversity network.

XIII SUPPLIER DIVERSITY PROGRAM TRAINING

In-depth presentations on the requirements of Public Laws 101-189, 95-507, 99-661, 100-180, and 100-656 alert all company organizations of the contractual impact of these laws. These presentations are used throughout Raytheon and serve to train supply chain management personnel and all organizations that impact the supplier selection process

Raytheon Company's external training program includes participation in seminars trade fairs and workshops where Raytheon' Procurement Processes can be discussed. Raytheon's external training includes information on electronic procurement activities and requirements

XIV INDIVIDUAL SUBCONTRACTING PLAN

1. GOALS

Individual goals for the utilization of small business concerns, small business concerns owned and operated by socially and economically disadvantaged individuals, small business concerns owned and operated by women, veteran owned small business, service disabled veteran owned small business, HUB Zone Certified Small Businesses and Historically Black Colleges, Universities, and Minority Institutions will be established as a percent of total domestic dollars planned to be subcontracted and in accordance with the guidelines for individual government or civilian agency contracts wherein a small business subcontracting plan is required.

a) It is hereby agreed that goals for each individual contract will be negotiated and presented to include applicable dollars and percents for the following:
   - Total planned dollars to be subcontracted domestically
   - Total dollars anticipated to small business

b) And, as a subset of anticipated small business subcontracting, separate goals will be identified for the groups below:
   - Small Disadvantaged Business which includes Historical Black Colleges or Universities and Minority Institutions and
   - Small Business Concerns owned and operated by Women

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- Veteran Owned Small Business
- Service Disabled Veteran Owned Small Business
- HUB Zone Certified Small Businesses

2. **PRINCIPAL PRODUCTS AND PROPOSED SOURCES**
Each subcontracting plan will include an appendix describing the principal products and services anticipated to be subcontracted in support of the respective government or civilian agency contract. The appendix will identify the type of business concern that may reasonably be expected to participate in the subcontracting effort.

3. **BASIS FOR SETTING GOALS**
Goals will be established based on the total volume of planned domestic subcontracting for individual government and civilian agency contracts in conjunction with considerations for complexity and security constraints. This effort includes screening the bills of material to evaluate areas for SB, SDB, WOSB, VOSB, SDVOSB, SBHZ and HBCU/MI inclusion. A best effort will be made to use, whenever feasible, Historically Black Colleges or Universities (HBCUs) and Minority Institutions (MIs). This will be determined by the extent to which contemplated contracts will involve research or studies of the type normally performed by academic institutions.

4. **INDIRECT AND OVERHEAD COSTS**
Unless otherwise negotiated, indirect and overhead products and services will not be considered in establishing goals for individual subcontracting plans. Only products and services that will be procured in direct support of the individual government or civilian agency contract will be considered.
(Exhibit 6 Sample Individual Subcontracting Plan)

5. **REPORTS**
Raytheon Company will prepare and submit reports in compliance with Paragraph (d) (10) of Federal Acquisition Regulation Clause 52.219-9 for all government and civilian agency contracts and subcontracts that meet the small business subcontracting plan reporting requirements. Reports will cover the period specified by the respective government or civilian agency with a yearend report being submitted for the period ending 30 September on an annual basis. A final report will be submitted upon contract completion to the cognizant administrative contracting officer. Each report will be submitted by the 30th day following the close of the reporting period unless otherwise negotiated. Raytheon agrees to cooperate in any studies or surveys requested by appropriate government contracting representatives to determine subcontracting plan compliance. (see X Reports)

XV Timely Payments to Subcontractors

In addition to Raytheon's general compliance with the federally legislated Small Business Prompt Payment Act, all supply chain organizations will work to ensure the prompt payment of invoices submitted by small businesses. Supplier diversity advocates will also assist small businesses that are having difficulty receiving payment for products or services. Supplier Diversity Business Unit Leaders will assist the local operations, if necessary in resolving small business payment disputes.

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Appendix

GLOSSARY OF DEFINITIONS

Affiliates: Business concerns are defined as affiliates if, directly or indirectly, either one controls or has the power to control the other; or another concern controls or has the power to control both. This includes common ownership, common management, and contractual relationships. Any business entity may be found to be an affiliate, whether or not it is organized for profit or located in the United States.
Annual Receipts means gross income of a concern and its domestic and foreign affiliates from sales of products and services and/or interest, rent, fees, and commissions from whatever other source derived for its most recently completed fiscal year, less returns, allowances, sales of fixed assets, and inter-affiliate transactions.
Average Annual Receipts mean, for the purpose of size standards, annual receipts averaged over three continuous years. For a concern in business less than three years, they are computed by determining average weekly receipts for the period in which it has been in business, multiplying by 52.
Company Percentage Goals are structured using all purchased materials and services whether direct or indirect in nature. Such goals are established based on current statutory requirements and represent stretch targets for all businesses.
Contractual Percentage Goals are structured using only identifiable materials and services, which are chargeable directly to a specific customer contract or higher-tier subcontract.
Controlled is defined as exercising the power to make policy decisions.
Disadvantaged means a small, domestic concern which, including domestic and foreign divisions, subsidiaries, and affiliates, is at least 51 per cent owned by one or more socially and economically disadvantaged individuals; or in the case of a publicly-owned business, at least 51 per cent of the stock is owned by one or more such individuals, and whose management and daily business operations are controlled by one or more such individuals. Socially and economically disadvantaged individuals include Black Americans who are U.S. citizens; Hispanic Americans who are U.S. citizens and whose ancestry and culture are rooted in South America, Central America, Mexico, Cuba, the Dominican Republic, Puerto Rico, Spain or Portugal; Native Americans i.e. American Indians, Eskimos, Aleuts or Native Hawaiians; Asian Pacific Americans who are U.S. citizens whose origins are from Japan, China, The Philippines, Vietnam, Korea, Samoa, Guam, U.S. Trust Territory or the Pacific Islands, Northern Mariana Islands, Laos, Cambodia, or Taiwan; Subcontinent Asian Americans (formerly Asian Indian Americans) who are U.S. citizens whose origins are from India, Pakistan, Bangladesh, or Sri-Lanka; and any other individual/concern currently certified for participation in the Section 8 (a) Small Business Administration Program.
Foreign means any concern whose principal base of operation is located outside the 50 United States, its territories, and possessions.
Historically Black Colleges and Universities ((HBCU) means institutions determined by the Secretary of Education to meet the requirements of 34 Code of Federal Regulations (CFR) Section 608.2. Must be a college or university established for black education and not as a result of changing demographics.
Large means any business concerns not categorized as "Small" in 13 CFR Section 121, Small Business Size Standards.
Minority Institutions (MIs) means institutions meeting the requirements of 34 CFR Section 607.2. This also includes any non-profit research institution that was an integral part of an HBCU before 14 November 1986.

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Non-Profit means any organization not conducted or maintained for the purpose of making a profit. Included in this category are sheltered workshops, universities, colleges, and local, state, and Federal governments.
Operated is defined as actively involved in day-to-day management. Publicly owned businesses, joint stock associations, and business trusts are exempt from this definition.
NAICS the North American Industrial Classification System. To be used in place of the Suppliers Industrial Classification for determining size standards in performance of government contracts. Use effective October1, 2000.
SIC Code is Suppliers Industrial Classification per 13 CFR Part 121, Small Business Size Standards.
Small means a domestic firm, including its affiliates, that is independently owned and operated, is not dominant in its field, and has been categorized by the United States Small Business Administration as "Small" in accordance with 13 CFR Part 121, Small Business Size Standards.
HUB Zone Certified Small Businesses small businesses certified in Dynamic Small Business Search as meeting the requirements defined in the HUB Zone Act of 1997.
Supplier Diversity Advocate (SDA) The individual appointed by business unit supply chain management to provide overall guidance and support of Company supplier diversity efforts and compliance with socioeconomic program requirements in government contracting.
Subcontract is any agreement entered into by a prime contractor or subcontractor for materials, supplies or services, other than personal in nature, required to support the performance of a U.S. Government contract.
Woman-owned means a small, domestic concern which, including domestic and foreign divisions, subsidiaries, and affiliates, is at least 51 per cent owned, controlled, and operated by a woman or women, and is not dominant in its field of operation.
Veteran-owned means a small, domestic concern which, including domestic and foreign divisions, subsidiaries, and affiliates, is at least 51 per cent owned, controlled, and operated by one or more veterans. Or, in the case of any publicly owned business, not less than 51 percent of the stock is owned by one or more veterans,
Service-disabled veteran-owned means a small, domestic concern which, including domestic and foreign divisions, subsidiaries, and affiliates, is at least 51 per cent owned, controlled, and operated by one or more service-disabled veterans. Or, in the case of any publicly owned business, not less than 51 percent of the stock is owned by one or more service-disabled veterans,

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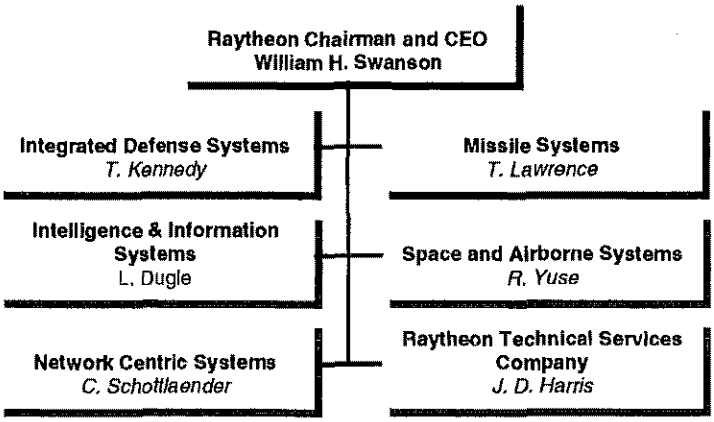
Exhibit 1. Raytheon Company Organization Chart



Raytheon Business
Presidents

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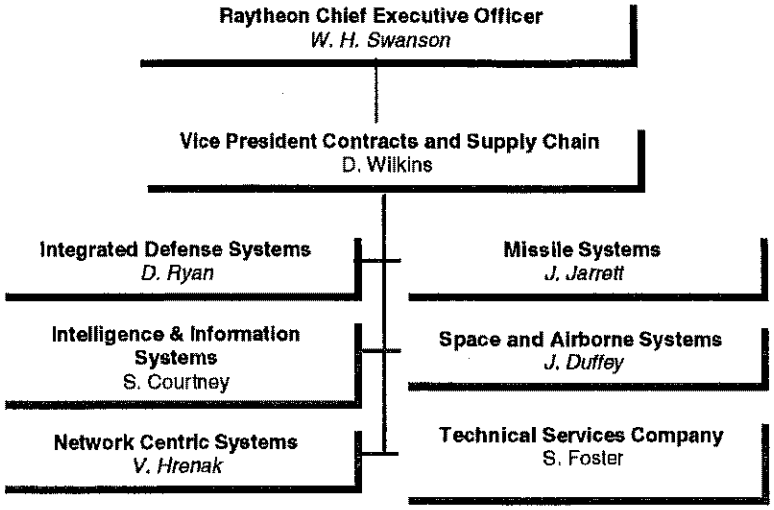
Exhibit 2. Supply Chain Management Organization Chart



Supply Chain Management Leadership

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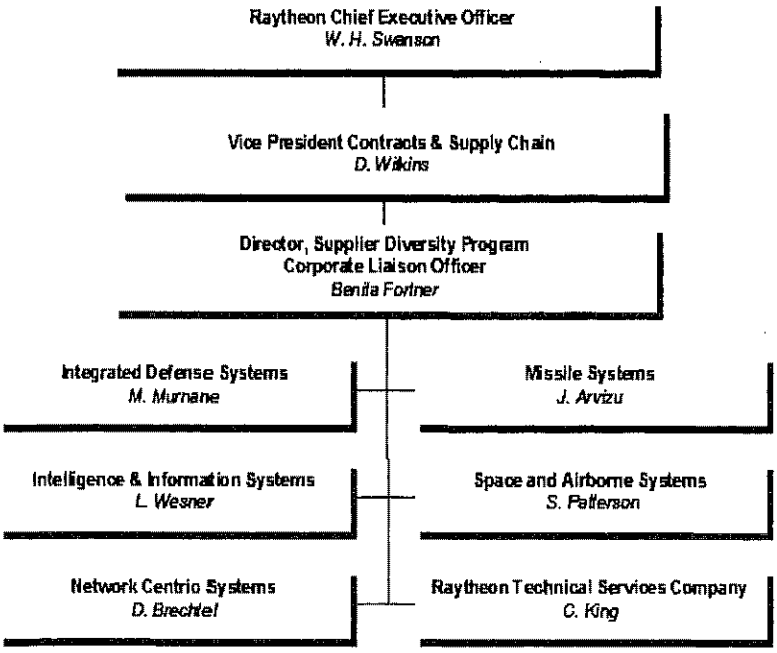
Exhibit 3. Supplier Diversity Program Organization Chart



Raytheon Supplier Diversity Business Leaders Chart

Exhibit 4. Past Performance

2000	SDB	%	WOSB	%	SB	%	HUBZONE	%	Veteran	%	SDV	%	HBCU/MI	%	LB	TB
RC TOTAL	$221,824,010	5.9%	$121,802,312	3.2%	$1,663,946,235	44.0%	$58,515,089	1.6%	[illegible]	[illegible]	[illegible]	[illegible]	$680,169	0.0%	$2,110,977,356	$3,774,823,588
2001	SDB	%	WOSB	%	SB	%	HUBZONE	%	Veteran	%	SDV	%	HBCU/MI	%	LB	TB
RC TOTAL	$221,005,008	6.1%	$125,992,472	3.4%	$1,580,494,020	43.6%	$41,109,782	1.1%	$44,170,725	1.2%	$28,963,752	0.8%	$287,350	0.0%	$2,043,782,729	$3,624,276,749
2002	SDB	%	WOSB	%	SB	%	HUBZONE	%	Veteran	%	SDV	%	HBCU/MI	%	LB	TB
RC TOTAL	$247,311,823	6.5%	$123,318,543	3.2%	$1,437,095,705	38.2%	$49,716,084	1.3%	$72,975,202	1.9%	$27,971,778	0.7%	$6,479	0.0%	$2,325,003,536	$3,762,069,241
2003	SDB	%	WOSB	%	SB	%	HUBZONE	%	Veteran	%	SDV	%	HBCU/MI	%	LB	TB
RC TOTAL	$268,560,287	6.4%	$162,704,044	3.9%	$1,720,529,647	40.8%	$65,153,990	1.5%	$92,653,828	2.2%	$15,091,488	0.4%	$323,387	0.0%	$2,493,846,342	$4,214,475,989
2004	SDB	%	WOSB	%	SB	%	HUBZONE	%	Veteran	%	SDV	%	HBCU/MI	%	LB	TB
RC TOTAL	$243,975,080	6.5%	$167,240,216	4.4%	$1,520,441,288	40.2%	$82,020,061	2.2%	$142,594,927	3.8%	$14,444,976	0.4%	$544,114	0.0%	$2,259,429,110	$3,779,870,398
2005	SDB	%	WOSB	%	SB	%	HUBZONE	%	Veteran	%	SDV	%	HBCU/MI	%	LB	TB
RC TOTAL	$284,627,978	7.2%	$184,599,137	4.7%	$1,586,050,693	40.3%	$97,476,420	2.5%	$199,285,766	5.1%	$19,426,982	0.5%	$1,035,285	0.0%	$2,346,769,062	$3,932,810,855
2006	SDB	%	WOSB	%	SB	%	HUBZONE	%	Veteran	%	SDV	%	HBCU/MI	%	LB	TB
RC TOTAL	$218,701,983	5.5%	$187,542,841	4.7%	$1,540,583,619	38.9%	$94,336,276	2.4%	$190,888,951	4.8%	$25,811,831	0.6%	$481,065	0.1%	$2,434,030,170	$3,962,619,989
2007	SDB	%	WOSB	%	SB	%	HUBZONE	%	Veteran	%	SDV	%	HBCU/MI	%	LB	TB
RC TOTAL	$227,091,666	4.7%	$211,294,336	4.3%	$1,815,495,061	37.3%	$58,646,691	1.2%	$205,443,818	4.2%	$32,354,417	0.6%	$1,573,278	0.2%	$3,047,290,364	$4,862,785,425
2008	SDB	%	WOSB	%	SB	%	HUBZONE	%	Veteran	%	SDV	%	HBCU/MI	%	LB	TB
RC TOTAL	$444,730,031	6.7%	$256,165,107	3.8%	$2,311,567,980	34.6%	$62,953,125	0.9%	$374,089,873	5.6%	$118,608,334	1.8%	$862,213	0.1%	$4,368,210,883	$6,679,778,783
2009	SDB	%	WOSB	%	SB	%	HUBZONE	%	Veteran	%	SDV	%	HBCU/MI	%	LB	TB
RC TOTAL	$372,058,187	5.5%	$291,133,068	4.3%	$2,176,591,235	32.0%	$60,949,032	0.9%	$373,194,446	5.5%	$131,269,350	1.9%	$1,179,687	0.0%	$4,628,651,729	$6,803,242,964

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Exhibit 5. Supplier Diversity Network/Organization Listing

RAYTHEON INTEGRATED DEFENSE SYSTEMS			
Mike Mumane	Business Leader	978-858-9611	michael_mumane@raytheon.com
Katie Boyle	Tewksbury, MA	978-858-4683	mary_c_boyle@raytheon.com
Ferlandos Davis	Tewksbury, MA	978-858-9475	ferlandos_davis@raytheon.com
Terence Downing	Anaheim, CA	951-850-2622	terry@raytheon.com
Judy Hardin	Huntsville, AL	256-542-4788	judy_c_hardin@raytheon.com
Kimberly Teague	San Diego, CA	858-522-2070	kateague@raytheon.com
RAYTHEON INTELLIGENCE AND INFORMATION SYSTEMS			
Lee Wesner	Business Leader	972-205-4308	lwesner@ratytheon.com
Stephen Beck	Falls Church, VA	571-226-1115	stephen_m_beck@raytheon.com
Sharon Denton	Dallas, TX	972-205-7199	sharon_l_denton@raytheon.com
Warren Elbeck	Aurora, CO	720-858-5788	waelbeck@raytheon.com
James Phelan	Reston, VA	703-757-1642	james_a_phelan@raytheon.com
RAYTHEON MISSILE SYSTEMS			
Jo Anne Arvizu	Business Leader	520-665-5919	jnarvizu@raytheon.com
Lisa Marie Cates	Tucson, AZ	520-545-8430	lisa_m_cates@raytheon.com
David Montgomery	Louisville, KY	502-364-6701	dmontgomery@raytheon.com
RAYTHEON NETWORK CENTRIC SYSTEMS			
Don Brechtel	Business Leader	727-302-4747	donald_l_brechtel@raytheon.com
Debra Acton	Goleta, CA	805-562-4724	dmacton@raytheon.com
Ronald L. (RB) Bell	Largo, FL	727-768-8668	ron_l_bell@raytheon.com
Charles (Chuck) Caulfield	Towson, MD	410-583-4126	charles_j_caulfield@raytheon.com
Jon Carroll	Raleigh, NC	919-865-1258	Jon.carroll@raytheon.com
Nancy Hayward	Dallas, TX	972-205-4690	n-hayward@raytheon.com
Valerie King	Marlborough, MA	508-490-2331	valerie_king@raytheon.com
John Kleinfelder	Eatontown, NJ	732-544-1200	jmkleinfelder@raytheon.com
Ronald Pearce	Largo, FL	727-768-8629	gsikosek@raytheon.com
Cristina Salinas	Dallas, TX	972-344-6226	c-salinas@raytheon.com
Jim Solomon	Fullerton, CA	714-446-2325	jsolomon@raytheon.com
Nancy Walfield	Dallas, TX	972-205-4556	nancy_walfield@raytheon.com
RAYTHEON TECHNICAL SERVICES COMPANY			
Crystal King	Business Leader	571-250-3725	crystal_l_king@raytheon.com
Jennifer Cason	Dulles, VA	571-250-3717	jennifer_e_cason@raytheon.com
Naomi Hardcastle	Orlando, FL	407-421-2386	naomi_hardcastle@raytheon.com
Justine Manning	Centennial, CO	303-790-8606	justine.manning.contractor@usap.gov
William Trump	Webster, TX	281-280-4322	william_e_trump@raytheon.com
RAYTHEON SPACE & AIRPBORNE SYSTEMS			
Shirley Patterson	Business Leader	310-616-1683	sjpatterson@raytheon.com
Nancy Hayward	Dallas, TX	972-344-8351	n-hayward@raytheon.com
Kathleen Ringsby	El Segundo, CA	310-616-1363	kathleen_m_ringsby@raytheon.com
Nancy Walfield	Dallas, TX	972-205-4556	nancy_walfield@raytheon.com
RAYTHEON ENTERPRISE			
Carol Philipps	Waltham, MA	781-768-3962	carol.philipps@raytheon.com
RAYTHEON CORPORATE			
Benita Fortner	Director	781-522-6337	bfortner@raytheon.com
Jeanné Martin	Waltham, MA	781-522-5857	jeanne.c.martin@raytheon.com

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Response to Request for Proposal No. 24997

Surface Management System at John F. Kennedy International Airport

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Submitted by the PASSUR Mosaic Joint Venture

PASSUR. NOW

MOSAIC ATM

PASSUR. NOW.
AEROSPACE

MOSAIC ATM

August 8, 2011

Letter of Transmittal

The Port Authority of NY & NJ
Purchasing Services Division
Attn: Ms. Lesley Brown
One Madison Avenue, 7th FL.
New York, NY 10010

Dear Ms. Brown,

This submission in response to Request for Proposals for a Surface Management System (SMS) at John F. Kennedy International Airport is tendered as a Common Law Joint Venture between PASSUR Aerospace, Inc. (PASSUR®) and Mosaic ATM, Inc. (Mosaic), referred to for the purposes of this proposal as the PASSUR Mosaic Joint Venture, or PMJV.

The submission reflects the extensive experience both companies have in surface management systems – including the past 18 months of operation of the JFK departure metering program and several of the leading surface management decision support programs instituted at other airports around the country. The current departure metering program at JFK has been a widely recognized success at many levels and reflects a longstanding and successful partnership between PASSUR and the Port Authority. The success of the metering program was recently validated by an extensive study of the program's fuel and emissions reductions conducted by MIT Lincoln Laboratory. We look forward to continuing our long-term successful relationship with you. You'll be pleased to see that our proposal includes additional automation immediately in Phase A (and a commensurate reduction in labor requirements), an integrated web interface for air and surface management on one screen, and the complete integration of the other PASSUR modules used by the Port Authority into a single solution. We believe we represent the team with the most experience implementing surface management operations, including complex surface management decision support technology (predictive analytics, live monitoring, post-operational analysis), and hands-on implementation of surface management operations.

PASSUR will be the lead company in the venture with respect to the software platform accessed by users, onsite staffing and operation of the system, training, and customer service. Mosaic will provide its existing technology platform and extensive expertise in surface decision support systems, including monitoring, predicting, and analyzing the movement of aircraft on airport runways and taxiways, as well as in the ongoing maintenance and technical support of these systems. The PASSUR Integrated Traffic Management software platform will be the single user interface representing the combined technical capabilities of PASSUR and Mosaic, ensuring a seamless user experience.

PASSUR is a business intelligence company, which develops predictive analytics built on proprietary algorithms and the concurrent integration and simultaneous mining of multiple databases. PASSUR offers vertical expertise in the aviation market – providing data consolidation, information, decision support, predictive analytics, collaborative solutions, and professional services for aviation operations worldwide.

PASSUR's principal business is to provide business intelligence and predictive analytics solutions, which save money, enhance operational efficiency, increase safety and security, and improve the passenger experience. These analytics are derived from the company's PASSUR Proprietary Surveillance Network (the "PASSUR Network") of live flight information, updated every 4.6 seconds, and include decision support software, predictive analytics, and web-delivered collaborative decision solutions, enhanced by professional services provided by industry experts.

The PASSUR solutions, supported by the PASSUR operational team, are used by more than 50 airports, dozens of airlines (including five of the top six North American airlines, all five of the top hub carriers), more than 50 airport customers (including 23 of the top 30 North American airports), approximately 200 corporate aviation customers, as well as the U.S. government, including the Federal Aviation Administration (FAA) and the Transportation Security Administration (TSA).

PASSUR Subject Matter Experts (SMEs) are at the core of PASSUR's solution delivery. The SMEs are drawn from airlines (SOC and hub control management, operations finance, operations analysis, and pilot groups), air traffic management (FAA), airports (operations, environmental, and finance), business aviation, and aviation fleet management. These SMEs are focused exclusively on solving customer challenges in the area of aviation operational constraints, inefficiencies, and opportunities for optimization. They are involved in every step of the PASSUR solution delivery cycle: onsite analysis of customer challenges, operating environment, and business processes; as well as product development, training, and program implementation. This SME involvement helps to ensure our solutions achieve the desired customer outcome.

Mosaic is a recognized leader in the study and development of the Surface Decision Support System (SDSS) and its precursor technologies and systems, including SMS. Three of the four recognized inventors of SMS are employees of Mosaic (the fourth is retired) and lead the continuing surface decision support tool analysis and research. Mosaic personnel led the SMS development and deployment efforts from Technology Readiness Level 1 (TRL1) through TRL9. In addition to employing the inventors and developers of SMS, Mosaic has been responsible for maintaining the FAA's software baseline of the SDSS system since 2005.

Mosaic has been instrumental in the delivery of several of the most successful surface management system programs to date, including Memphis, TN, Louisville, KY, and Orlando, FL. It has also been involved in the development of several seminal and related traffic management programs and standards for the FAA and NASA, such as Surface Trajectory Based Operation (STBO), Collaborative Departure Queue Management (CDQM), and the Flight Operator Surface Application (FOSA interface standard).

Both companies in the PMJV have specific experience and qualifications directly relevant to the requirements of this RFP:

PASSUR

- Major experience managing the first phase of an SMS at JFK:
    - Includes taxi-time (slot) allocation software and procedures, extensive performance reporting related to the slot program, and extensive experience managing the complex relationships between all the parties at JFK.
    - Includes hands-on experience managing the onsite surface operations center at JFK, including the training and management of staff with the necessary skills to ensure a seamless, reliable operation on which all the carriers and the Port Authority have been able to depend since February 2010.

- Eight years of successful implementation of winter/deicing operations programs with both software and professional services staff at JFK, LGA, and several other large North American airports using many of the same core tools and processes that play a role in the company's SMS submission in response to this RFP. This program provided the foundation for the first phase of the departure metering program at JFK introduced in March 2010.

- Extensive experience in web-based collaborative solutions hosting and maintaining a software platform available on demand to all parties, geographically dispersed, to ensure common situational awareness, collaborative decision making, and maximum use of available surface and airspace capacity for the benefit of the entire operation. This platform is used by more than 16 airports nationwide – including JFK, LGA, EWR, BOS, IAD, DEN, SEA, and others – and is accessed by thousands of aviation professionals around the world for real-time updates on critical airport operational plans and information.

- Extensive experience in airspace optimization solutions with airlines, including management of critical constraint such as Ground Delay Programs and other Traffic Management Initiatives, diversions, and hub management decisions (servicing arrivals and managing connections):
    - PASSUR has deployed data and software solutions, and professional services, at the system operations control centers and hub operational control centers of all the major U.S. carriers with operations at JFK.

- Integrated surveillance network, air and surface, providing all of the necessary live data surveillance inputs that underlie the SMS:
    - PASSUR operates the world's largest private passive radar surveillance network, which adds critical elements of live tracking, with the detail, precision, fidelity of motion, location, and trajectory needed to generate higher-level predictive algorithms that deliver the accuracy and precision required by a sophisticated SMS. The PASSUR radar system at JFK is equipped to process ADS-B messages, providing an additional source of surface surveillance data to supplement ASDE-X (which is processed by the PASSUR system).
    - The PASSUR surveillance network also enables PASSUR to ensure that the en route, arrival, surface, and departure segments of a flight are all managed as a continuum of the flight cycle, and that surface constraints – the focus of this RFP – are managed in light of airborne conditions and constraints.

- Extensive experience translating multiple data feeds into decision support solutions (this includes predictive analytics for surface and airborne operations):
    - PASSUR will be integrating highly specialized surface predictive, live and post-operational analysis, alerting, and decision support capabilities from Mosaic, which itself has extensive experience pioneering surface management solutions for the FAA, NASA, and commercial carriers.

- Managing specialized databases: all the surveillance data acquired by the PASSUR Network is integrated and correlated into specialized databases to support predictive, real-time and post-operational requirements. Critical to these capabilities is the storage of years of detailed operational data from the NAS, essential to support predictive analytics, and which we believe is unique to PASSUR.

Mosaic

Mosaic conducts research and develops solutions for improving the efficiency and safety of air transportation. The Mosaic staff consists of experts who combine substantial operational knowledge of NAS with extensive capabilities and experience in computer science, operations research, systems engineering, and human factors. Mosaic maintains a strong, cooperative relationship with the FAA, ATC facilities and specialists, NASA, major airlines, and air cargo operators.

Mosaic performs a combination of government-funded research and development, commercial services, as well as product development, consulting, and internal research and development. Through these projects and internal efforts, a significant corporate infrastructure has been developed to support future efforts. This infrastructure includes data repositories, software libraries, analysis tools, algorithms, and processes that are critical to the successful development of advanced systems for aviation, military, and commercial markets.

Mosaic supports the FAA in the design, development, and deployment of SDSS in Memphis, Orlando, and Louisville, and supports UPS' use of SDSS in Louisville. The capabilities of SDSS include the display of flight information and surface and terminal area aircraft positions to Air Traffic Controllers and Traffic Managers, Flight Operators, Airport Authorities, and other specialists at the operational facilities of aviation organizations involved in the airport surface operation. SDSS is used by UPS to drastically reduce the length of departure queues in UPS' nightly operation. It is also at the heart of the Collaborative Departure Queue Management (CDQM) trials conducted by the FAA in Memphis. The accuracy and reliability of SDSS' traffic predictions, produced by the Mosaic Prediction Engine (MPE), are unparalleled by any other solution anywhere.

For a detailed list of specific experience, please refer to the Proposer Prerequisites document, and to the same list in the Technical Proposal Vol.2, Management Programs.

Corporate Information

PASSUR Aerospace, Inc., corporate headquarters are located at One Landmark Square, Suite 1900, Stamford, CT 06901. The main telephone number is 203-622-4086.

Mosaic ATM, Inc., corporate headquarters are located at 801 Sycolin Road SE, Suite 306, Leesburg, VA 20175. The main telephone number is 800-405-8576.

PASSUR and Mosaic are submitting this proposal as a common law joint venture.

For this proposal the PASSUR Mosaic Joint Venture (PMJV) is also teaming with the following subcontractor:

- ARINC Incorporated, with offices located at 2551 Riva Road, Annapolis, MD 21401, is currently not a registered contractor in the Port Authority's contractor database.

The following individuals are authorized to negotiate and execute the contract and can be reached at PASSUR corporate headquarters. Telephone: 203-622-4086, Fax: 203-629-2970

- Tom White, Senior Vice President of Technology and Air Traffic Management, e-mail: twhite@passur.com
- Tina Jonas, Executive Vice President, Operations, e-mail: tinajonas@passur.com
- Jeff Devaney, Chief Financial Officer, Treasurer, and Secretary, e-mail: jeffdevaney@passur.com

The Port Authority can address questions or issues relating to this RFP to the following PASSUR employees, who can be reached at our corporate headquarters. Telephone: 203-622-4086 Fax: 203-629-2970

- Tom White, Senior Vice President of Technology and Air Traffic Management, e-mail: twhite@passur.com

- Ron Dunsky, Senior Vice President, Marketing and Communications, e-mail: rondunsky@passur.com.
- Jeff Devaney, Chief Financial Officer, e-mail: jeffdevaney@passur.com

PASSUR's officers' names and addresses are listed below:

Name	Residential Address
James T. Barry	
James A. Cole	
Jeffrey P. Devaney	
Ron A. Dunsky	
Tina W. Jonas	Ex. 1
John R. Keller	
Chris Maccarone	
Mathew H. Marcella	
Thomas J. O'Halloran	
Thomas White	

Mosaic's officers' names and address are listed below:

Name	Residential Address
Christopher R. Brinton	
Stephen C. Atkins	Ex. 1
Stephen Simmons	

Each company's certificate of incorporation is attached with a declaration signed by the secretary of the corporation.

By signing this Letter of Transmittal, PASSUR and Mosaic make the certifications set forth in Attachment B, Clause 32, Contractor's Integrity Provisions.

Sincerely,

Jeff Devaney
PASSUR Aerospace, Inc.
Chief Financial Officer

Steve Simmons
Mosaic ATM, Inc.
Chief Financial Officer

Acting jointly and severally

PASSUR. AEROSPACE NOW

MOSAIC ATM

August 8, 2011

The Port Authority of NY & NJ
Purchasing Services Division
One Madison Avenue, 7th Fl.
New York, NY 10010

Re: Request For Proposals No. 24997

Ladies and Gentlemen:

Reference is made to that certain Request for Proposals for Surface Management System at John F. Kennedy International Airport (JFK), No. 24997 (the "Request for Proposals"), made by The Port Authority of NY & NJ (the "Authority"). In response to the Request for Proposals, the undersigned submitted a proposal to the Authority on August 5, 2011 (the "Proposal").

In connection with the Proposal, each of the undersigned hereby acknowledges that:

(1) the Parties have formed a common law joint venture in connection with the Request for Proposals, and have jointly submitted the Proposal on behalf of such common law joint venture; and

(2) each Party shall be held jointly and severally liable to the Authority for, and must individually execute and perform all acts required by, the Proposal.

[*signature page follows*]

Very truly yours,

PASSUR AEROSPACE, INC.

By: _____
Name: JAMES T. BAKKY
Title: President + CEO.

Accepted and agreed to
this 4th day of August, 2011

MOSAIC ATM, INC.

By: _____
Name: Christopher R. Brinkin
Title: President

PASSUR AEROSPACE, INC.

CERTIFICATE OF SECRETARY

I, Jeffrey P. Devaney, the duly elected and qualified Secretary of PASSUR Aerospace, Inc. (the "Company"), do hereby certify to the best of my knowledge and belief as follows:

1. Attached hereto as Exhibit A is a true, correct and complete composite copy of the Company's Certificate of Incorporation as in full force and effect on the date hereof. The attached composite copy reflects the Company's Certificate of Incorporation and all amendments made thereto through the date hereof. No further amendment of the Company's Certificate of Incorporation has been made and no action has been taken by the Company in contemplation of any such amendment or restatement.

IN WITNESS WHEREOF, the undersigned has executed this Certificate of Officer as of this 11 day of July, 2011.

Name: Jeffrey P. Devaney
Title: Secretary

COMPOSITE

CERTIFICATE OF INCORPORATION

OF

PASSUR AEROSPACE, INC.

FIRST: The name of the Corporation is PASSUR Aerospace, Inc.

SECOND: The purposes for which it is formed are as follows:

(a) To engage in the business of manufacturing, creating, compounding, developing, inventing, owning, acquiring, producing, processing, constructing, storing, assembling, preparing for market, exhibiting, distributing, installing, buying, selling, leasing, renting, mortgaging, licensing, exchanging, reconstructing, repairing, importing, exporting, and otherwise dealing with instruments, machinery, raw materials, natural or manufactured products, devices, systems, parts, supplies, apparatus, personal property, goods, wares, equipment, and merchandise of every kind, nature and description, tangible or intangible.

(b) To engage in any mercantile distributing or trading business of any kind, character or description whatever within or without the State of New York or the United States of America. To buy and sell as broker, representative or agent or on its own account at wholesale and/or retail. To import, export, acquire, own, exchange, barter, transfer, contract, lease, encumber, prepare for market, package, distribute, ship, service, install, repair, alter, conduct, operate and deal with all goods, wares and merchandise of all types and every description.

(c) To develop, apply for, obtain, register, purchase, lease, or otherwise acquire, and to hold, own, exercise, use, operate and introduce, any trade names, trademarks, labels, brands, designs, patents, inventions, improvements and processes, and to sell, lease, license, assign, pledge or dispose of any of the same, or any rights, privileges or interests in any of them, and to carry on any similar business, manufacturing or otherwise, which may be directly or indirectly necessary to effectuate these objects or any of them, provided always that this shall not be deemed to include any

business except such as is permitted by the Corporation Laws of the State of New York.

(d) To carry on and conduct a general agency business, to act, and to appoint others to act, as general agent, special agent, broker, factor, manufacturers' agent, purchasing agent, sales agent, distributing agent, representative and commission merchant, for individuals, firms, associations, and corporations in the distribution, delivery, purchase, and sale of goods, wares, merchandise, property, commodities, and articles of commerce of every kind and description, and in selling, promoting the sale of, advertising, and introducing, and contracting for the sale, introduction, advertisement, and use of, services of all kinds, relating to any and all kinds of businesses, for any and all purposes.

(e) As principal, agent or broker and on commission or otherwise, to acquire, by purchase or otherwise, hold, own, develop, improve, repair, manage, maintain, rent, sell, convey, exchange, trade in and dispose of real property or any estate, interest or right therein; to erect, construct, alter, maintain, improve, demolish, raze, wreck and abandon buildings and structures of every kind and nature on any lands of the Corporation or upon any other lands, and to rebuild, alter and improve existing buildings and structures of every kind and nature to the extent now or hereafter permitted by law; to act as a loan broker; to lend money, whether secured by mortgages, mortgage bonds or other liens on real estate or unsecured.

(f) To purchase, acquire, hold and dispose of the stocks, bonds and other securities or evidences of indebtedness of any corporation, domestic or foreign; and to pay cash therefor or to issue in exchange therefor this corporation's stock, bonds, or other obligations, and while owner of any such stock, bonds or other obligations, to possess and exercise in respect thereof all rights, powers and privileges of individual owners or holders thereof and to exercise any and all voting powers thereon.

(g) To acquire the good will, rights and property of any other persons, firm, association or corporation engaged in any of the trades or businesses authorized to be carried on under this certificate of incorporation and to pay cash therefor or to issue or exchange therefor this corporation's stocks, bonds or other obligations, and to hold or in any manner dispose of the whole or any part of the property so purchased, or to conduct in any lawful manner the whole or any part of the business so acquired, and to exercise all the powers necessary or convenient in and about the conducting and management of such business.

(h) To purchase, hold, sell, transfer, reissue or cancel the shares of its own capital stock or any securities or other obligations of the corporation in the manner and to the extent now or hereafter permitted to corporations organized under the laws of the State of New York.

(i) To borrow or raise moneys for any of the purposes of this corporation, without limit as to amount, and in connection therewith to furnish collateral or other security either alone or jointly with any other person, firm or corporation; to make, execute, draw, accept, endorse, pledge, issue, sell or otherwise dispose of promissory notes, warrants, bonds, debentures and other evidence of indebtedness, negotiable or non-negotiable, transferable or non-transferable, secured or unsecured; to confer upon the holders of any of the obligations of this corporation such powers, rights and privileges as from time to time may be deemed advisable by the Board of Directors, to the extent permitted under the laws of the State of New York; to lend and advance money, extend credit, take notes, open accounts and any other evidence of indebtedness in connection therewith, whether secured or unsecured.

(j) To make any guarantee respecting dividends, stock, bonds, contracts or other obligations of any other corporations or associations in which this corporation has or may have an interest so far as the same may be permitted by corporations organized under the corporation laws of the State of New York.

(k) To have one or more offices, to carry on all or any of its operations and business, and, without restrictions or limit as to amount, to purchase or otherwise acquire, to hold, own, mortgage, sell, convey or otherwise dispose of real and personal property of every class and description in any of the states, districts, territories or colonies of the United States and in any and all foreign countries, subject to the laws of such state, district, territory, colony or country.

(l) To carry on any of the above businesses or any business connected therewith wherever the same may be permitted by law, and to the same extent as the laws of this State will permit and as fully and with all the powers that the laws of this State confer upon corporations or organizations under this Act, and to do any and all of the business above mentioned and set forth to the same extent as natural persons might or could do.

(m) To undertake, contract for or carry on any business incidental to or in aid of, or advantageous in pursuance of any of the objects or purposes of the corporation.

(n) To do any of the things hereinbefore enumerated, for itself or for account of others, and to enter into, make, perform and carry out contracts, agreements or arrangements of every sort and kind for doing any part thereof which may be necessary or convenient for the business of this corporation, or business of a similar nature, with any person, entity, syndicate, partnership, association, trust or governmental or public authority, domestic or foreign, so far as and to the extent that the same may be done and performed by corporations organized under the New York Business Corporation Law.

(o) To act generally as principal, agent, factor, representative, dealer, exporter, or importer, and in one or more of said capacities, to do, perform and carry out any and all of the purposes hereinbefore set forth.

(p) In general, to carry on any other similar business in connection with the foregoing, and to have and exercise all the powers conferred by the laws of New York upon corporations formed under the Act hereinbefore referred to, and to do any or all of the things hereinbefore set forth to the same extent as natural persons might or could do.

The foregoing clauses shall be construed as describing both purposes and objects, and powers, and it is hereby expressly provided that the foregoing enumeration of specific powers shall not be held to limit or restrict in any manner the power of this Corporation.

THIRD: The office of the location is to be located in the Town of Deer Park, County of Suffolk, State of New York.

FOURTH: The aggregate number of shares which the Corporation shall have authority to issue is fifteen million (15,000,000), of which Ten Million (10,000,000) shares shall be Common Stock, par value $0.01 per share, and Five Million (5,000,000) shares shall be Preferred Stock, par value $.01 per share.

The Preferred Stock may be issued from time to time in one or more series. The Board of Directors of the Company is hereby expressly authorized to provide, by resolution or resolutions duly adopted by it prior to issuance, for the creation of each such series and to fix the designation and the powers, preferences, rights, qualifications, limitations and restrictions relating to the shares of each such series. The authority of the Board of the Directors with respect to each series of Preferred Stock shall include, but not be limited to, determining the following:

(a) the designation of the series and the number of shares to constitute such series (which number may be increased or decreased from time to time unless otherwise provided by the Board of Directors);

(b) the dividend rate (or method of determining such rate), any conditions on which and times at which dividends are payable, the preference or relation which such dividends shall bear to the dividends payable on any other class or classes or of any other series of capital stock including the Preferred Stock, and whether such dividends shall be cumulative or non-cumulative;

(c) whether the series will be redeemable (at the option of the Company or the holders of such shares or both, or upon the happening of a specified event) and, if so, the redemption prices and the conditions and times upon which redemption may take place and whether for cash, property or rights, including securities of the company or another corporation;

(d) whether the shares of such series shall be subject to the operation of a retirement or sinking fund and, if so, the extent to and manner in which any such retirement

or sinking fund shall be applied to the purchase or redemption of the shares of such series for retirement or other corporate purposes and the terms and provisions relating to the operation thereof;

(e) the conversion or exchange rights (at the option of the Company or the holders of such shares or both, or upon the happening of a specified event), if any, including the conversion or exchange times, prices, rates, adjustments and other terms of conversion or exchange;

(f) whether the shares of such series shall have voting rights in addition to any voting rights provided as a matter of law and, if so, the terms of such voting rights, which may be general or limited;

(g) the conditions or restrictions, if any, upon the creation of indebtedness of the Company or upon the issue or reissue or sale of any additional stock, including additional shares of such series or of any other series of Preferred Stock or of any other class;

(h) the rights of the holders upon voluntary or involuntary liquidation, dissolution or winding up of the affairs of the Company or upon any dissolution of the assets of the Company (including preferences over the Common Stock or other class or classes or series of capital stock including the Preferred Stock);

(i) the preemptive rights, if any, to subscribe to additional issues of stock or securities of the Company;

(j) the limitations and restrictions, if any, to be effective while any shares of such series are outstanding upon the payment of dividends or the making of other distributions on, and upon the purchase, redemption or other acquisition by the Company of, the Common Stock or shares of stock of any other class or any other series of Preferred Stock; and

(k) such other special rights and privileges, if any, for the benefit of the holders of the Preferred Stock, as shall not be inconsistent with the provisions of the Certificate of Incorporation, as amended, or applicable law.

All shares of Preferred Stock redeemed, purchased or otherwise acquired by the Company (including shares surrendered for conversion) shall be cancelled and thereupon restored to the status of authorized but unissued shares of Preferred Stock undesignated as to series.

Except as otherwise may be required by law, and except as otherwise may be provided in this Certificate of Incorporation, as amended, or in the resolution of the Board of Directors of the Company creating any series of Preferred Stock, the Common Stock shall have the exclusive right to vote for the election of directors and for all other purposes, each holder of the Common Stock being entitled to one vote for each share thereof held.

FIFTH: The Secretary of State is designated as the agent of the Corporation upon whom process against the Corporation may be served. The post office address to which the Secretary of State shall mail a copy of any process against the Corporation served upon him is 35 Orville Drive, Bohemia, New York 11716.

SIXTH: No holders of shares of the Corporation or any class, now or hereafter authorized, shall have any preferential or preemptive right to subscribe for, purchase or receive any shares of the Corporation of any class, now or hereafter authorized, or any options or warrants for such shares, or any rights to subscribe to or purchase such shares, or any securities convertible into or exchangeable for such shares, which may at any time be issued, sold or offered for sale by the Corporation.

SEVENTH: No director of the Corporation shall be personally liable to the Corporation or its shareholders for monetary damages for any breach of duty as a director, except for liability of any director if a judgment or other final adjudication adverse to him establishes that his acts or omissions were in bad faith or involved intentional misconduct or a knowing violation of law or that he personally gained in fact a financial profit or other advantage to which he was not legally entitled or that his acts violated section 719 of the New York Business Corporation Law. Any repeal or modification of this Article or adoption or an inconsistent provision shall not adversely affect any right or protection of a director of the Corporation in respect of any matter occurring, or any cause of action, suit, or claim that would accrue or arise prior to such repeal, modification, or adoption of an inconsistent provision.

EIGHTH:

I. **Certain Restrictions on the Transfer of Stock.** In order to preserve the Tax Benefits (as such term is hereinafter defined), the restrictions set forth below shall apply for the period beginning on the ARTICLE EIGHTH Effective Date (as such term is hereinafter defined) and ending on the Expiration Date (as such term is

hereinafter defined), unless the Board of Directors shall fix an earlier or later date in accordance with Section VI of this ARTICLE EIGHTH:

A. Definitions.

1. Article Eighth Effective Date. March 2, 2000, which date is the date of the filing of this Amendment to this Corporation's Certificate of Incorporation with the Department of State of the State of New York.

2. Control. The possession, direct or indirect, of the power to direct or cause the direction of the management and policies of a Person (as such term is hereinafter defined), whether through the ownership of voting securities, by contract, or otherwise. Such definition shall also apply to the terms "controlling," "controlled by" and "under common control with."

3. Expiration Date. November 30, 2000.

4. Internal Revenue Code. The Internal Revenue Code of 1986, as amended. Any reference to a particular Section or provision of the Internal Revenue Code shall be deemed to also refer to any successor Section or provision having similar effect.

5. Ownership Change. An "ownership change" with respect to the Company, as that term is used in Section 382(g) of the Internal Revenue Code and Treasury Regulations Section 1.382-2T(a)(1).

6. Other Permitted Holders. Any Person which has a Prohibited Ownership Percentage permitted under this Section I, whether pursuant to a consent of the Board of Directors or otherwise.

7. Person. Any individual, corporation, estate, trust, association, company, partnership, joint venture, or similar organization, or any other entity described in Treasury Regulations Section 1.382-3(a)(1)(i).

8. Prohibited Ownership Percentage. Any ownership in the Company that would cause a Person or Public Group (as such term is hereinafter defined) to be a "5-percent shareholder" of the Company within the meaning of Treasury Regulations Section 1.382-2T(g)(1)(i) or (ii). For this purpose, whether a Person or Public Group would be a "5-percent shareholder" shall be determined (u) by substituting "4.5 percent" for "5 percent" each place it appears in such provisions, (v) without giving effect to the following provisions: Treasury Regulations Sections

1.382-2T(g)(2), 1.382-2T(g)(3), 1.382-2T(h)(2)(iii) and 1.382-2T(h)(6)(iii), (w) by treating every Person or Public Group which owns Stock, whether directly or by attribution, as directly owning such Stock notwithstanding any further attribution of such Stock to other Persons and notwithstanding Treasury Regulations Section 1.382-2T(h)(2)(i)(A), (x) by substituting the term "Person" in place of "individual" in Treasury Regulations Section 1.382-2T(g)(1)(i), (y) by taking into account ownership of Stock at any time during the "testing period" as defined in Treasury Regulations Section 1.382-2T(d)(1), and (z) by treating each day during the testing period as if it were a "testing date" as defined in Treasury Regulations Section 1.382-2(a)(4). In addition, for the purpose of determining whether any Person or Public Group has a Prohibited Ownership Percentage as of any date, the definition of Stock set forth in Subparagraph A(10) of this Section I shall be applied in lieu of the definition in Treasury Regulations Section 1.382-2T(f)(18), except that any option shall be treated as Stock only to the extent that treating it as Stock would cause an increase in ownership of such Person and such option would be deemed exercised pursuant to Treasury Regulations in effect from time to time

(disregarding whether treating such option as exercised would cause an ownership change).

9. Public Group. A "public group" with respect to the Company, as that term is used in Treasury Regulations Section 1.382-2T(f)(13), excluding any "direct public group" with respect to the Company, as that term is used in Treasury Regulations Section 1.382-2T(j)(2)(ii).

10. Stock. All classes of stock of the Company, all options to acquire stock of the Company and all other interests that would be treated as stock in the Company pursuant to Treasury Regulations Section 1.382-2T(f)(18)(iii), other than (x) stock described in Section 1504(a)(4) of the Internal Revenue Code and (y) stock that would be described in such Section 1504(a)(4) but is not so described solely because it is entitled to vote as a result of dividend averages. As used in this ARTICLE EIGHTH, the term "option" shall have the meaning set forth in Treasury Regulations Section 1.382-2T(h)(4).

11. Tax Benefits. The net operating loss carryovers and capital loss carryovers to which the Company is entitled under the Internal Revenue Code, free of restrictions under Section 382 of the Internal Revenue Code.

12. Testing Date Action. Any Transfer or acquisition of Stock or any other action (including the acquisition or issuance of an option to Transfer or acquire Stock), if the effect of such Transfer, acquisition or other action would be to cause a "testing date" with respect to the Company within the meaning of Treasury Regulations Section 1.382-2(a)(4), determined by treating every Person and Public Group which has a Prohibited Ownership Percentage as a 5-percent shareholder as used in such Section.

13. Transfer. Any means of conveyance of legal or beneficial ownership of Stock, whether such ownership is direct or indirect, voluntary or involuntary, including, without limitation, an indirect transfer of ownership through the transfer of any ownership interest of any entity that owns Stock.

14. Transferee Undertaking. A duly executed undertaking for the benefit of the Company by any transferee pursuant to which the transferee agrees that (i) it will not take any of the following actions without the prior consent of the Board of Directors: (x) acquire any additional Stock, (y) Transfer any Stock in violation of Paragraph B of this Section I, or (z) take or cause to be taken any Testing Date Action, (ii) upon request by the Company, it will furnish or cause to be

furnished to the Company all certificates representing Stock held of record or beneficially, directly or indirectly, by it or by any Person, controlling, controlled by or under common control with it for the purpose of placing a legend on such certificates to reflect the undertakings described in clause (i) above, (iii) it acknowledges that "stop transfer" orders may be entered with the transfer agent (or agents) and the registrar (or registrars) of Stock against the transfer of Stock subject to the undertakings described in clause (i) above except in compliance with the requirements of such undertakings, and (iv) it will agree to such other actions and remedies as the Company may reasonably request in order to preserve the Tax Benefits.

15. Treasury Regulations. The regulations promulgated by the Secretary of the Treasury under the Internal Revenue Code. Any reference to a particular Treasury Regulation or Section or provision thereof shall be deemed to also refer to any successor Regulation or Section or provision having similar effect.

B. Transfer Restrictions. The following Transfers and actions shall be prohibited, unless (i) the Board of Directors has consented to such transfer and (ii) the transferee has entered into a Transferee Undertaking:

1. General. No Person shall Transfer any Stock to any other Person to the extent that such Transfer, if effected, (i) would cause the transferee or any Person or Public Group to have a Prohibited Ownership Percentage, or (ii) would increase the ownership percentage of any transferee or any Person or Public Group having a Prohibited Ownership Percentage within the three-year period ending on and including the date of such Transfer.

2. Additional Restrictions On Transfers Involving Other Permitted Holders. In addition to the restrictions under Subparagraph B(1) above, (i) no Other Permitted Holder shall Transfer any Stock, and no other Person shall Transfer any Stock to an Other Permitted Holder, if, in either case, such Transfer would constitute a Testing Date Action, and (ii) no Other Permitted Holder shall take any other action that would constitute a Testing Date Action.

3. Additional Restrictions Under Transferee Undertakings. In addition to the restrictions under Subparagraph B(1) above, (i) no Person who has delivered a Transferee Undertaking shall Transfer any Stock, and no Person shall Transfer any Stock to any Person who has delivered a Transferee Undertaking, if, in either case, such Transfer would result in a violation of such Transferee Undertaking, and (ii) no

Person who has delivered a Transferee Undertaking shall take or cause to be taken any other action that would constitute a Testing Date Action.

C. Permitted Transfers. Unless otherwise restricted under Paragraph B of Section I or under a Transferee Undertaking or other agreement, Transfers of Stock may be made without a consent of the Board of Directors.

D. Waivers. Notwithstanding anything herein to the contrary, the Board of Directors may waive any of the restrictions contained in Paragraph B of this Section I of this ARTICLE EIGHTH: (1) in the event of a tender or exchange offer within the meaning of the Securities Exchange Act of 1934, as amended, to acquire Stock constituting more than fifty percent in value of the outstanding Common Stock of the Company, so long as such waiver shall apply to all Transfers pursuant to such tender or exchange offer; (2) in connection with any Transfers of Stock in connection with underwritten offerings of such Stock; (3) in connection with any investment in or acquisition of a business or any business combination involving the Company or any subsidiary of the Company; and (4) in any other instance in which the Board of Directors reasonably and in good faith determines that a waiver would be in the best interests of the Company.

II. **Attempted Transfer In Violation Of Transfer Restrictions.** Unless the consent or waiver of the Board of Directors is obtained and except as provided in Paragraph C of Section II below, any attempted Transfer of shares of Stock of the Company in excess of the shares that could be Transferred to the transferee without restriction under Paragraph B of Section I above shall not be effective to transfer ownership of such excess shares (the "Prohibited Shares") to the purported acquiror thereof (the "Purported Acquiror"), and the Purported Acquiror shall not be entitled to any rights as a shareholder of the Company with respect to the Prohibited Shares, including, without limitation, the right to vote or to receive dividends with respect thereto. Nothing contained in this ARTICLE EIGHTH shall preclude the settlement of any transaction involving Stock entered into through the facilities of any national securities exchange. The application of the provisions and remedies described in the first sentence of this Section II and in Paragraphs A, B and C of this Section II this shall be deemed not to so preclude any such settlement. Paragraphs A, B and C below shall apply only in the case of violations of the restrictions contained in Subparagraph B(1) of Section I above.

A. Transfer Of Certificates; Sale Of Stock. Upon demand by the Company, the Purported Acquiror shall transfer any certificate or other evidence of purported ownership of the Prohibited Shares within the Purported Acquiror's possession or control, together with any dividends or other distributions paid by the Company with respect to the Prohibited Shares that were received by the Purported Acquiror (the "Prohibited Distributions"), to an agent to

be designated by the Company (the "Agent"). If the Purported Acquiror has sold the Prohibited Shares to an unrelated party in an arm's-length transaction after purportedly acquiring them, the Purported Acquiror shall be deemed to have sold the Prohibited Shares for the Agent, and in lieu of transferring the Prohibited Shares and Prohibited Distributions to the Agent shall transfer to the Agent the Prohibited Distributions and the proceeds of such sale (the "Resale Proceeds") except to the extent that the Agent grants written permission to the Purported Acquiror to retain a portion of the Resale Proceeds not exceeding the amount that would have been payable by the Agent to the Purported Acquiror pursuant to Paragraph B of this Section II if the Prohibited Shares had been sold by the Agent rather than by the Purported Acquiror. Any purported Transfer of the Prohibited Shares by the Purported Acquiror, other than a transfer described in one of the two preceding sentences (unless such transfer itself violates the provisions of this ARTICLE EIGHTH), shall not be effective to transfer any ownership of the Prohibited Shares.

B. Allocation And Distribution Of Proceeds. The Agent shall sell to a Person whose ownership of such shares would not exceed the Prohibited Owner Percentage in an arm's-length transaction any Prohibited Shares transferred to the Agent by the Purported Acquiror, and the proceeds of such sale (the "Sale Proceeds"), or

the Resale Proceeds, if applicable, shall be allocated to the Purported Acquiror up to the following amount: (1) where applicable, the purported purchase price paid or value of consideration surrendered by the Purported Acquiror for the Prohibited Shares and (2) where the purported Transfer of the Prohibited Shares to the Purported Acquiror was by gift, inheritance, or any similar purported transfer, the fair market value of the Prohibited Shares at the time of such purported Transfer. Any Resale Proceeds or Sales Proceeds in excess of the amount allocable to the Purported Acquiror pursuant to the preceding sentence, together with any Prohibited Distributions (such excess amount and Prohibited Distributions are collectively the "Subject Amounts"), shall be transferred to an entity designated by the Company that is described in Section 501(c)(3) of the Internal Revenue Code (the "Designated Charity"). In no event shall any such Prohibited Shares or Subject Amounts inure to the benefit of the Company or the Agent, but such Subject Amounts may be used to cover expenses incurred by the Agent in performing its duties.

C. Limitation On Enforceability. Notwithstanding anything herein to the contrary, with respect to any Transfer of Stock which would cause a Person or Public Group (the "Prohibited Party") to violate a restriction provided for in Subparagraph B(1) of Section I above only on account of the attribution to the Prohibited Party of the

ownership of Stock by a Person or Public Group which is not controlling, controlled by or under common control with the Prohibited Party, which ownership is nevertheless attributed to the Prohibited Party, Subparagraph B(1) of Section I above shall not apply in a manner that would invalidate such Transfer. In such case, the Prohibited Party and any Persons controlling, controlled by or under common control with the Prohibited Party (collectively the "Prohibited Party Group") shall automatically be deemed to have disposed of, and shall be required to dispose of, sufficient shares of Stock (which shares shall consist only of shares held legally or beneficially, whether directly or indirectly, by any member of the Prohibited Party Group, but not shares held through another Person, other than shares held through a Person acting as agent or fiduciary for any member of the Prohibited Party Group, and which shares shall be disposed of in the inverse order in which they were acquired by members of the Prohibited Party Group) to cause the Prohibited Party, following such disposition, not to be in violation of Subparagraph B(1) of Section I above, provided that in the event no member of the Prohibited Party Group (i) is an Other Permitted Holder and (ii) had any actual knowledge that such Transfer was prohibited under Subparagraph 8(1) of Section I above, such disposition shall only be effected to the extent necessary in order to prevent an Ownership Change. Such disposition shall be deemed to occur simultaneously with the

Transfer giving rise to the application of this provision, and such number of shares which are deemed to be disposed of shall be considered Prohibited Shares and shall be disposed of through the Agent as provided in Paragraph B of this Section II, except that the maximum amount payable to the Prohibited Party in connection with such sale shall be the fair market value of the Prohibited Shares at the time of the Prohibited Transfer.

D. Other Remedies. In the event that the Board of Directors determines that a Person proposes to take any action in violation of Paragraph B of Section I above, or in the event that the Board of Directors determines after the fact that an action has been taken in violation of Paragraph B of Section I, the Board of Directors, subject to the second and third sentences of the introductory paragraph of this Section II, may take such action as it deems advisable to prevent or to refuse to give effect to any Transfer or other action which would result, or has resulted, in such violation, including, but not limited to, refusing to give effect to such Transfer or other action on the books of the Company or instituting proceedings to enjoin such Transfer or other action. If any Person shall knowingly violate Paragraph B of Section I, then that Person and all other Persons controlling, controlled by or under common control with such Person shall be jointly and severally liable for, and shall pay to the Company, such amount as will, after taking

account of all taxes imposed with respect to the receipt or accrual of such amount and all costs incurred by the Company as a result of such loss, put the Company in the same financial position as it would have been in had such violation not occurred.

III. **Prompt Enforcement Against Purported Acquiror**. Within 30 business days of learning of a purported Transfer of Prohibited Shares to a Purported Acquiror or a Transfer of Stock to a Prohibited Party, the Company through its Secretary shall demand that the Purported Acquiror or Prohibited Party surrender to the Agent the certificates representing the Prohibited Shares, or any Resale Proceeds, and any Prohibited Distributions, and if such surrender is not made by the Purported Acquiror or Prohibited Party within 30 business days from the date of such demand, the Company shall institute legal proceedings to compel such surrender; provided, however, that nothing in this Section III shall preclude the Company in its discretion from immediately bringing legal proceedings without a prior demand, and also provided that failure of the Company to act within the time periods set out in this Section III shall not constitute a waiver of any right of the Company to compel any transfer required by Section II above. Upon a determination by the Board of Directors that there has been or is threatened a purported Transfer of Prohibited Shares to a Purported Acquiror or a Transfer of Stock to a Prohibited Party or any other violation of Paragraph B of Section I above, the Board of Directors may authorize such additional action as it deems advisable to give effect to the provisions of this ARTICLE EIGHTH, including, without limitation, refusing to give effect on the books of the Company to any

such purported Transfer or instituting proceedings to enjoin any such purported Transfer.

IV. **Obligation To Provide Information**. The Company may require as a condition to the registration of the Transfer of any Stock that the proposed transferee furnish to the Company all information reasonably requested by the Company with respect to all the direct or indirect ownership of Stock by the proposed transferee and by Persons controlling, controlled by or under common control with the proposed transferee.

V. **Legends**. All certificates evidencing Stock that is subject to the restrictions on transfer set forth in this ARTICLE EIGHTH shall bear a conspicuous legend referencing such restrictions.

VI. **Further Actions**. Subject to the second and third sentences of the introductory paragraph of Section II, nothing contained in this ARTICLE EIGHTH shall limit the authority of the Board of Directors to take such other action to the extent permitted by law as it deems necessary or advisable to protect the Company and the interests of the holders of its securities in preserving the Tax Benefits. Without limiting the generality of the foregoing, in the event of a change in law (including applicable regulations) making one or more of the following actions necessary, in the case of actions described in clauses (B), (C) and (D) below, or desirable, in the case of actions described in clause (A) below, the Board of Directors may (A) accelerate the Expiration Date, (B) extend the Expiration Date, (C) conform any terms or numbers set forth in the transfer restrictions in Section I

above to make such terms consistent with the Internal Revenue Code and the Treasury Regulations following any changes therein to the extent necessary to preserve the Tax Benefits, or (D) conform the definitions of any terms set forth in this ARTICLE EIGHTH to the definitions in effect following such change in law; provided that the Board of Directors shall determine in writing that such acceleration, extension, change or modification is reasonably necessary to preserve the Tax Benefits or that the continuation of these restrictions is no longer reasonably necessary for the preservation of the Tax Benefits, which determination shall be based upon an opinion of legal counsel to the Company and which determination shall be filed with the Secretary of the Company and mailed by the Secretary to all stockholders of the Company within ten days after the date of any such determination.

VII. **Severability**. If any provision of this ARTICLE EIGHTH or the application of any such provision to any Person or under any circumstance shall be held invalid, illegal, or unenforceable in any respect by a court of competent jurisdiction, such invalidity, illegality or unenforceability shall not affect any other provision of this ARTICLE EIGHTH.

As amended through February 19, 2010

MOSAIC ATM, INC.

CERTIFICATE OF SECRETARY

I, Stephen C. Atkins, the duly elected and qualified Secretary of Mosaic ATM, Inc. (the "Company"), do hereby certify to the best of my knowledge and belief as follows:

1. Attached hereto as Exhibit A is a true, correct and complete copy of the Company's Certificate of Incorporation, as amended as of April 1, 2010, certified by the Secretary of State of the State of Virginia and in full force and effect on the date hereof. No further amendment of the Company's Certificate of Incorporation has been made and no action has been taken by the Company in contemplation of any such amendment or restatement.

IN WITNESS WHEREOF, the undersigned has executed this Certificate of Officer as of this 28th day of July, 2011.

Name: Stephen C. Atkins
Title: Secretary

EXHIBIT A

Commonwealth of Virginia

STATE CORPORATION COMMISSION

Richmond, August 11, 2004

This is to certify that the certificate of incorporation of

Mosaic ATM, Inc.

was this day issued and admitted to record in this office and that the said corporation is authorized to transact its business subject to all Virginia laws applicable to the corporation and its business. Effective date: August 11, 2004

State Corporation Commission
Attest:

Joel H. Peck
Clerk of the Commission

CIS0313

Executive Summary

This submission in response to Request for Proposals for a Surface Management System (SMS) at John F. Kennedy International Airport (PANYNJ RFP #24997) is tendered as a Common Law Joint Venture between PASSUR Aerospace, Inc. (PASSUR) and Mosaic ATM, Inc. (Mosaic), referred to for the purposes of this proposal as the PASSUR Mosaic Joint Venture, or PMJV.

This proposal builds on PASSUR's partnership with the Port Authority, which pioneered the successful departure metering program at JFK which has operated for the past 18 months and evolved from the earlier winter operations and field condition reporting program, in place for the past eight years. The departure metering program resulted in widely recognized benefits and the successful migration from the Bay Runway closure period into full-time departure metering.

The proposal meets or exceeds each of the Port Authority's RFP requirements, eliminates technical, operational, legal, and compatibility risks which would be associated with transitioning to a new provider, and introduces significant new levels of automation and analytics as well as reduced labor requirements. As a result, the monthly operating fee for Phase A of the program is lower than the current departure metering program's monthly fee, while the monthly fee for Phase B is only a minimal increase over the current PASSUR pricing.

PASSUR leads an excellent team of partners who contribute new technical capabilities: Mosaic and ARINC (as a subcontractor). PASSUR will manage the entire SMS program. The customer and end user will access all SMS solutions on the enhanced PASSUR integrated traffic management platform.

Highlights of the PMJV SMS proposal

- **Increased automation in Phase A and Phase B,** particularly related to airline slot (taxi time) management (reducing the levels of airline workload) – including automated slot swap, automated substitution modeling, and automated flight "ready state" information.
- **Experienced, proven team of aviation professionals** who have successfully managed the first phase of surface management at JFK and who bring a thorough understanding of the New York and national airspace, JFK surface operation, and organizational relationships at JFK.
- **Enhanced surface management predictive analytics** to enable efficient queue management, sequencing, allocation, and surface conflict resolution, through the integration of the Mosaic Predictive Engine (MPE) – the pioneering surface management technology suite developed for NASA and the FAA and currently deployed at several airports.
- **A single visual platform for integrated flight tracking**– en route, terminal, and surface.
- **A full suite of new live and post-operational** surface performance analysis tools, powered by the Mosaic Surface Operations Data Analysis and Adaptation (SODAA) engine – all accessed on the integrated PASSUR interface.

- **Major enhancements to the PASSUR OPSnet collaborative platform** to further facilitate wide distribution of critical airport information to key users, including runway and taxiway status visualization on the SMS airport map, and detailed field condition reports. Pioneered by the partnership between PASSUR and the Port Authority, PASSUR OPSnet is now used by many of the world's largest airports and airlines.
- **Integration of airline "ready state" data feeds** directly from ARINC as a single-source feed – greatly simplifying the acquisition of this critical data set.

A program successfully used by major airports, airlines, and the U.S. government

The PASSUR solutions, supported by the PASSUR operational team, are used by more than 50 airports, dozens of airlines (including five of the top six North American airlines, all five of the top hub carriers, and all of the major carriers at JFK), more than 50 airport customers (including 23 of the top 30 North American airports), approximately 200 corporate aviation customers, as well as the U.S. government, including the Federal Aviation Administration (FAA) and the Transportation Security Administration (TSA).

Partnering with a leader in surface management

Mosaic is the recognized leader in the study and development of the Surface Decision Support System (SDSS) and of its precursor technologies and systems, including Surface Management System (SMS). Three of the four recognized inventors of SMS are employees of Mosaic (the fourth is retired) and lead the continuing surface decision support tool analysis and research. Mosaic has been instrumental in the delivery of several of the most successful surface management system programs to date, including Memphis, TN, Louisville, KY, and Orlando, FL. It has also been involved in the development of several seminal and related traffic management programs and standards for the FAA and NASA, such as Surface Trajectory Based Operation (STBO), Collaborative Departure Queue Management (CDQM), and the Flight Operator Surface Application (FOSA interface standard).

A continuation of a successful program

A study conducted by MIT Lincoln Laboratory/PASSUR of the JFK metering program estimates that the program, on an annualized basis, has reduced flight taxi time by 14,800 hours, and cut fuel burn by 5 million gallons for a savings to airlines of between $10-$15 million, and a reduction of 48,000 metric tons of CO_2. The JFK metering program is heralded as one of the early, real-world successes of NextGen.

Pricing

Phase A pricing includes the PASSUR Professional Services team and increased automation as outlined in the Scope of Work. The monthly price of $74,250 – reduced from the current price with all the additional capabilities included – reflects the accretion of experience and knowledge gained in the last 18 months and a reduction in required labor.

Phase B pricing reflects the established and proven surface management capabilities of the PASSUR team and includes all capabilities outlined in the Scope of Work at a monthly price of $90,000.
In addition to the monthly fees, the proposal includes a separate one-time set up price of $356,643 to cover the costs of systems engineers and technical writers required for the development of 35 technical manuals as well as the costs of set-up training for Phase A and Phase B.

ATTACHMENT A
AGREEMENT ON TERMS OF DISCUSSION

The Port Authority's receipt or discussion of any information (including informatio contained in any proposal, vendor qualification, ideas, models, drawings, or othe material communicated or exhibited by us or on our behalf) shall not impose an obligations whatsoever on the Port Authority or entitle us to any compensation therefo (except to the extent specifically provided in such written agreement, if any, as may b entered into between the Port Authority and us). Any such information given to the Por Authority before, with or after this Agreement on Terms of Discussion ("Agreement") either orally or in writing, is not given in confidence. Such information may be used, o disclosed to others, for any purpose at any time without obligation or compensation an without liability of any kind whatsoever. Any statement which is inconsistent with thi Agreement, whether made as part of or in connection with this Agreement, shall be voi and of no effect. This Agreement is not intended, however, to grant to the Port Authorit rights to any matter, which is the subject of valid existing or potential letters patent. Th foregoing applies to any information, whether or not given at the invitation of th Authority.

Notwithstanding the above, and without assuming any legal obligation, the Por Authority will employ reasonable efforts, subject to the provisions of the Port Authority's Freedom of Information Policy and Procedure adopted by the Port Authority's Board o Commissioners on November 20, 2008, which may be found on the Port Authorit website at: *http://www.panynj.gov/corporate-information/pdf/Freedom-of-Information-Policy-and-Procedure.pdf*, not to disclose to any competitor of the undersigned, information submitted which are trade secrets or is maintained for the regulation o supervision of commercial enterprise which, if disclosed, would cause substantial injur to the competitive position of the enterprise, and which information is identified by the Proposer as proprietary, which may be disclosed by the undersigned to the Port Authority as part of or in connection with the submission of a proposal.

PASSUR AEROSPACE, INC. MOSAIC ATM, INC.
(Company)

(Signature)

Chief Financial Officer Chief Financial Officer
(Title)

8/8/2011
(Date)

acting jointly and severally

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PART I – CONTRACT SPECIFIC TERMS AND CONDITIONS

Documentation of Proposer Prerequisites

This submission in response to Request for Proposals for a Surface Management System (SMS) at John F. Kennedy International Airport is tendered as a Common Law Joint Venture between PASSUR Aerospace, Inc. (PASSUR) and Mosaic ATM, Inc. (Mosaic), referred to for the purposes of this proposal as the PASSUR Mosaic Joint Venture, or PMJV.

The PASSUR Mosaic Joint Venture brings the best of industry knowledge and skill to support the Port Authority's needs and requirements

- Experience installing, operating, and maintaining surface management systems at four airports (including JFK), at airlines, and at air traffic control facilities (including hands-on direct operating experience, uniquely associated with the JFK departure metering program, unlike any other surface program in the U.S. to date).
- Experienced, proven team of aviation professionals who have successfully managed the first phase of surface management at JFK and who bring a thorough understanding of the New York and national airspace, JFK surface operation, and organizational relationships at JFK – and who can respond to any situation in a complex environment with extensive training and experience.
- All airlines at JFK have extensive exposure to PASSUR processes, staff, and systems
- Experience in airspace optimization solutions for multiple airlines.
- Experience delivering live, mission critical systems to airlines, airports, and the U.S. government.
- Technical expertise and experience implementing and managing similar services.

The PMJV certifies that it complies with and meets the RFP requirement that "the proposer shall have at least three (3) years of continuous experience prior to the date of the submission of its proposal in the development, installation, management, testing, and operation of a system that is specifically tailored to the function of improving overall surface and airspace system efficiency and predictability while enhancing safety, and shall actively be engaged in providing these capabilities to a commercial entity" including "in at least one airport environment." Upon the Authority's request, the PMJV will provide additional documentation containing sufficient detail for the Authority to verify that the PMJV meets the scope and term of prerequisite experience. Specific experience of each company is summarized below.

PASSUR Experience

PASSUR is a pioneer in surface management, including decision support, predictive analytics, collaborative processes, and overall business process improvement. For the past 10 years, PASSUR has partnered with airlines and airport operators at several large airports – including JFK, LGA, IAD, and DEN – to deliver surface management during winter operations. That program formed the foundation for a more comprehensive surface management program at JFK, which has been in place full-time since March 2010 and has been widely heralded as an early and significant NextGen success.

PASSUR has also been directly involved in airspace system efficiency for many years, including management of critical constraints such as Ground Delay Programs and other Traffic Management Initiatives, diversions, and hub management decisions (servicing arrivals and managing connections). All the major carriers at JFK use live, mission-critical PASSUR systems in their System Operations Control centers and many of their key Hub Operations Control centers, for management of key flight operations decision-points (diversion decisions, connection decisions, delay/cancellation decisions). In addition, the FAA and TSA rely on PASSUR live decision support systems for airspace security.

Mosaic Experience

Mosaic is the recognized leader in the study and development of the Surface Decision Support System (SDSS) and of its precursor technologies and systems, including Surface Management System (SMS). Three of the four recognized inventors of SMS are employees of Mosaic (the fourth is retired) and lead the continuing surface decision support tool analysis and research. Mosaic personnel led the SMS development and deployment efforts from Technology Readiness Level 1 (TRL1) through TRL 9. In addition to employing the inventors and developers of SMS, Mosaic has been responsible for maintaining the FAA's software baseline of SDSS since 2005.

Mosaic has been instrumental in the delivery of several of the most successful surface management system programs to date, including Memphis, TN, Louisville, KY, and Orlando, FL. It has also been involved in the development of several seminal and related traffic management programs and standards for the FAA and NASA, such as Surface Trajectory Based Operation (STBO), Collaborative Departure Queue Management (CDQM), and the Flight Operator Surface Application (FOSA interface standard).

Specific Experience of the PMJV

The PMJV has had more than three (3) years experience in the areas of prerequisites outlined in the RFP, as summarized below:

a. Surface Systems

1. JFK International Airport Departure Metering Program (PASSUR)
    a. Contracting party: Aviation Development Council, 141-07 20th Avenue, Suite 404, Whitestone, NY 11357
    b. Location where work is performed: JFK International Airport
    c. Duration of contract: 2/1/2010-present
    d. Approximate dollar value: $89,000/month
2. Snow Operations Assistance Program (software and staffing) and Field Condition Reporting (PASSUR)

a. Contracting party: Aviation Development Council, 141-07 20th Avenue, Suite 404, Whitestone, NY 11357

b. Locations where work is performed: JFK International Airport and LaGuardia Airport

c. Duration of contract:

i. Software systems: 12/1/2002-present

ii. Onsite staffing and management program: 12/1/2007-present

d. Approximate dollar value: $17,000/month

3. Snow Operations Assistance Program (software and staffing) and Field Condition Reporting (PASSUR)

a. Contracting party: Metropolitan Washington Airports Authority (MWAA), 1 Aviation Circle, Washington, DC 20001

b. Location where work is performed: Dulles International Airport

c. Duration of contract:

i. Software systems: 9/1/2004-present (and ongoing)

ii. Staffing and management program: 8/1/2008-present

d. Approximate dollar value: $22,000/month

4. NextGen Surface Trajectory-Based Operations (Mosaic)

a. Contracting party: FAA AWA; 800 Independence Ave SW, Washington, DC 20591

b. Locations where work is performed: Memphis Tower, Orlando Tower, Orlando TRACON, FAA Washington, D.C. Lab for JFK International Airport

c. Duration of contract: 8/1/2008 – 7/31/2013

d. Approximate dollar value: $9,275,446

5. UPS SDSS Support (Mosaic)

a. Contracting party: United Parcel Service Global Operations Center, 825 Lotus Ave, Louisville, KY 40213

b. Location where work is performed: Louisville International Airport

c. Duration of contract: 3/8/2007-present

d. Approximate dollar value: $5,000/month

6. Surface Operations Data Analysis and Adaptation (Mosaic)

a. Contracting party: NASA Ames Research Center, Mail Stop 210-10, Moffett Field, CA 94035-1000

b. Locations where work is performed: Leesburg, VA, and Dallas/Fort Worth International Airport

c. Duration of contract: 8/28/2009-10/31/2011

d. Approximate dollar value: $932,573

7. Development of weather translation models for traffic flow management (Mosaic)

   a. Contracting party: NASA Ames Research Center, Mail Stop 210-10, Moffett Field, CA 94035-1000

   b. Locations where work is performed: Leesburg, VA, and San Francisco International Airport

   c. Duration of contract: 12/15/2010-9/15/2013

   d. Approximate dollar value: $1,443,048

8. Tower Flight Data Manager (Mosaic)

   a. Contracting Party: MIT Lincoln Laboratory; 244 Wood Street, Lexington, MA 02420 (for FAA)

   b. Locations where work was performed: Cambridge, MA, and Leesburg, VA

   c. Duration of contract: 12/1/2009 – 5/13/2011

   d. Approximate dollar value: $1,381,345

b. Airborne Systems

1. Delta Air Lines (which includes pre-merger Northwest Airlines locations) – Hub Management, Diversion Management, Airspace Optimization (PASSUR)

   a. Contracting party: Delta Air Lines, P.O. Box 2070, Atlanta, GA 30320-6001

   b. Locations where work is performed: Delta OCC Atlanta; hub operations in BOS, JFK, MEM, SLC

   c. Duration of contract: March 2001-present

   d. Approximate dollar value: $50,000/month

2. United Airlines (which includes pre-merger Continental Airlines locations) – Hub Management, Diversion Management, Airspace Optimization (PASSUR)

   a. Contracting party: United Airlines, 77 West Wacker Drive, Chicago, IL 60601

   b. Locations where work is performed:

      i. UAL SOC Chicago and Houston; hub operations at IAD, ORD, SFO, DEN, JFK, LGA, LAX, NRT, EWR, IAH, CLE

   c. Duration of contract: July 2002-present

   d. Approximate dollar value: $100,000/month

3. American Airlines – Hub Management, Diversion Management (PASSUR)

   a. Contracting party: American Airlines

   b. Locations where work is performed:

i. AAL SOC Dallas/Fort Worth;

ii. Hub operations at ORD, MIA, LGA, LAX, JFK, DFW

c. Duration of contract: February 2009-present

d. Approximate dollar value: $85,000/month

4. US Airways – Hub Management (PASSUR)

   a. Contracting party: US Airways

   b. Locations where work is performed: US Airways hubs at LGA, BOS, PHL, CLT, DCA

   c. Duration of contract: June 2006-present

   d. Approximate dollar value: $30,000/month

5. JetBlue Airways – Hub Management, Airspace Optimization (PASSUR)

   a. Contracting party: JetBlue Airways

   b. Locations where work is performed: JetBlue SOC, New York, NY; JetBlue hub operations at JFK

   c. Duration of contract: January 2006-present

   d. Approximate dollar value: $30,000/month

Signature and Notarization of Documentation of Prerequisites:

Ron Dunsky
PASSUR Aerospace
SVP Marketing and Communications

Acting jointly and severally

Sworn to and subscribed in my presence by Ron Dunsky this 5th day of August yr. 2011.

My commission expires: 8-31-2015

Notary Name: Madeleine Szabo
(Notary Public)

Date: 8/5/2011

Madeleine Szabo
Notary Public
My Commission Expires:
August 31, 2015

MADELEINE SZABO
NOTARY
PUBLIC
CONNECTICUT

Stephen Simmons
Mosaic ATM, Inc.
Chief Financial Officer

Acting jointly and severally

Sworn to and subscribed in my presence by Stephen Simmons this 2nd day of August yr. 2011.

My commission expires: 4-30-2014

Notary Name: BPM
(Notary Public)

Date: 8-2-2011

BALMORI MAXIMINO PRUDENCIO
Notary Public
Commonwealth of Virginia
7334765
My Commission Expires Apr 30, 2014

Response to Request for Proposal No. 24997 Surface Management System at John F. Kennedy International Airport

Section 1

Technical Proposal

Volume 1

Statement of Work and Specifications

Technical Proposal Volume 1

Statement of Work and Specifications

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I. General Description of Services

This submission in response to Request for Proposals for a Surface Management System (SMS) at John F. Kennedy International Airport is tendered as a Common Law Joint Venture between PASSUR Aerospace, Inc. (PASSUR) and Mosaic ATM, Inc. (Mosaic), referred to for the purposes of this proposal as the PASSUR Mosaic Joint Venture, or PMJV.

PASSUR will be the lead company in the venture with respect to the software platform accessed by users, onsite staffing and operation of the system, training, and customer service. Mosaic will provide its existing technology platform, and extensive expertise in surface decision support systems, including monitoring, predicting, and analyzing the movement of aircraft on airport runways and taxiways, as well as in the ongoing maintenance and technical support of these systems. The PASSUR Integrated Traffic Management software platform will be the single user interface representing the combined technical capabilities of PASSUR and Mosaic, ensuring a seamless user experience.

All of the technical capabilities described in this proposal are being developed by the PMJV for the aviation market as part of an existing commercial product suite, and are not specifically prepared or compiled in connection with this agreement.

The overall goals of the PMJV Surface Management System (SMS) are:

1. Maximize the use of existing capacity consistent with current and forecasted constraints on the operation
2. Manage the JFK surface operation as part of a single, seamless, integrated whole consisting of arrival, surface movement (arrival and departure), and departure into the airspace
3. Maximize automation to reduce workload requirements of SMS users (for example, airline operators)
4. Minimize engines-on taxi times and queue lengths, consistent with the goal of maintaining constant demand on the available runway capacity
5. Maximize predictive capabilities to ensure a proactive rather than reactive posture and enhance strategic, pre-tactical and tactical decision-making

A. Summary of Services

In this proposal, the PMJV offers a total SMS solution inclusive of the following service lines:

- Surface management software: this includes all modules required to achieve the airspace and surface efficiencies envisioned in this proposal

- Data integration services: all the varied data sets and sources required to power the above functionalities and capabilities will be ingested, processed, stored and managed by PASSUR. The solution is compliant with the FOSA 2.5 standard for integration with stakeholder information systems and includes redundant and fault tolerant data management infrastructure.
- Project management services, including:
  - Training and orientation of both SMS service providers and SMS end users
  - Onsite SMS management
  - 24/7 live help desk support for end users

B. References

The PMJV intends to be fully compliant with all applicable regulations, codes, standards, and specifications.

II. Project Delivery Guidelines

A. Implementation Schedule

The PMJV plans to deploy the SMS in the two phases defined in the RFP: Phase A on or before February 15, 2012, and Phase B on or before August 1, 2012. For a detailed description of timelines, please see the detailed project schedule plan in the Management Proposal.
Most of the requirements of Phase A are already operational through the current PASSUR Departure Metering Program in place at JFK. These requirements will be supplemented with enhancements to current capabilities, and with new capabilities to be deployed in Phase A, more fully defined later in this document.

It is anticipated that several elements of the project delivery timeline can be accelerated, allowing earlier deployment of Phase A, because of the extensive exposure of both the SMS operators and the end-user community to the existing PASSUR software platform, departure metering rationing and management protocols and practices, and the existing software platform deployment in the actual operating environment for one and a half years in its current form (and eight years for the winter deicing and PASSUR OPSnet program). Elements which can be accelerated include:

- Pre-acceptance and acceptance tests can be limited to only those enhancements and new capabilities that PASSUR will develop to existing software for Phase A. The customer has already accepted all other operational parts of the software that has been running successfully for one and a half years.

- Operational test – The 14-day operational test can be reduced to reflect only new capabilities, since the core platform has been successfully operational for the existing program.
- Training – Both SMS operators and end users are already trained and competent on the existing software base and would need training only in the new enhancements.

The PMJV is prepared to perform all of the elements in the project implementation specified in the Scope of Work, Attachment C, Sections VII and VIII, and has submitted a plan reflecting full adherence to that schedule. However, in conjunction and consultation with the Port Authority and other relevant stakeholders, a number of the elements specified in these sections may be eliminated, to the benefit of all users, through a more speedy and rapid deployment (and seamless transition from the current SMS/Metering program).

Phase A will include all of the specific functionalities listed in Attachment C, section IV, item C, 1-32, with the addition of the following from Phase B:

- Item a: Airport capacity and demand forecasted eight hours ahead in a rolling time (already deployed)
- Item b: Alert notifications that correspond to specific operational events
- Item c: Automated alerts to forecasted imbalances between capacity and demand for both arrival and departure traffic (aural alert will be added; visual alert exists)
- Item d: "Chat" function
- Item g: Surface surveillance (moving-map visual, tabular and timeline displays of flights, Region of Interest tracking)
- Item i: Secure, web-based environment available to authorized, geographically dispersed users
- Item o: Enable users to swap their own flights

Phase A will also include the following predictive capability additional to the requirements in the RFP:

- PASSUR Estimated Time of Arrival algorithm extended to the gate, and earlier in the flight than current

B. Base Date of Operational Usage

The PMJV will be ready on or before February 15, 2012 with all items listed in Attachment C, section IV, item C, 1-32, along with the additional capabilities indicated above to coincide with Phase A.

III. Staffing

The PMJV will provide PASSUR management and operational staff required to ensure successful, fully compliant operation of the SMS. The staffing will build on the existing professional services staff which has successfully administered and operated the current departure metering program at JFK for one and a half years, and the eight-plus years of winter operations management. Please see the detailed organizational chart and staffing plan included in Section 3, Management Proposal.

IV. Functional Overview

A. General Description of Services

PMJV has teamed with ARINC (as an airline data consolidation source) to provide a comprehensive SMS that will meet and, in several instances, exceed the requirements of this RFP.

The core of the PMJV SMS is PASSUR's extensive experience in providing airspace surveillance and predictive analytics capabilities, departure metering software and management, a collaborative software platform for instant secure distribution of information, and surface tracking display technology, combined with Mosaic's extensive experience in surface prediction models and tools, live surface monitoring ("region of interest" and constraint analysis), departure metering and sequencing decision support software, and surface performance reporting and analysis.

The system will deliver these core benefits:

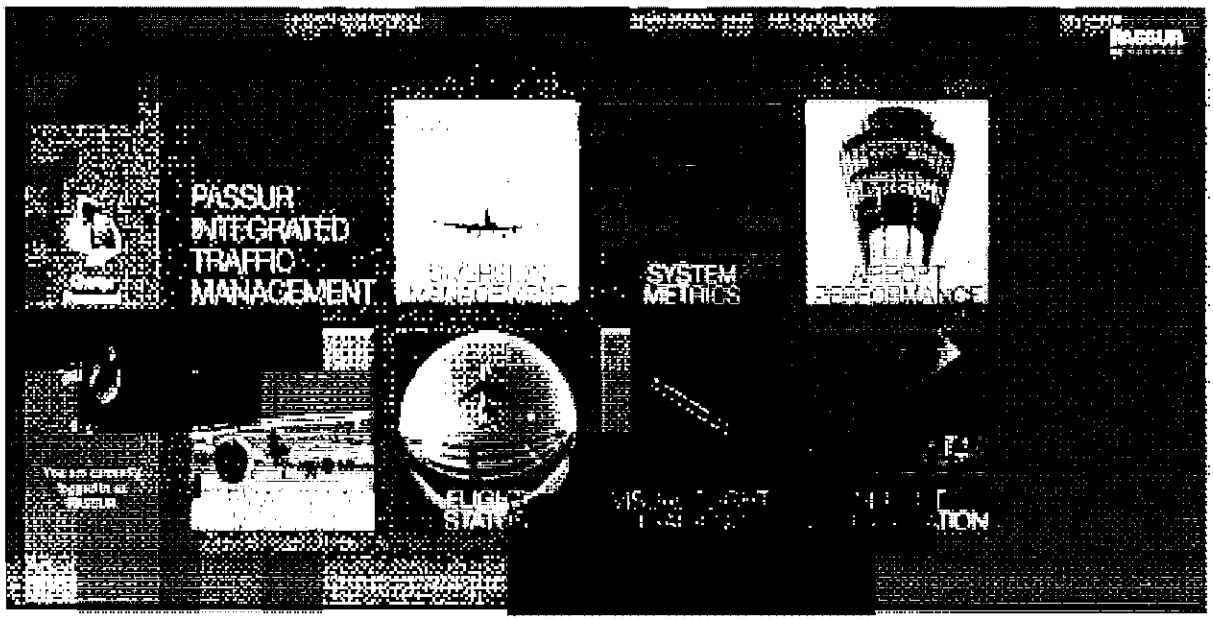
- **Increased automation in Phase A and Phase B,** particularly related to airline slot (taxi time) management (reducing the levels of airline workload) – including automated slot swap, automated substitution modeling, and automated flight "ready state" information
- **Experienced, proven team of aviation professionals** who have successfully managed the first phase of surface management at JFK and who bring a thorough understanding of the New York and national airspace, JFK surface operation, and organizational relationships at JFK – with reduced onsite staffing levels from enhanced automation
- **Surface management predictive analytics** to enable efficient queue management, sequencing, allocation, and surface conflict resolution, through the integration of the Mosaic Predictive Engine (MPE) – the pioneering surface management technology suite developed for NASA and the FAA and currently deployed at several airports
- A single visual platform for integrated flight tracking – en route, terminal, and surface

- **A full suite of new live and post-operational** surface performance analysis tools, powered by the Mosaic Surface Operations Data Analysis and Adaptation engine (SODAA) – accessed on the integrated PASSUR interface
- **Major enhancements to the PASSUR OPSnet collaborative platform** to further facilitate wide distribution of critical airport information to key users, including runway and taxiway status visualization on the SMS airport map, and detailed field condition reports. Pioneered by the partnership between PASSUR and the Port Authority, PASSUR OPSnet is now used by many of the world's largest airports and airlines
- **Integration of airline "ready state" data feeds** directly from ARINC as a single-source feed – greatly simplifying the acquisition of this critical data set

The SMS proposed in this submission builds on the existing, tested, and proven PASSUR and Mosaic decision support platforms, and will include predictive analytics (especially related to surface queuing, departure metering, and surface delay management), performance analysis (especially in surface operations performance), and automation of slot time allocation. It also includes an entirely new PASSUR surface visual display, web hosted, and integrated with the existing PASSUR airborne display, creating a single air-to-ground, en route to terminal airspace to surface, gate-to-gate flight tracking capability (wherever ASDE-X or other surface tracking technologies are available).

To produce the greatest accuracy and function possible, the SMS contains sophisticated techniques to predict information such as flight readiness to push. This information is supplemented and enhanced by participating users through the Flight Operator Surface (FOSA) interface standard established by the FAA in collaboration with Mosaic. Several airlines, including Delta Air Lines, have already implemented FOSA interfaces to Mosaic tools for surface management and departure metering.

All capabilities delivered in the SMS solution proposed in this submission, including the Mosaic elements, will be accessed through a single PASSUR software interface, PASSUR Integrated Traffic Management (PITM) – to ensure a seamless user experience.



PASSUR Integrated Traffic Management (PITM) provides decisions support for the entire flight lifecycle, gate to gate, and consolidates all modules relevant to the SMS onto a single web-based platform.

The entire SMS software solution is 100% web hosted, for complete access to geographically distributed users, without requirements for the Port Authority or any SMS end user to manage software installations or maintenance.

The SMS solution will include:

- Predictive analytics to determine system and airport capacity imbalances in advance, predict departure queue conditions, and alert to arrival/departure gate conflicts – all in support of effective queue management and sequencing, and the lowest possible engines-on taxi times.
- Extensive predictive tools related to departure times and departure delays by taxiway and runway, in order to maximize the efficient use of both runway and common departure fix capacity, with the ultimate goal of feeding the overhead stream in the most efficient manner, for an overall efficiency gain in the New York Metroplex operational area.
- Surface monitoring tools: "Region of Interest" tracking, conflict alerts, and other user-defined live information about specific subsets of the surface operation that are of interest and focus.
- Taxi-time (slot time) allocations in collaboration with airline operations managers, using automated assignments based on rationing principles, current and forecasted operational constraints, capacity/demand balancing (for example fix-load balancing),

and automation to manage flight readiness and slot time swaps and substitutions for minimal airline manual inputs.

- Shared situational awareness through an existing collaborative platform, through which all relevant information about the JFK operation is available on demand to all interested and authorized stakeholders. This includes both "web dashboards" of aggregated information, and visual flight tracking of the surface and airborne operations.
- The existing Airfield Operations page where NOTAM and non-NOTAM field status information is maintained and distributed, integrated directly with the FAA NOTAM system; Diversion Management portal; Airspace Optimization dashboard; Flight Status Portal; System Metrics dashboards.
- Fuel emissions modeling module – built on ICAO internationally accepted fuel emissions models, fed by data from the departure metering archive database, and enhanced by MIT Lincoln Laboratory's surface operations models for fuel burn reduction through metering, as well as MIT's proposed (prototyped) enhancements to the ICAO fuel emissions modeling formulas.
- Integration of the arrival operation and its effect on the departure operation, through system demand forecasting, individual fight arrival time predictions, and gate conflict forecasting and alerting.
- Post-operational reporting modules for performance analysis – to include airspace, surface and field condition statistics, and detailed reporting on demand/capacity performance in the terminal airspace, as well as detailed surface performance reporting.

PASSUR will continue to provide the SMS staffing team, supplemented where needed by Mosaic for training and orientation for SMS operators and end users for the new surface prediction, live surface monitoring, and post-operations performance analysis and reporting.

Hosting of the SMS software will be provided from remote data centers, with full backup and redundancy, building and expanding an existing geographically redundant infrastructure that was originally deployed for the Port Authority as a backup facility for PASSUR OPSnet. Mosaic solutions will be provided in the form of software modules that will reside in the PASSUR network operating center (data and software hosting) in Bohemia, NY, and in a redundant PASSUR data center, providing data seamlessly into the SMS solution. Delivery of the SMS solution will continue to be performed onsite at JFK, as it is done today, but with the addition of new software and operational capabilities, as described in this document.

B. Description of Work

This section groups the major SMS capabilities into the following categories:

- Predictive analytics and surface monitoring/visualization
- Taxi time allocations
- Shared situational awareness

Predictive Analytics and Surface Monitoring/Visualization

Surface Predictions – Mosaic Prediction Engine (MPE)
The Mosaic Prediction Engine (MPE) fulfills multiple objectives to support surface management capabilities. These objectives include predicting the Out, Off, On, and In (OOOI) events for flights, predicting the overall flow rates at the airport, on runways and on taxiways, predicting the delays that will occur in the operation, and supporting the automated analysis of operational alternatives in the additional decision support tools. The fundamental approach used in the MPE model algorithm is to perform an internal fast-time simulation of the airport surface and terminal area operation, applying the necessary decisions and constraints that controllers will have to apply in managing the traffic. This internal simulation modeling approach is used in contrast to other methods such as historical, statistical, or regression-based approaches to predict the taxi times or OOOI event times for flights, because it addresses the highly nonlinear and non-stationary nature of the airport operating environment far better.

The MPE addresses pushback, taxi in, ramp, spot queuing and taxi clearance request, taxiing in the airport movement area, queuing at the runway for departure, and required runway spacing constraints. Runway spacing constraints account for both same-runway separations for wake vortices, runway occupancy times, required separations between flights operating on dependent runways – for both arriving and departing flights, and separations required across departure fixes. It also addresses staging and sequencing of flights to meet traffic management restrictions.

The MPE assigns times to each flight to represent the time at which the flight is expected to cross the four primary control points: gate (pushback or block-in), spot (transition from ramp to movement area or vice-versa), runway (takeoff or landing) and the arrival or departure fix. In general, the MPE determines a fixed runway assignment and a fixed taxi path for each flight. It automatically relies on the current airport configuration and predicted schedule of airport configuration changes provided by the PASSUR ATC Portal.

MPE has the following uses in SMS (addressing identified requirement areas):

- Provides efficient queue management and sequencing
- Ensures current surface constraints are factored into the plan (the MPE considers multiple constraint points in its prediction calculations)

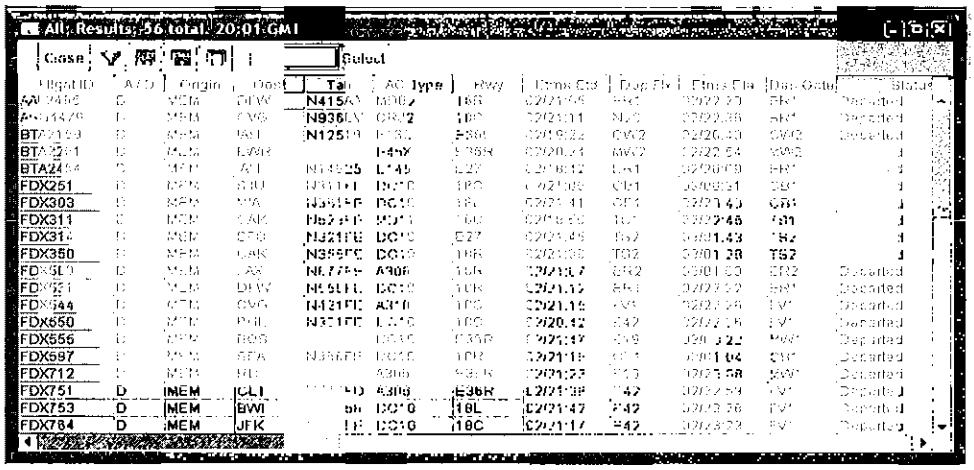
- Contributes to strategic, pre-tactical, and tactical flow management for both allocation of taxi times, ability to meet taxi times, and for merging into the en route stream to a common departure fix
- Predicts runway queues and anticipated delays for each queue
- Allocates taxi times that take into account current and forecasted constraints to maintain departure queue lengths to multiple runways

MPE Output/Visualization

The surface predictions rendered by the MPE will be visualized on the PASSUR Integrated Traffic Management (PITM) interface on the appropriate modules.

Flight Table

The Flight Table displays multiple data points for all flights (actual, estimated, and predicted). A typically configured flight table is shown in the figure below.



Flight tables contain a row for each displayed flight and columns for various (configurable) data. Multiple flight tables will be viewable simultaneously. The configuration of each table is controlled separately, so that different views and aspects of flight tables can be viewed simultaneously.

Flights can be filtered to allow users to focus on flights of interest or flights according to function. For example flights can be segmented by:

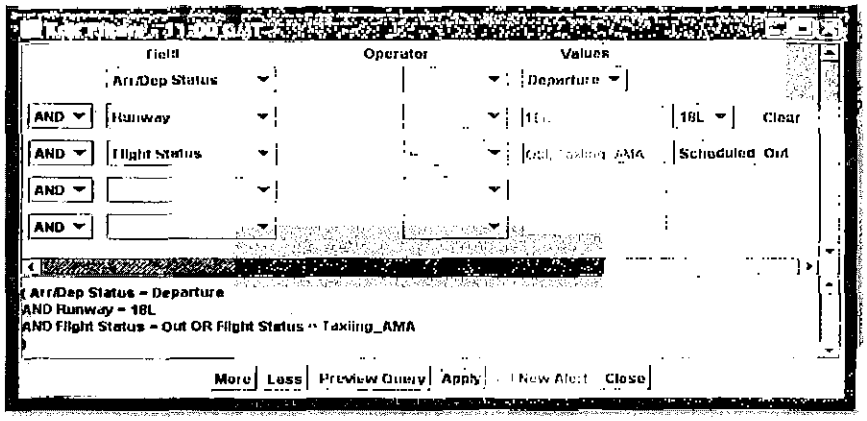
- Not yet ready to push
- Ready to push but held
- Non-movement area

- Taxiing, movement area
- Queued for runway

An operator focused on departure metering at a glance can use this table to see which flights to call next for taxi release. Similarly, an airline user can quickly see the times at which each of his flights is likely to be wheels-up, and use that information to swap or substitute positions in the virtual departure queue.

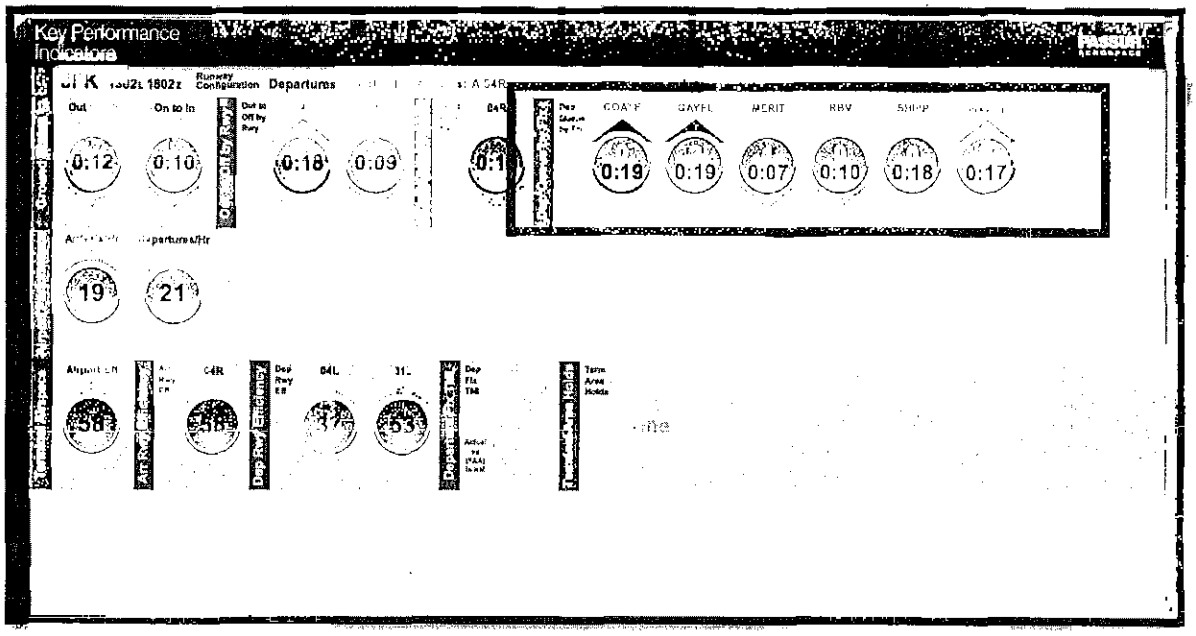
The PMJV is adding a new field, *ETA at the destination,* accounting for departure queuing, surface and all other delays. Unavailable from any other source, this field will allow an airline user to see the implications on their *destination* schedules of the swap and substitution choices they make. This information will enable airline users to be proactive about crew legality issues and about passenger, crew, and equipment connections further down the line.

Alerts can be set up in this way as well. For example, a table can be set to display all flights that are *predicted* to have a total surface time of more two and a half hours. The figure below shows the filter functionality set to select all departures assigned to runway 18L that are either out or taxiing in the movement area.



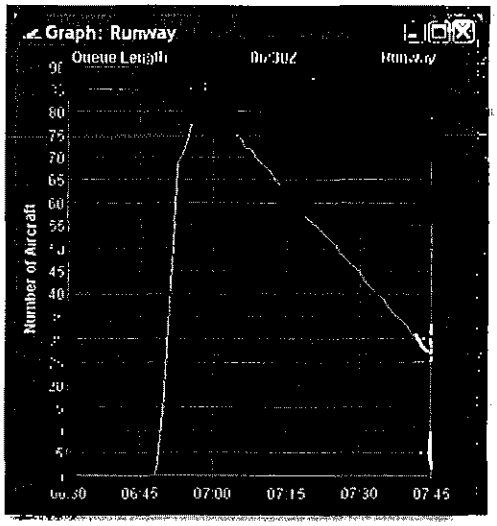
Example of Flight Tables – filtering to a subset of flights

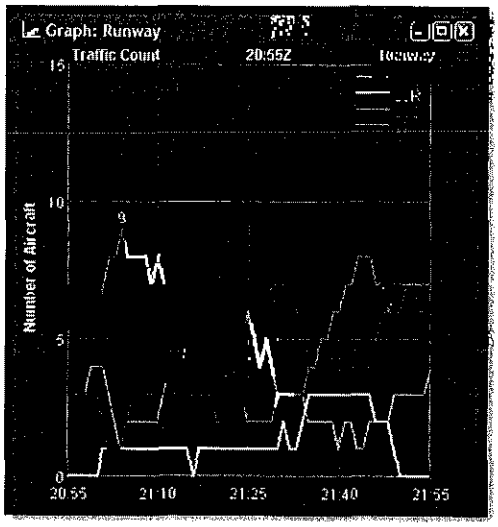
Departure fix delays can also be predicted and displayed in the prediction engine output. These will be incorporated into the existing Systems Metrics dashboard (Patent Pending), already deployed on PITM, as shown here:



Load Graph

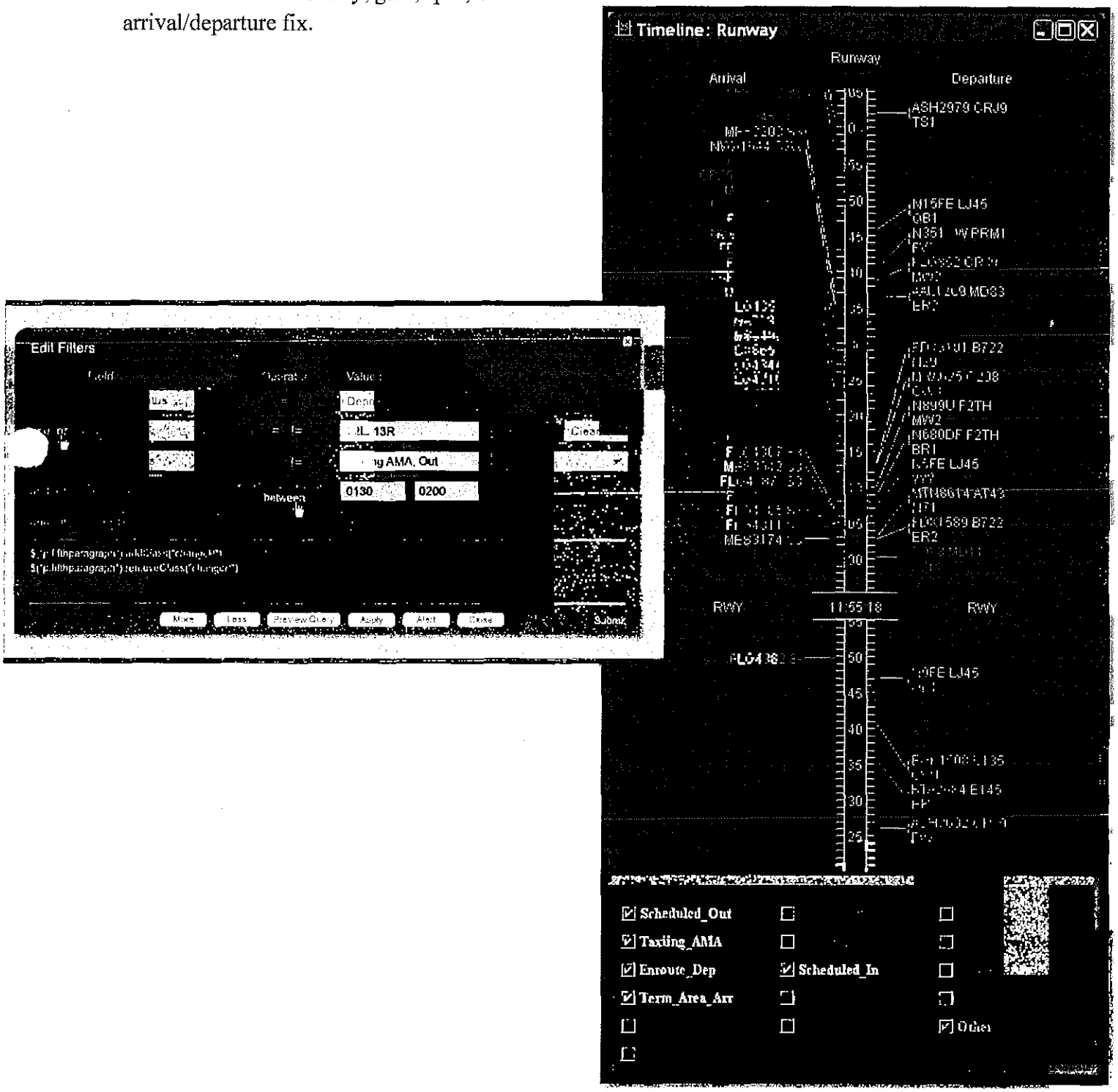
A load graph can be configured to measure load at a spot, runway, departure fix, or gate. The figure below shows a load graph displaying the number of aircraft operating on each of the runways over a one-hour period. For departure metering, a load graph showing the predicted queue length over time will be useful as a quick visual to ensure that pressure is being maintained on the runway, but that queues are not likely to become too long.





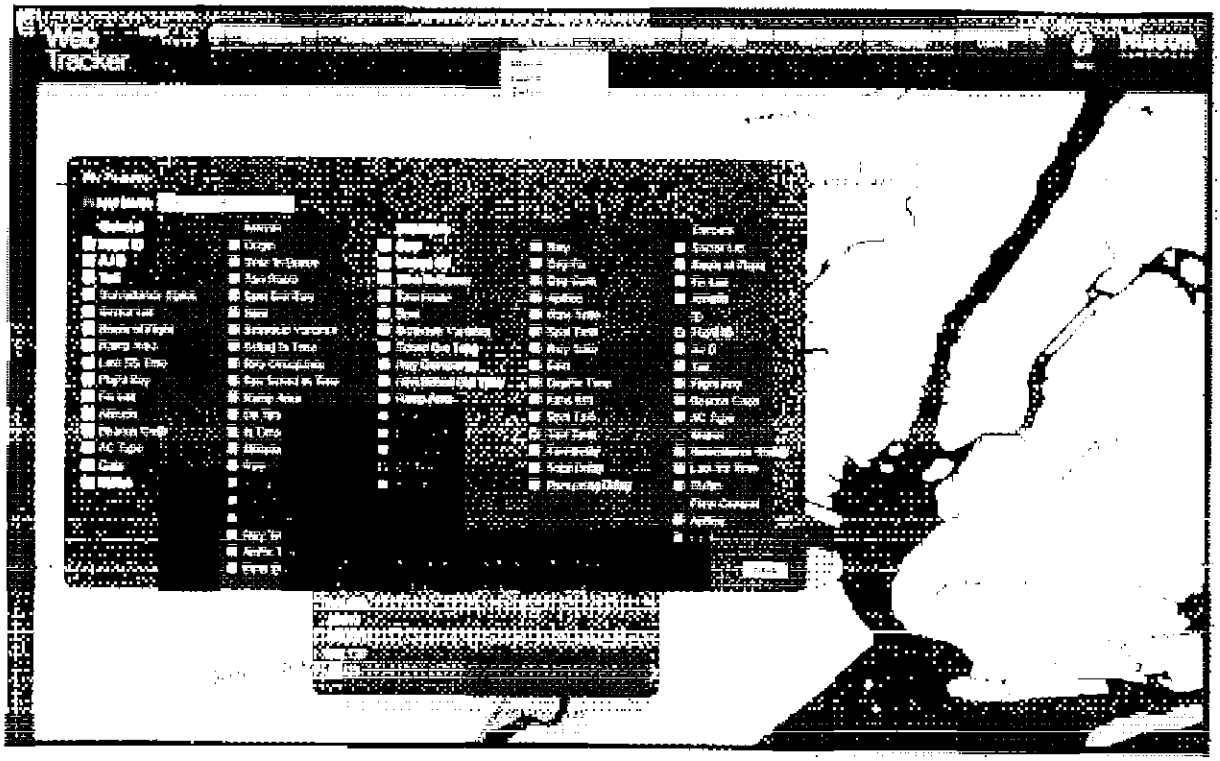
Timeline

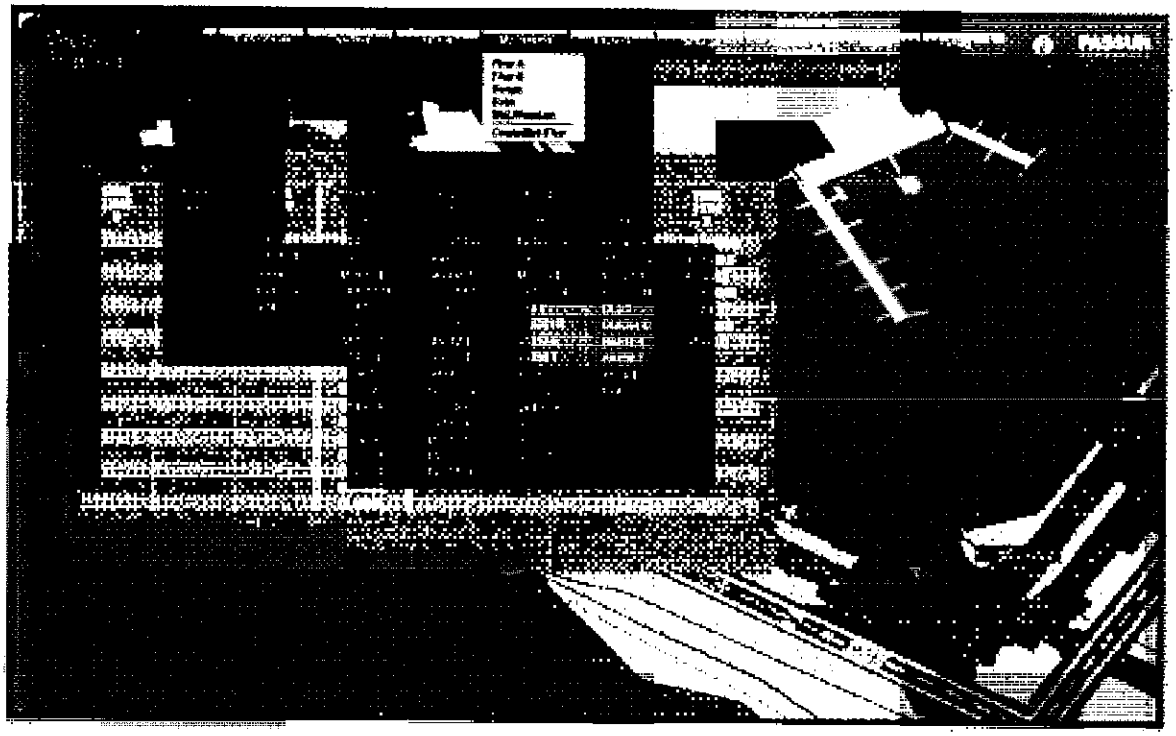
Timelines offer another view of the traffic that is useful for understanding at a glance the pace of operations and the flights involved. The timeline holds some of the same information displayed in flight tables, but the flights are depicted graphically based on their time of operation at points of interest such as runway, gate, spot, and arrival/departure fix.



Single SMS Visual Interface – Air and Surface

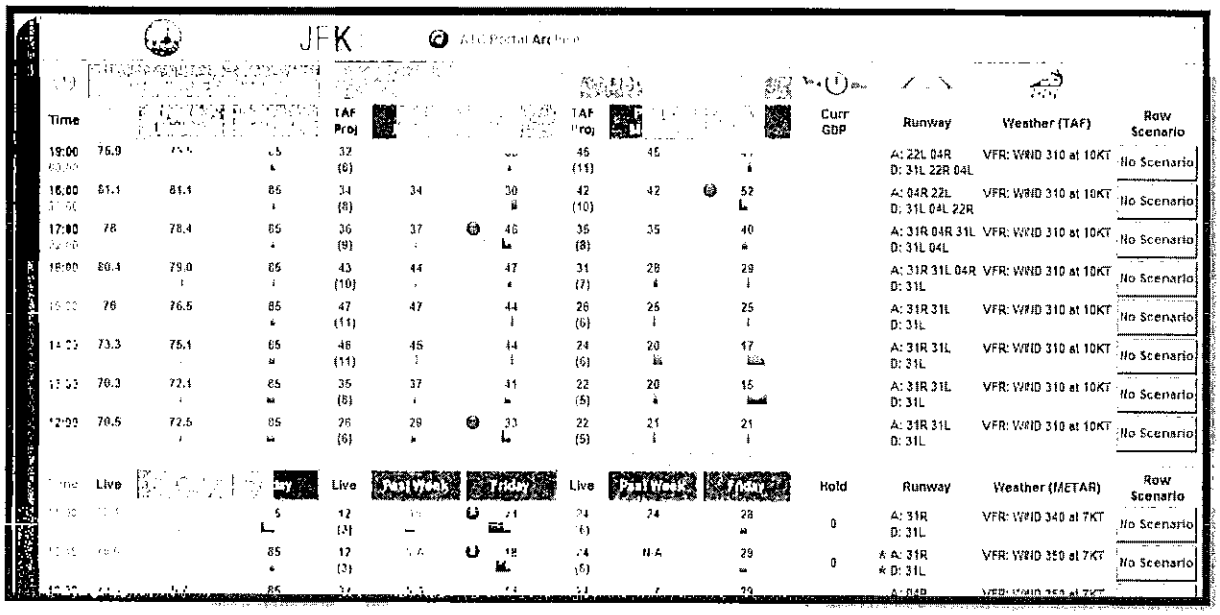
The MPE tools will be integrated directly onto the PASSUR integrated web tracking display, which provides en route, terminal and surface surveillance on a single interface:





Additional Predictive Tools

Airport performance predictions – ATC Portal (Patent Pending) (available to SMS Operators only under this SMS licensing proposal)



PASSUR ATC Portal (patent pending)
Area above gray horizontal bar shows rolling eight-hour prediction of performance for key airport metrics.

ATC Portal provides an eight-hour look ahead into performance of specific terminal airspaces to predict and alert to potential imbalances between demand and capacity. ATC Portal uses the Terminal Area Forecast (TAF) to generate predicted performance of key metrics, based on past performance under identical conditions; and user-defined triggers and scenarios to create alerts and performance scores for an accurate forecast of performance.

Key metrics tracked on ATC Portal:

- Arrival rate and departure rate
- Runway configuration
- Holding (number and specific identity of aircraft holding)
- Arrival efficiency score (based on assessment of required wake turbulence spacing)

- Weather
- Current Ground Delay Programs

Uses in SMS (addressing identified requirement areas):

- Sets correct rates for departure metering program (in taxi-time/slot time allocation calculator) based on predicted arrival and departure volumes, runway configurations, and constraints (e.g. Traffic Management Initiatives). Taxi-time allocations are typically done two hours in advance, per established operational protocols, but can be extended up to eight hours in advance based on ATC Portal predictive window.
- Allows the SMS operator to correctly forecast true (likely) performance of the airport based on Terminal Area Forecast and planned Ground Delay Programs, independently of actual ATC published rate.
- Ensures that the SMS is taking into account forecasted FAA, airfield, capacity, and weather restrictions – and also that the SMS is correctly calibrating performance plans based on actual performance capabilities under identical conditions forecasted.
- Ensures that departure queue lengths are maintained at ideally calibrated volumes, by helping the SMS operator to allow appropriate level of demand onto the movement area (neither too much demand nor too little).

The PASSUR ETA (Patent Pending)
The PASSUR ETA is derived from algorithms which are fed by multiple data sources in real time, including flight position information from the network of PASSUR radar systems installed at more than 154 airports in the U.S., Canada, Europe, and Asia. It is calculated by tracking multiple real-time measurements of the target flight, as well as other nearby aircraft in the surrounding airspace, along with current and historic/archived airspace conditions.

The PASSUR radar surveillance tracks are updated every 4.6 seconds, which provides the detail and precision of aircraft position and movement required to create predictive accuracy that is built on tracking the behavior of multiple aircraft simultaneously in real time, as well as the comparison of current conditions to identical conditions stored in the PASSUR flight/NAS archive. There is no comparable network or capability.

The extensive historical/archived data is a critical additional component, providing operational pattern recognition to enable past performance to predict future performance. The depth and breadth (detail and number of years) of the PASSUR historical archive provides the sample size required for this predictive capability to be effective.

Beacon code/tail number correlation: PASSUR flight tracking can operate independently of ASDI (the FAA flight plan/en route radar feed other third party ETA providers must rely on absent the PASSUR radar network) because of PASSUR's independent acquisition of beacon code and tail number. This allows tracking to continue even if/when the ASDI feed fails – which, over the past year, has occurred almost daily (the filed flight plan ID will be absent if ASDI fails, though tail number and beacon code will remain). In some instances, flight ID will be retained even in the absence of ASDI, through a "pre-correlation."

The PASSUR ETA requires NO manual updates to continue operating or to maintain its predictive accuracy – it is completely automated.

Unique Capabilities

- Automatically adjusts for dynamically changing ATC conditions, such as:
- Holding
- Runway changes
- Vectors (e.g., S-turns)
- Extended downwind legs
- Speed of preceding aircraft (taking into account wind and TMI restrictions such as miles-in-trail or sequencing on final)
- Includes extensive historical archiving, which enables more accurate predictive capabilities, including dynamic adjustments for TMIs and On-to-In predictions

Enhancements

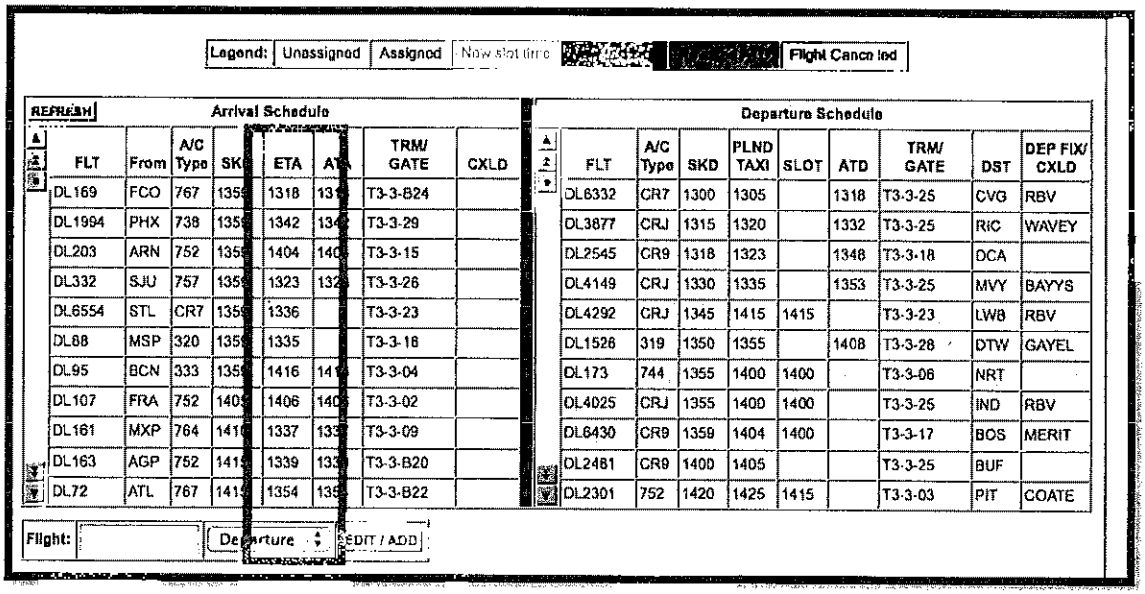
- With the "fusing" of the entire PASSUR radar surveillance network into a single national and transnational (U.S./Canada/Caribbean) coverage area, the PASSUR ETA algorithm is being extended to gate-to-gate coverage (the original ETA activation was limited to the 150 mile-radius of each PASSUR radar) for a much earlier and accurate prediction of arrival time. This will be available in Phase B of the SMS.
- With the addition of the surface prediction capabilities outlined above, the PASSUR ETA will be advanced to pre-departure (pre-push), giving users at JFK an unusually long lead-time in accurate arrival prediction for their departing flight's next destination (one which factors in current JFK surface constraint as well as metering slot times).

Uses in SMS (addressing identified requirement areas):

- Critical component in ensuring that the management, sequencing, and allocation of departures is done in the context of the arrival operation demand.
- Critical on a flight-specific basis for gate management (meter at gate or to remote pad, depending on status of arrival flight) and gate conflict alerting (new capability being developed for Phase B of the SMS).

PASSUR ETA Output/Visualization

Airline Slot Request Page (Patent Pending): The page where airline users of the SMS manage their departure taxi time requests and assignment also includes the PASSUR ETA for their flight arrival times.



FLT	From	A/C Type	SKD	ETA	ATA	TRM/ GATE	CXLD
DL169	FCO	767	1359	1318	131[illegible]	T3-3-B24	
DL1994	PHX	738	1359	1342	134[illegible]	T3-3-29	
DL203	ARN	752	1359	1404	140[illegible]	T3-3-15	
DL332	SJU	757	1359	1323	132[illegible]	T3-3-26	
DL6554	STL	CR7	1359	1336		T3-3-23	
DL88	MSP	320	1359	1335		T3-3-18	
DL95	BCN	333	1359	1416	141[illegible]	T3-3-04	
DL107	FRA	752	1409	1406	140[illegible]	T3-3-02	
DL161	MXP	764	1410	1337	133[illegible]	T3-3-09	
DL163	AGP	752	1419	1339	133[illegible]	T3-3-B20	
DL72	ATL	767	1419	1354	135[illegible]	T3-3-B22	

FLT	A/C Type	SKD	PLND TAXI	SLOT	ATD	TRM/ GATE	DST	DEP FIX/ CXLD
DL6332	CR7	1300	1305		1318	T3-3-25	CVG	RBV
DL3877	CRJ	1315	1320		1332	T3-3-25	RIC	WAVEY
DL2545	CR9	1318	1323		1348	T3-3-18	DCA	
DL4149	CRJ	1330	1335		1353	T3-3-25	MVY	BAYYS
DL4292	CRJ	1345	1415	1415		T3-3-23	LWB	RBV
DL1526	319	1350	1355		1408	T3-3-28	DTW	GAYEL
DL173	744	1355	1400	1400		T3-3-06	NRT	
DL4025	CRJ	1355	1400	1400		T3-3-25	IND	RBV
DL6430	CR9	1359	1404	1400		T3-3-17	BOS	MERIT
DL2481	CR9	1400	1405			T3-3-25	BUF	
DL2301	752	1420	1425	1415		T3-3-03	PIT	COATE

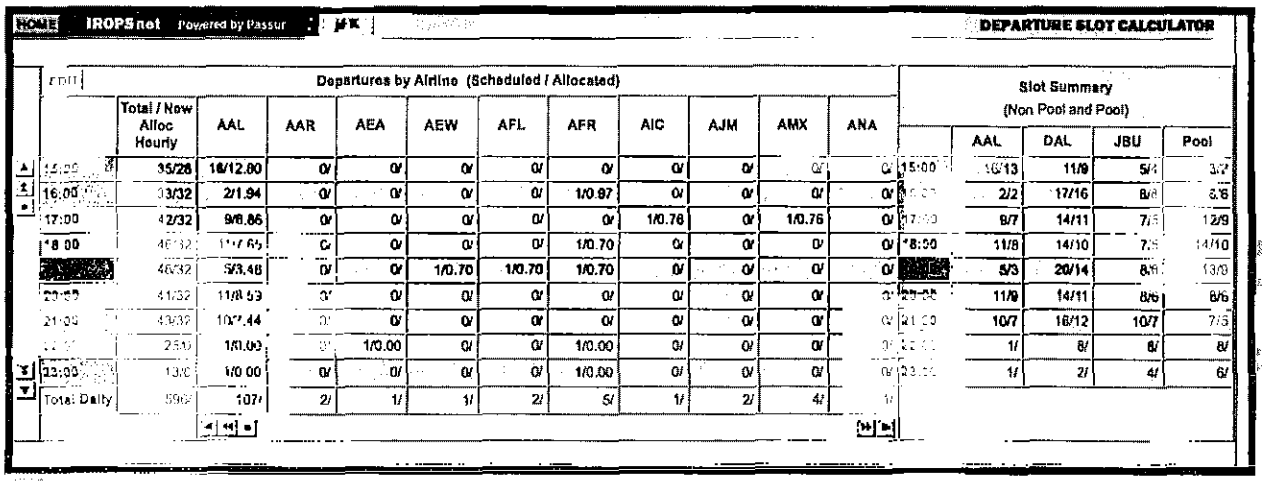
Other ETA visualization locations:

- Data tags in flight tracking application (surface and airborne)
- Flight tables generated by MPE, which will be integrated into the PMJV SMS (see above)
- Flights listed on System Metrics (Key Performance Indicators) dashboard (see above)

Taxi Time Allocations

The departure slot management module of the PMJV SMS provides much of the functionality required in Phase A to satisfy the requirement to allocate taxi times in order to maximize the use of capacity consistent with keeping active "engines on" taxi queues as short as possible.
The slot (taxi time) module consists of the following capabilities (all elements of Taxi Time Allocation functions below are Patent Pending):

Slot calculator: Automatically calculates number of departure slots available to each airport flight operator based on industry-accepted "ration by schedule" calculations, based on the rate which the SMS operator enters into the calculator (the accurate forecasted rate is provided by the Airport Performance predictive dashboard, ATC Portal, discussed in the previous section, "Predictive Analytics").



	Total / New Alloc Hourly	AAL	AAR	AEA	AEW	AFL	AFR	AIC	AJM	AMX	ANA
15:00	35/28	16/12.80	0/	0/	0/	0/	0/	0/	0/	0/	0/
16:00	33/32	2/1.94	0/	0/	0/	0/	1/0.97	0/	0/	0/	0/
17:00	42/32	9/8.86	0/	0/	0/	0/	0/	1/0.76	0/	1/0.76	0/
18:00	46/32	[illegible]	0/	0/	0/	0/	1/0.70	0/	0/	0/	0/
[redacted]	46/32	5/3.46	0/	0/	1/0.70	1/0.70	1/0.70	0/	0/	0/	0/
20:00	41/32	11/8.53	0/	0/	0/	0/	0/	0/	0/	0/	0/
21:00	43/32	10/7.44	0/	0/	0/	0/	0/	0/	0/	0/	0/
[illegible]	25/0	1/0.00	0/	1/0.00	0/	0/	1/0.00	0/	0/	0/	0/
23:00	13/0	1/0.00	0/	0/	0/	0/	1/0.00	0/	0/	0/	0/
Total: Daily	592	107/	2/	1/	1/	2/	5/	1/	2/	4/	1/

	AAL	DAL	JBU	Pool
15:00	16/13	11/9	5/4	3/2
[illegible]	2/2	17/16	8/8	8/8
17:00	9/7	14/11	7/5	12/9
18:00	11/8	14/10	7/5	14/10
[redacted]	5/3	20/14	8/6	13/0
20:00	11/9	14/11	8/6	8/6
21:00	10/7	16/12	10/7	7/5
[illegible]	1/	8/	8/	8/
23:00	1/	2/	4/	6/

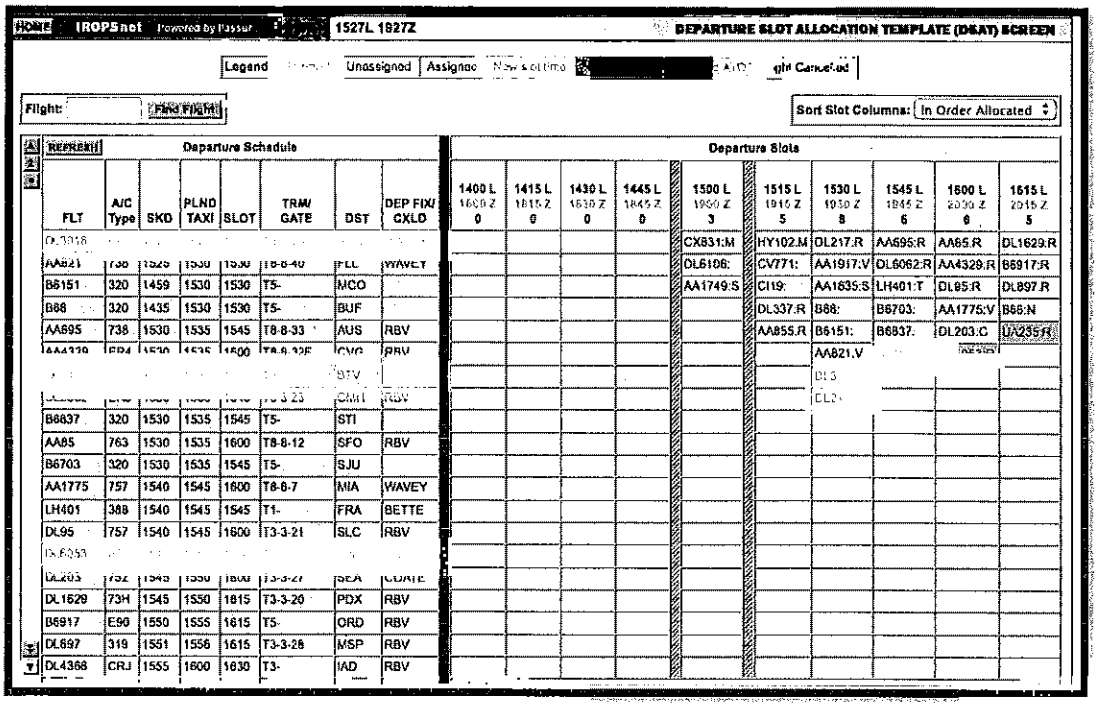
PASSUR SMS Slot Calculator (Taxi Time Calculator) using "ration by schedule" logic (patent pending)

Automatic population of taxi times: Once a rate is entered into the slot calculator, all flights scheduled for departure at JFK over the following eight hours are automatically re-allocated based on the new departure rate and the ration by schedule allocation. Initial slot times (before any adjustments are made) are assumed to be scheduled time + 5 minutes.

Flight operator adjustment of slot times: After initial allocation, each individual flight operator can access its schedule to request adjustments in departure slot times. This is done through the same slot display interface, on a flight-by-flight basis, and allows for multiple requests and changes. Once allocation change requests have been processed by the SMS manager on the slot management module (see below), changes are alerted on the flight operator screen and must be acknowledged on the interface.

Slot Management: After initial auto-allocation and/or after operator request for new times, the SMS manager is able to view all allocation requests and change allocation assignments. Change requests are color coded to alert SMS operators of actions they need to take. Allocation management is executed online through a variety of functions on the slot manager that allows the SMS operator to efficiently and quickly allocate flights individually or in bulk. Different color codes alert the SMS operator to different status levels of the allocation request or assignment, along with moving timelines to indicate potential problems in flights not achieving their planned taxi times. The inclusion of "first fix" information on the departure manager for each flight, combined with the other information sets available through the SMS about each flight (planned taxiway and runway, predicted times as described above for key milestones on the surface),

current runway configuration, and departure/arrival demand and capacity, allow the SMS operator to make taxi time assignments that consider "fix load balancing" in order to maximize the use of taxiway, runway, and departure fix capacity.



Uses in SMS (addressing identified requirement areas):

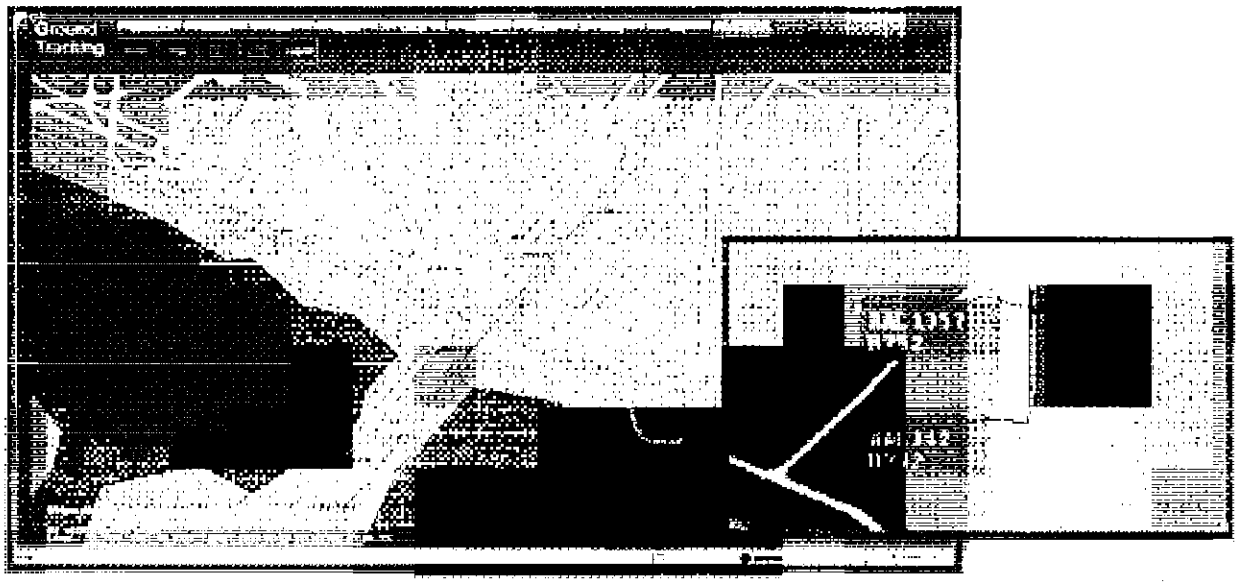
- Allocation of taxi times
- Departure management for merging into an en route stream or common departure fix from multiple runway configurations
- Pre-tactical, and tactical aircraft sequencing, scheduling and runway allocations to meet airport arrival and departure operating constraints

Enhancements (all Patent Pending)

The following enhancements are planned to ensure greater automation and less workload demand on SMS operators and end users, especially flight operators:

- Flight "ready state" feed: automated messages from airline flight management systems indicating key milestones in a flight pre-pushback, integrated with the departure slot allocation module, to automatically indicate whether a given flight will be ready for its assigned departure time or needs a new assignment. Relieves airline operators from the need to update the slot request page manually.

- PASSUR's partnership with ARINC will provide an efficient "single source" process from which to receive the airline "ready state" feed.
- Automated "flight swap" in allocation manager screen: if the SMS manager reassigns a flight to a new taxi time, the system will automatically recalculate the needed changes in all other taxi time allocations, based on the current departure demand present in the allocation module and the "ration by schedule" formula.
- Automated substitution modeling: flight operators will be able to model scenarios in which different flight taxi times are moved or changed onscreen, and the effects of those moves on all their other flights scheduled to be allocated that day are then displayed. This helps flight operators project sequencing plans prior to an initial slot request or a subsequent to a slot change request.



Shared Situational Awareness

The PMJV SMS includes detailed shared situational awareness tools to ensure that information is made available to all authorized stakeholders in a timely fashion, regardless of their geographical distribution. Key elements of the situational awareness tools are:

Real-time integrated air-to-surface flight tracking: A single web interface that enables the user to move from surface, to terminal airspace, to en route flight tracking on a single screen. This includes detailed surface surveillance in the movement and non-movement areas. Non-movement tracking is dependent on an amalgamation of the JFK ASDE-X feed, ADS-B (via the

PASSUR radar) transmissions, and ARINC "weight on wheels" aircraft position updates on the surface, available from participating airlines.
Surface tracking includes:

- Airport adaptation data to ensure a visually accurate representation of the airport surface operation
- All of the detailed operationally relevant elements of the surface operation, including taxiways, runways, ramps, gates and stands, buildings, etc.
- Surface tracking includes integration of several key Mosaic SMS capabilities, including:
- Map adaptation technology to ensure the most relevant surface map is represented supporting 2D spatial representation and manipulation of the surface map

Airborne tracking includes the ability to monitor:

- Holding
- Spacing between aircraft
- Aircraft vectoring
- Flow through fixes
- Aircraft sequencing
- Length of final

Other currently available airborne and surface tracking capabilities include:

- Weather overlay
- Multi-speed replay
- Multiple user-defined filters and preferences, and user-defined set preference set-ups names and stored by user for future use ("layouts")
- Information layers turned on/off by user (fixes, runways, roads, etc.)
- Aircraft icons with multiple user configurable information sets

Planned enhancements, to be delivered with the SMS:

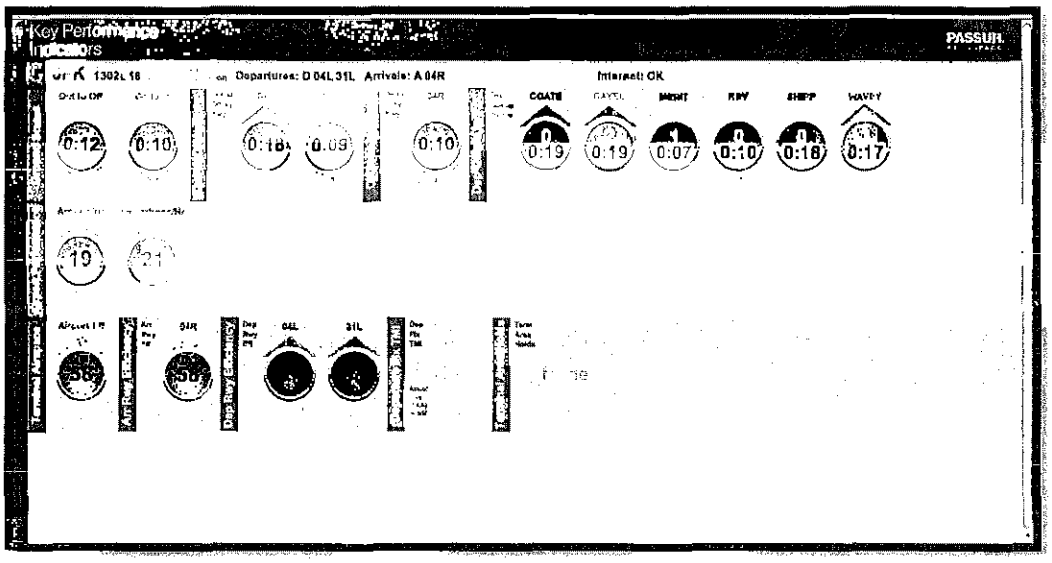
- Alerts to user (audio/visual): alarms to indicate movement in airborne or surface areas defined by the user, color coded
- Display of all gates and stands

The integrated web flight tracking tool will also integrate a variety of real-time surface analysis tools from Mosaic:

- Timelines representing each arrival and departure
- Tabular display data as defined in the RFP page 17-18
- "Region of Interest" monitoring – user-drawn areas allowing for specific focus on, and measurement of performance in, specifically defined regions of the surface operation

System metrics (Patent Pending):

- Designed to optimize departure decisions to ensure an unimpeded path from pushback to wheels up.



The core of the System Metrics module is the Departure Sequencing KPI/decision support dashboard, which includes the following (ASDE-X or airline OOOI needed for all unless specifically noted):

- Ground Status:
  - Out-to-Off: Indicates increasing and/or decreasing congestion for an airport, by departure runway. The Out-to-Off calculation is the average aircraft taxi out to takeoff time, presented by departure runway.
  - On-to-In: Indicates increasing and/or decreasing congestion for an airport by arrival runway. The On-to-In calculation is the average taxi-in to gateon time.
  - Departure queue by fix: current average wait times and total queue length by departure fix.
- Airport Performance:

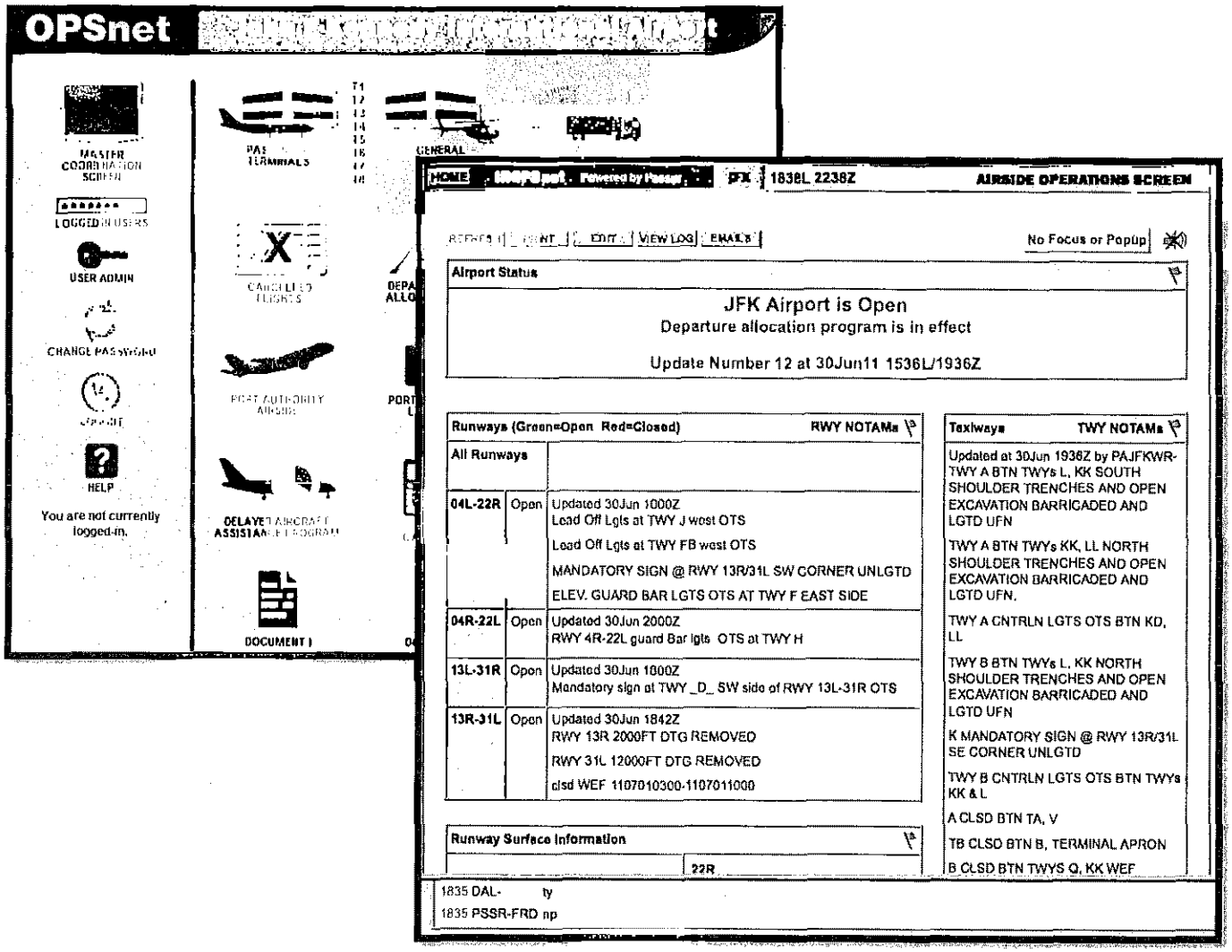
- Delay minutes: Indicates increasing and decreasing congestion for an airport. The delay calculation is the maximum aircraft taxi out to takeoff time, including aircraft Out but not yet Off, for an airport.
- Arrival rates: Indicates increasing and decreasing arrival counts for an airport. The Arrivals/Hr. calculation is the number of aircraft landings per hour (rolling 15-minute segments) for an airport.
- Departure rates: Departures/Hr. indicates increasing and decreasing departures counts for an airport. The Departures/Hr. calculation is the number of aircraft takeoffs per hour (rolling 15-minute segments) for an airport.
- Runway configuration

- Terminal Airspace Performance:
  - Airport Efficiency Score (aggregate arrival runway efficiency)
  - Arrival Efficiency by Runway: Indicates a differential measurement between required spacing (wake turbulence, FAA 7110.65s) versus actual spacing
  - Departure Efficiency by Runway (based on frequency of departures)
- Terminal Area Holds:
  - Holding stacks by fix, with number of aircraft in stack, average time in stack

Additional shared situational awareness tools

Field Condition Reporting (Patent Pending)

PASSUR OPSnet Field Condition Report with e-NOTAMs (available to all SMS users)



PASSUR OPSnet Field Condition Report (FCR) provides standard airport operational content areas, through a combination of menu-driven and free-form text areas. Vital airport information, both airfield and terminal, can be posted instantly and communicated through automatic e-mail and texts to airport users. PASSUR OPSnet FCR is viewable by airport users on a secure web-based platform.

Detailed information includes runway conditions/status, taxiways, tenant advisories, construction, general remarks, and planning information. The PASSUR OPSnet Field Condition Report is integrated seamlessly with the FAA Flight Services eNOTAM system, allowing for a single-source point of entry for all airfield conditions.

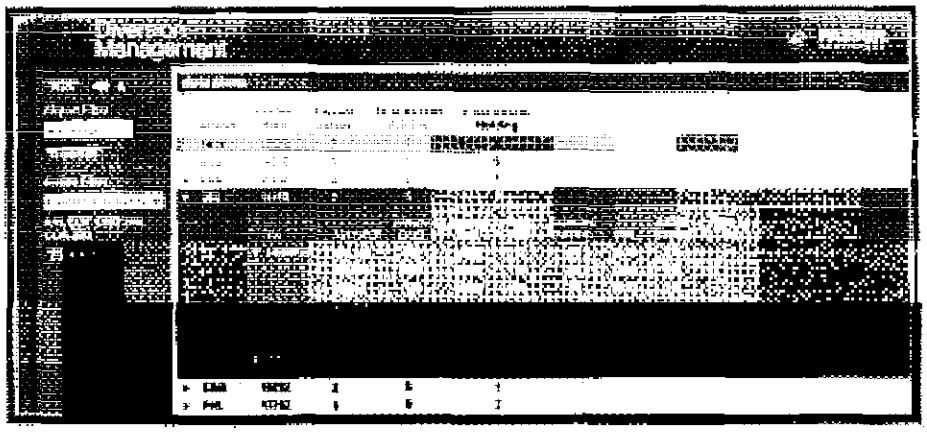
eNOTAM Integration with Flight Services:

PASSUR has worked directly with Lockheed Martin to ensure a seamless integration into the FAA eNOTAM system. The Airport Operation users are given specific NOTAM-access permission in order to create NOTAMs. Users are automatically identified as authorized PASSUR OPSnet NOTAM submitters by the FAA system.

NOTAMs are entered free form into designated NOTAM content areas, which follow standard FAA NOTAM conventions. NOTAMs can be entered as "until further notice," "with effect from/to (future)", and "until (auto-canceling)." Both submitted NOTAMs and published NOTAMs are auto-tracked on the FCR page. All NOTAM updates trigger an e-mail and/or text to a list of users managed by the Airport Operator.

Diversion management (Patent Pending) (available to SMS Operators only under this SMS licensing proposal):

Diversion Management Portal enables tracking and information related to aircraft holding anywhere in the NAS from a single screen.



The main screen of the Diversion Management Portal tracks diversions related to airports selected by the user. This top-level tracking provides:

- Audio-visual alerts for any holding tracked by the user-specified filters, with the following information:
- Airport code connected to the holding stack (all airports)
- Time of earliest hold connected to that airport
- Current number of holding stacks
- Total aircraft holding in stack(s)

- Total specific airline flights holding in stack(s) (user-defined filter)

From the main screen, the user can select any one of the airports displayed to "drill down" for further information about the specific holding stacks. The following information is displayed:

- Airborne fix (by name) where each holding stack is located
- Aircraft ID in each stack by fix (airline/flight number)
- Altitude of each flight in stack
- Time each flight entered hold
- Amount of time each flight has been in hold
- Expected (estimated) duration of flight in hold
- Estimated On time for each flight in hold (calculated when two or more aircraft have departed the fix)

Planned Enhancements for Diversion Management Portal:

- Adds tracking of status of alternates, including the following information:
- Identification of original (planned) arrival airport
- Identification of alternates associated with each planned arrival airport
- Total diversions currently on the ground at each alternate airport (all airlines)
- Average ground time for each diversion at each alternate airport (all airlines)
- Average On-to-In time currently at each alternate airport
- Identification of flights heading toward the hold stack, with the following information:
    - Flight ID
    - Estimated time to airborne fix where holding stack is occurring
    - Adds tracking of diversions in progress (real time), with the following information:
    - Original destination airport
    - Original scheduled time of arrival
    - Airport diverting to
    - Estimated time of arrival to diversion airport
- Adds Fuel On Board (FOB), as provided by airline feed

Airspace optimization (Patent Pending) *(available to SMS Operators only under this SMS licensing proposal):*

The real-time component of the ATC Portal module discussed above in "Predictive Analytics." Displays the current operating characteristics (profile) of an airport in 15-minute increments using the key performance metrics described above. Generates alerts to under-performance and performance scores based on user-defined triggers and scenarios, and enables the identification of the specific metric(s) contributing to the performance imbalance.

Time	Live	Past 3 Months	[redacted]	Live	Past 3 Months	[redacted]	Live	Past 3 Months	[redacted]	Hold	Runway	Weather (METAR)	Row Scenario
18:15	105.2	75.4	75	20 (5)	32	38	40 (10)	42	34	0	A: 22L * D: 31L 22R	VFR: WIND 190 at 15KT	No Scenario
18:00	75.9	74.2	75	24 (6)	33	38	32 (8)	38	34	0	A: 22L D: 22R	VFR: WIND 190 at 15KT	No Scenario
17:45	91.6	73.1	75	40 (10)	34	38	32 (8)	36	34	0	A: 22L 22R * D: 22R	VFR: WIND 200 at 15KT	No Scenario
17:30	86.8	73.3	75	48 (12)	31	38	36 (9)	42	34	0	A: 22L 22R D: 31L 22R	VFR: WIND 200 at 15KT	No Scenario
17:15	80.5	73.4	75	44 (11)	32	38	44 (11)	41	34	0	A: 22L D: 31L 22R	VFR: WIND 200 at 15KT	No Scenario
17:00	83.1	73.3	75	40 (10)	33	38	40 (10)	41	34	0	A: 22L 22R D: 31L 22R	VFR: WIND 200 at 15KT	No Scenario
16:45	71.1	70.3	75	32 (8)	39	38	44 (11)	33	34	0	A: 22L D: 31L 22R	VFR: WIND 260 at 10KT G 17KT	No Scenario
16:30	71.1	74.9	75	24 (6)	40	38	48 (12)	32	34	0	* A: 22L * D: 31L 22R	VFR: WIND 260 at 10KT G 17KT	No Scenario
16:15	86	76.8	75	44 (11)	41	38	32 (8)	31	34	0	A: 31R 31L D: 31L	VFR: WIND 280 at 10KT G 17KT	No Scenario
16:00	78.7	79.1	75	40 (10)	43	38	40 (10)	29	34	0	A: 31R 31L D: 31L	VFR: WIND 280 at 10KT G 17KT	No Scenario
15:45	72.5	76.9	75	48 (12)	45	38	28 (7)	30	34	0	A: 31R 31L D: 31L	VFR: WIND 270 at 11KT G 15KT	No Scenario

Fuel and Emissions Impact Modeling

PASSUR worked closely with MIT Lincoln Laboratory to build on the definitive study of the fuel burn reductions generated by the JFK departure metering program to date. This work forms the basis for the PASSUR SMS fuel emissions module, and will include the following calculations:

- Taxi fuel burn rate for each flight given engine types (fleet database to match to airframe/engine and ground fuel flow certification data for correct engine), APU, and single-engine taxi assumptions
- Fuel burn savings of metering by multiplying active taxi time savings for flights by the appropriate fuel flow rate
- Converting fuel burn savings to emissions savings using CO_2, HC, CO, NOx and smoke emissions indices (mass emission per mass of pollutant)
- Sum savings over all flights

Data needed by the emissions model calculations is fed automatically by the SMS, specifically archived taxi times, and metered slot acceptance times.
Enhancements:

- A module will be added to the archive engine to allow users to generate fuel and emissions impact reports, measuring impacts in terms of pollutants and financial savings of reduced fuel burn (user-defined financial assumptions)
- MIT is working to improve on the ICAO standard emissions models, specifically through the use of FDR data, which would account for multiple added operational factors that are important to fuel burn in addition to basic active taxi time. When these new models are available, they will be incorporated into the emissions module of the SMS.

Surface Saturation and Gate Conflict Forecasting and Alerting

Surface saturation and gate conflicts are forecasted using the same logic in the MPE. This logic is general and flexible enough to predict saturation, congestion, and conflicts at any part of the surface. It relies on two pieces of information: the forecast locations of aircraft and the aircraft holding capacity of any point of interest on the surface (such as gates). The former is produced by the MPE as its main function. The latter is available from the airport adaptation.

The MPE monitors current aircraft locations and predicts future locations using the fast-time simulation approach discussed above. Using this information, the surface saturation and gate conflict forecasting logic analyzes every part of the airport for which the adaptation contains an aircraft-holding capacity value. In the JFK SMS deployment, capacities will be set for gates, surface bottleneck areas such as alleyway entrances, and holding pad areas as well. Those areas where the forecast number of aircraft in the area approaches within the alerting threshold of the capacity will generate an alert. The surface map will have the capability to color the surface based on the forecast saturation level.

Gate conflict alerts are generated by the same mechanism. Gates are represented simply as geographic areas in the adaptation that have unit capacity. Any time that two aircraft are scheduled and/or predicted to occupy the same gate, that event exceeds the capacity and generates the alert.

Post-Operational Metrics and Reporting

The PMJV SMS will have access to the powerful PASSUR archive reporting engines and interfaces, which have long been a feature of PASSUR traffic management solutions, and will incorporate the Mosaic surface reporting engine, SODAA, an exceptionally powerful surface reporting and performance analysis tool. All reports will flow through the single PMJV SMS archive reports engine.

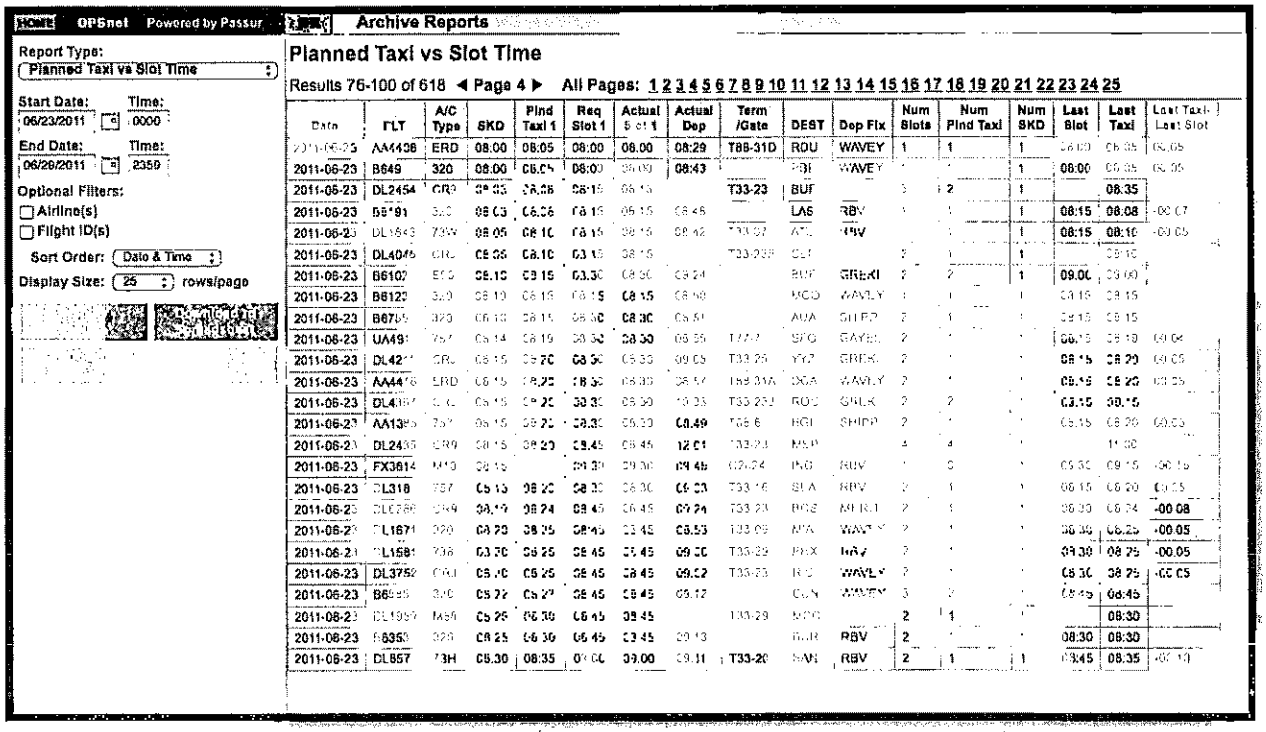
PASSUR Archive Reporting Interface:

A web-based user configurable reporting system that allows the user to generate multiple reports based on the variety of data sets being collected by the SMS specifically, and by numerous other modules of the PITM suite.

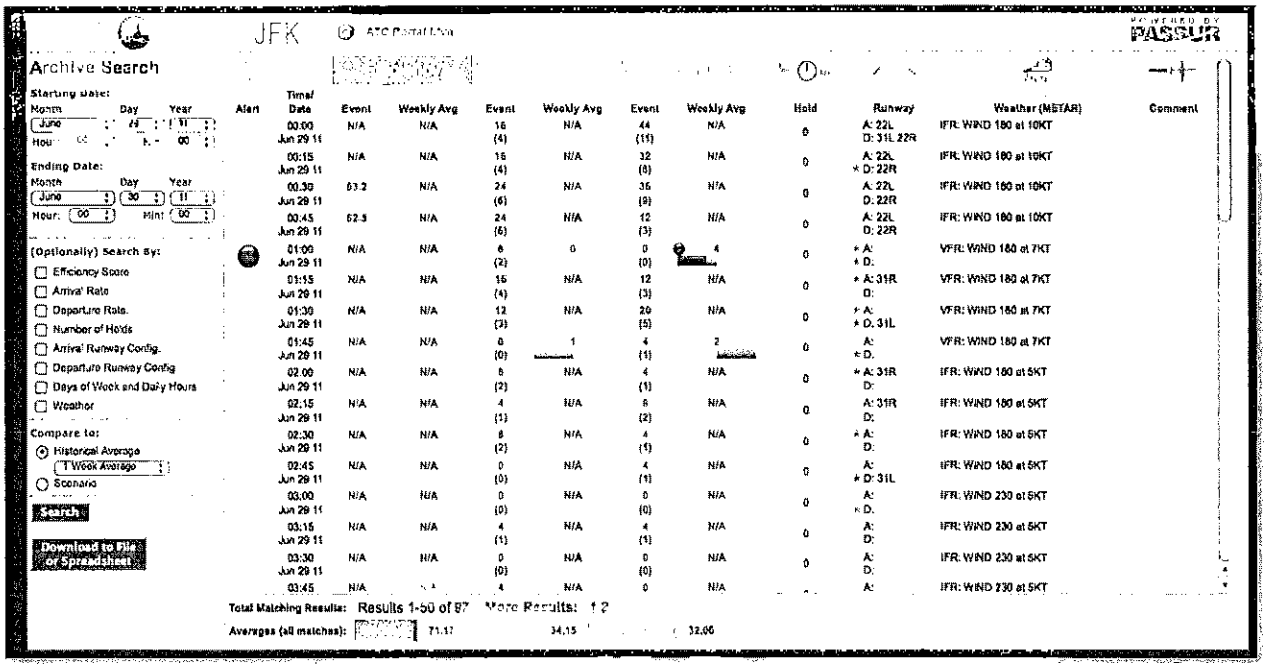
SMS Reporting (current reports):

- Planned taxi vs. slot time
- Departure cancellations
- Planned taxi vs. wheels up time
- Slot time vs. wheels up time
- Non-compliant early
- Non-compliant late
- Non-compliant unlisted
- Chat history
- NOTAMs by number
- NOTAMs by date/status/type
- Arrivals/Departures by runway, time, gate and delay factor
- Runway utilization reports, gate utilization reports, delay reports
- Airport Performance Reports: arrival/departure rates, arrival efficiency score, holding, runway configuration, weather
- These reports are relational (snapshot in time showing status of each of the above variables, to show relative status of key metrics and change over time) and also display user-defined performance alerts to imbalances in demand and capacity.

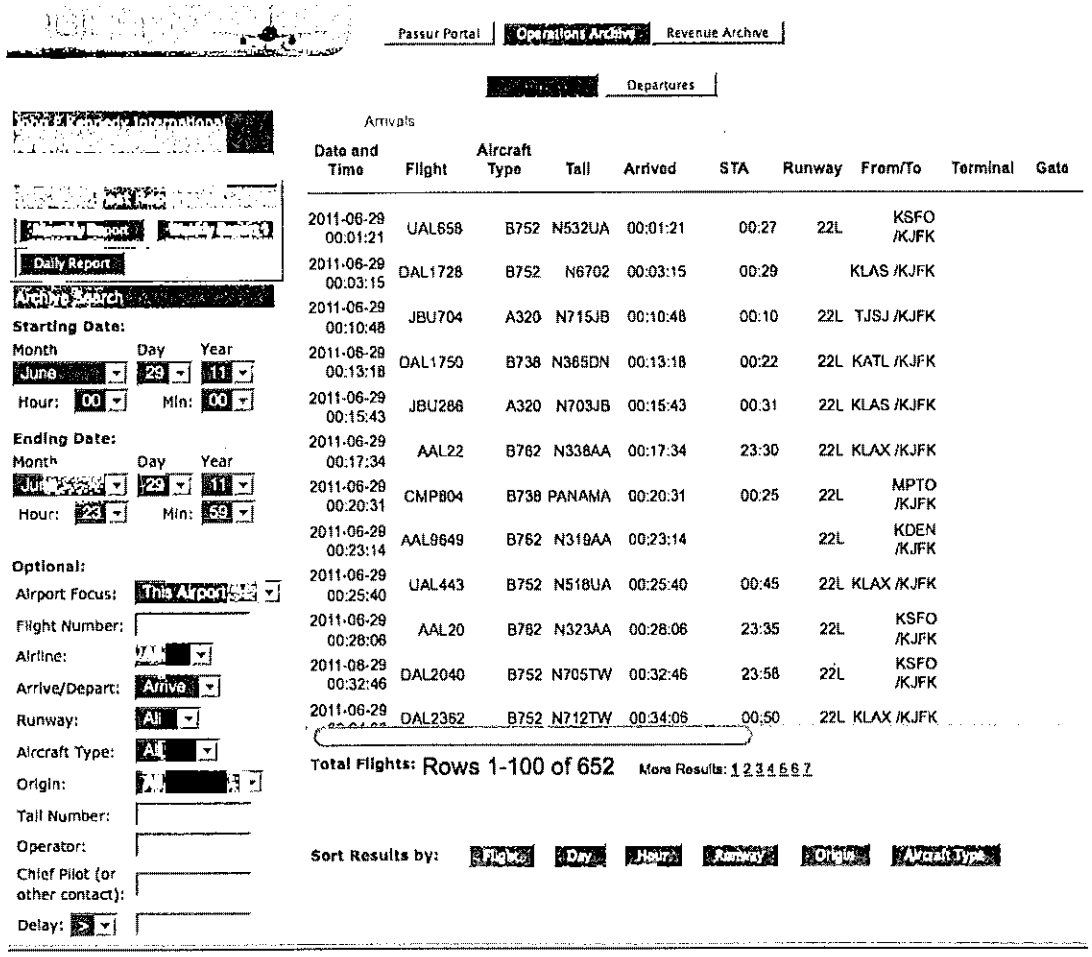
Sample SMS Reports



Sample SMS Archive Report: Airport Performance Metrics



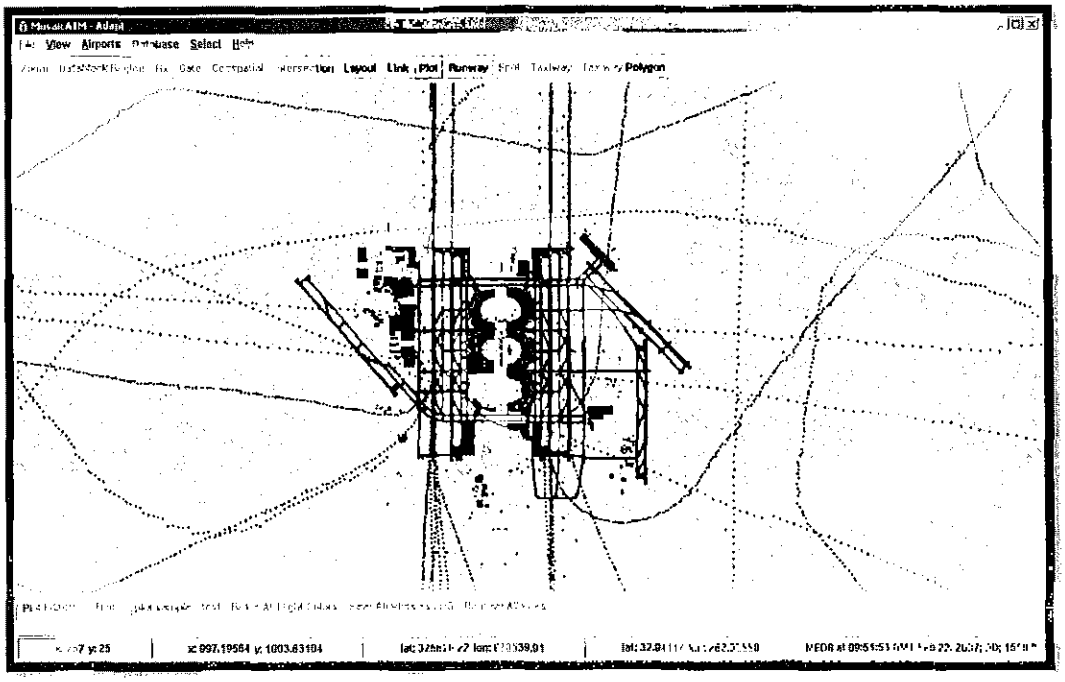
Sample SMS Archive Report: Planned Taxi vs. Slot Time



Sample SMS Archive Report: Operational Statistics

Mosaic SODAA reporting engine

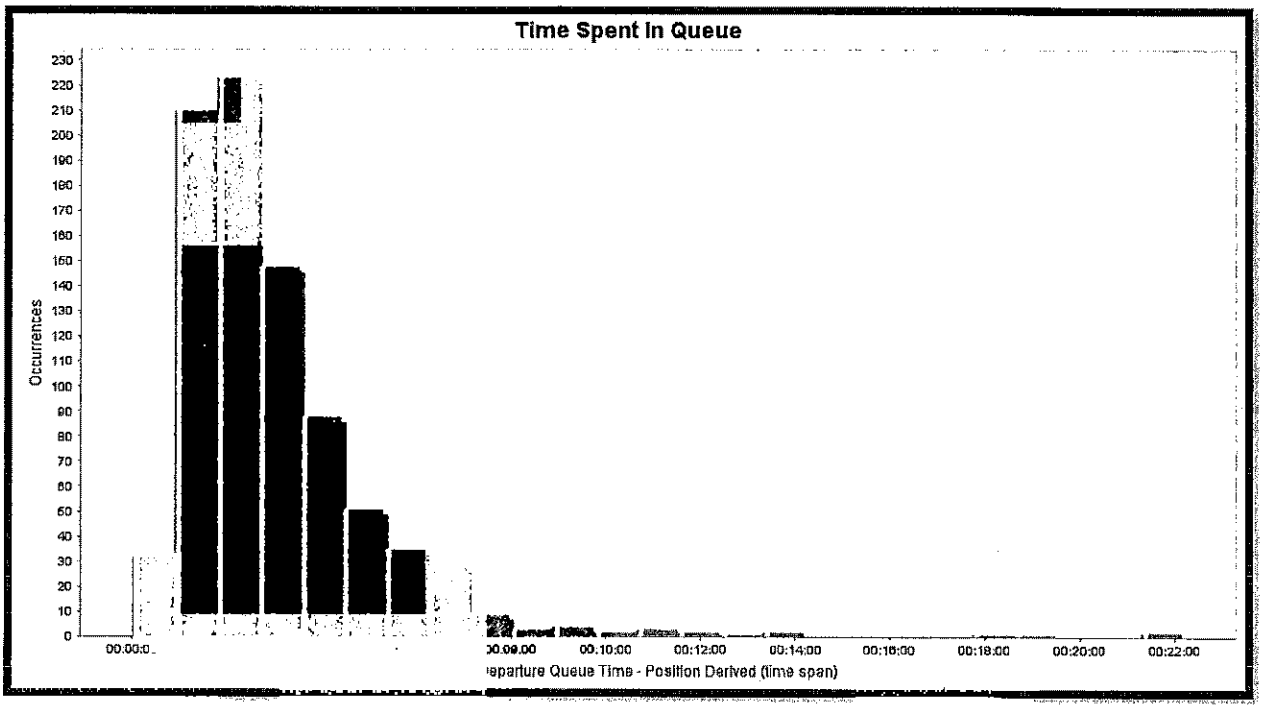
Many critical post-operational metrics of the PMJV SMS are based on the SODAA tool (see figures below for examples). SODAA supports automatic generation of pre-defined standard reports as well as custom generation of new reports through a sophisticated, geographic-aware query engine. All the report samples listed below will be displayed on the single PASSUR Integrated Traffic Management (PITM) interface.



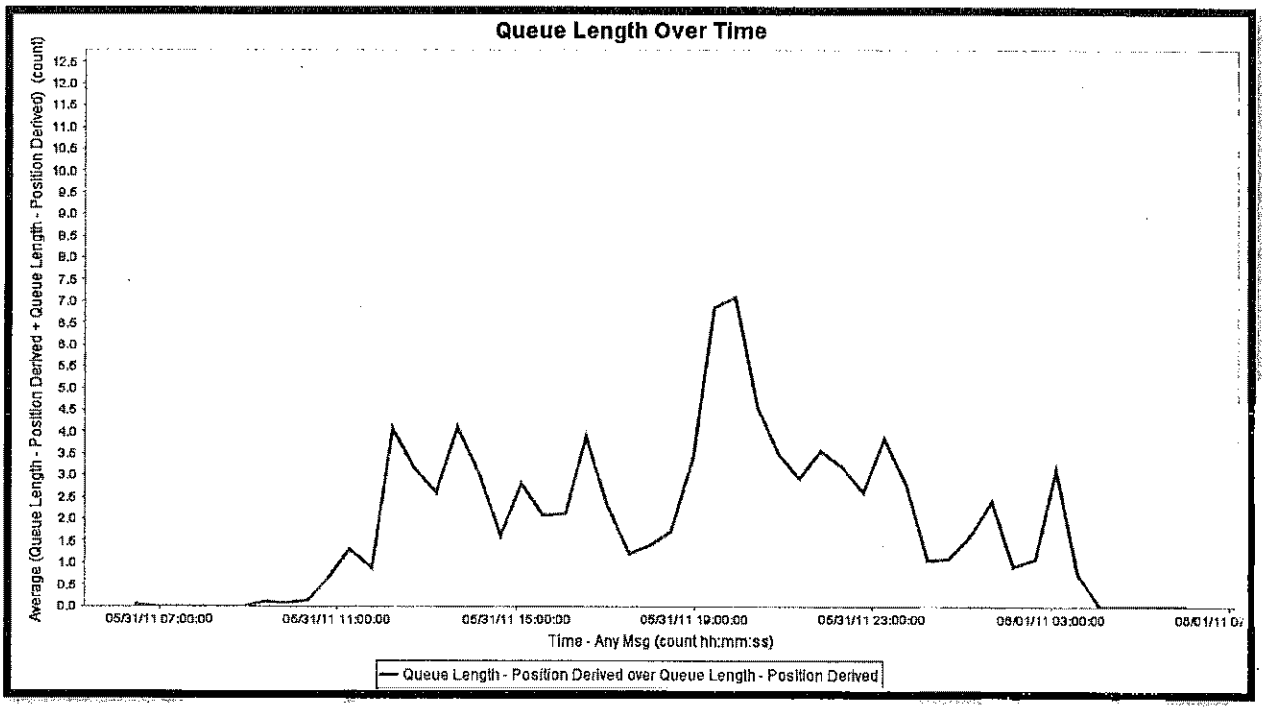
SODAA tool provides an interactive, graphical geographic plotting capability for interacting with large aviation datasets.

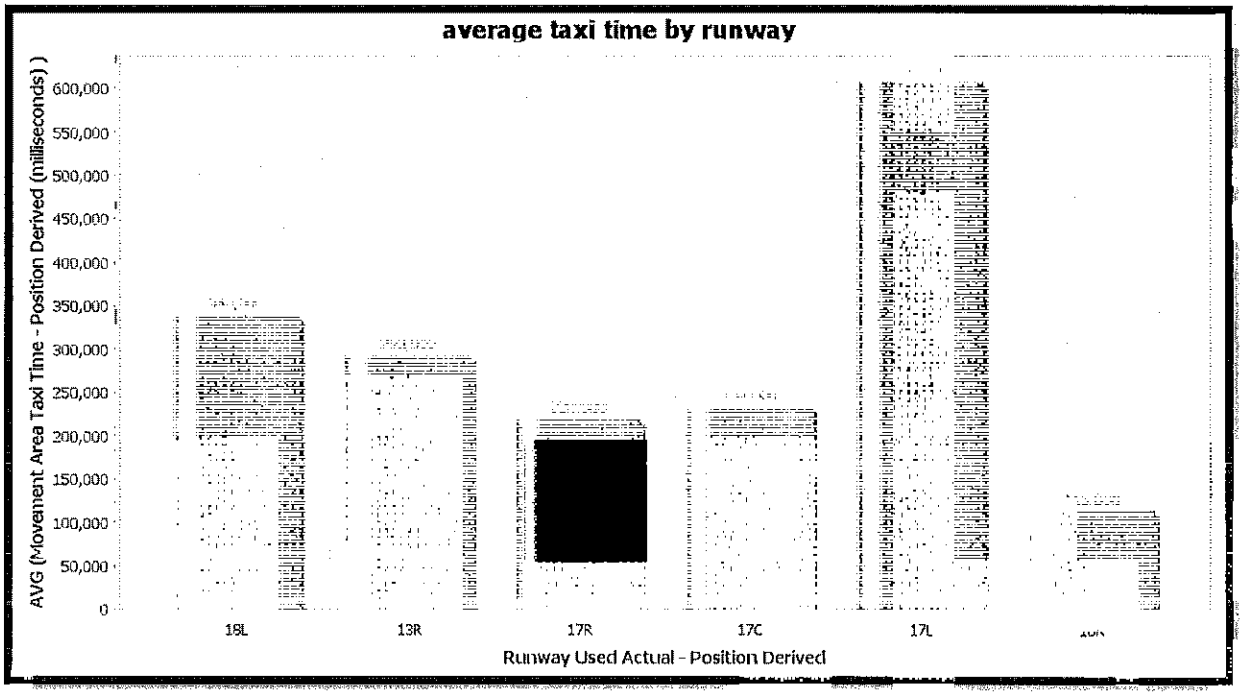
SODAA extracts key information from surveillance data, identifying when aircraft enter queues, cross defined geographic locations, use taxiway and runway segments, etc. Because it interprets the data, it is able to support queries and analyses on the information that matters to airport and airline managers, such as the time spent in queue, the length of taxi, the taxi paths used, queue lengths, operations counts, usage of different resources such as fixes, gates, spots, taxiway elements and runways, and so forth. Not only can SODAA produce a wide variety of analyses, it can also present the information in a wide variety of formats, including textual output, histograms, time plots, geographic plots, and so forth.

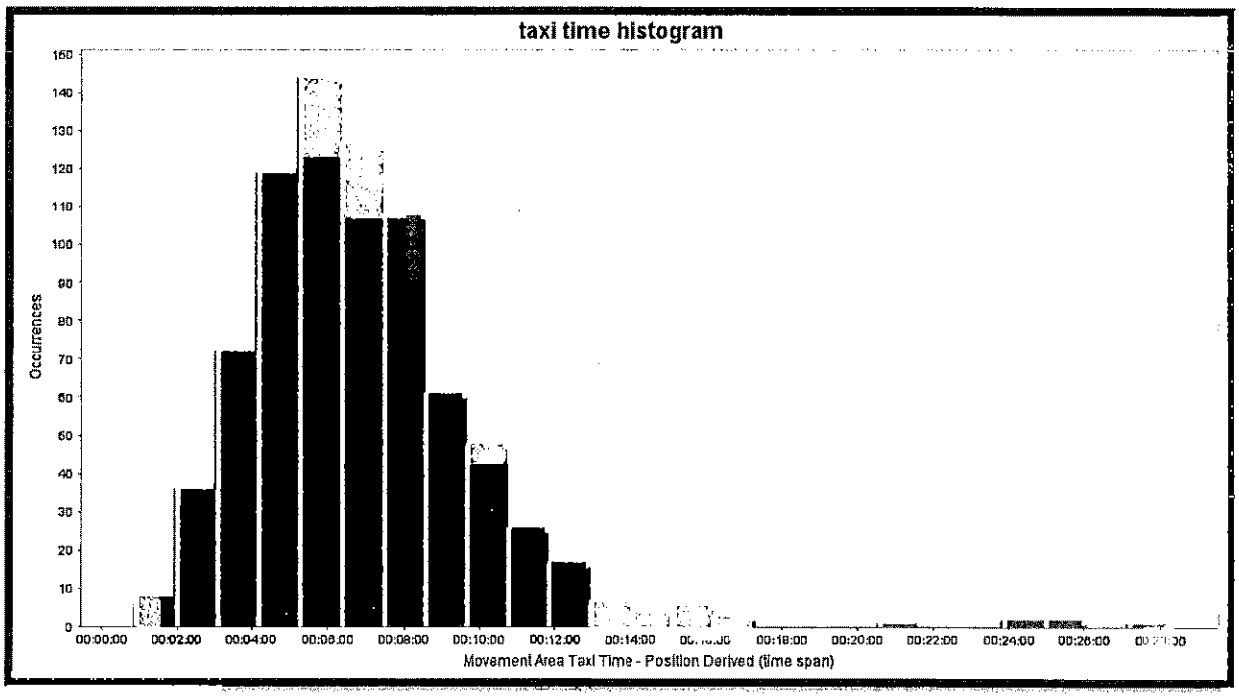
For instance, the figure above shows a histogram of the time each flight spent in departure queues. Presented this way, the data tells a more complete story than providing mere averages and similar statistics. SODAA has sophisticated capabilities to select the data on which to produce reports; thus it is a simple matter to start from a standard report and then drill down into outliers or other characteristics of the report to understand the detail driving the statistics.



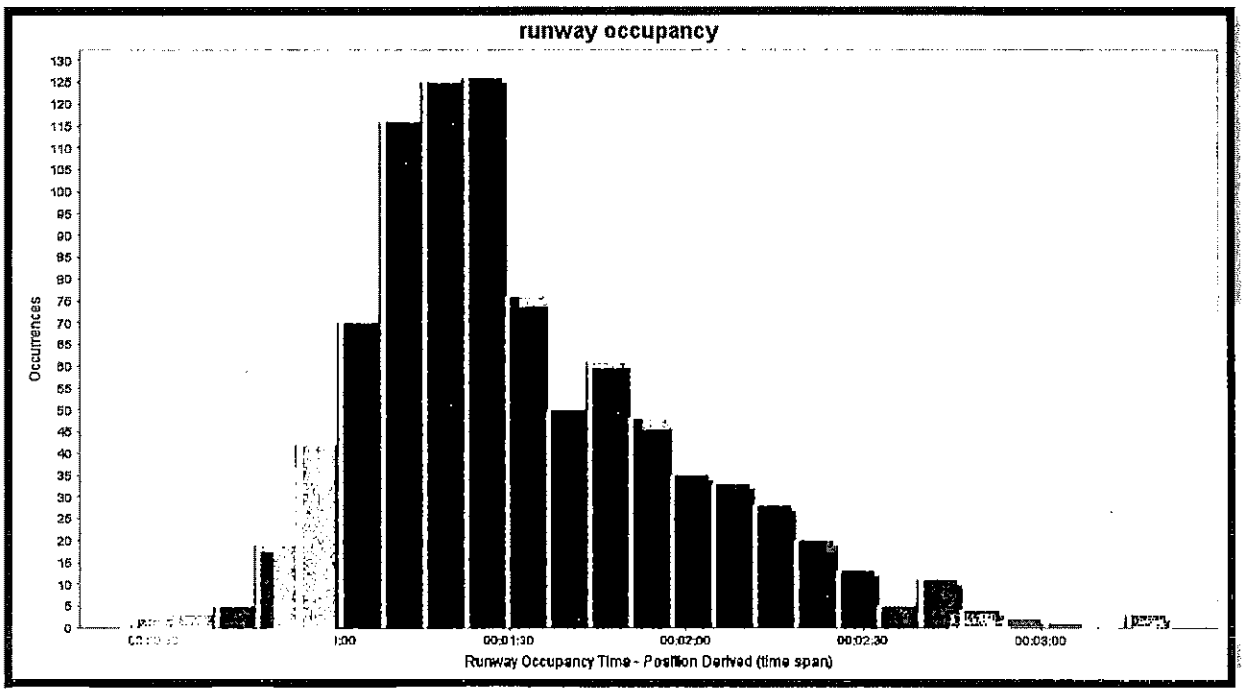
SODAA-generated bar chart (above) and histogram (below) showing time spent in/length of the departure queue, respectively



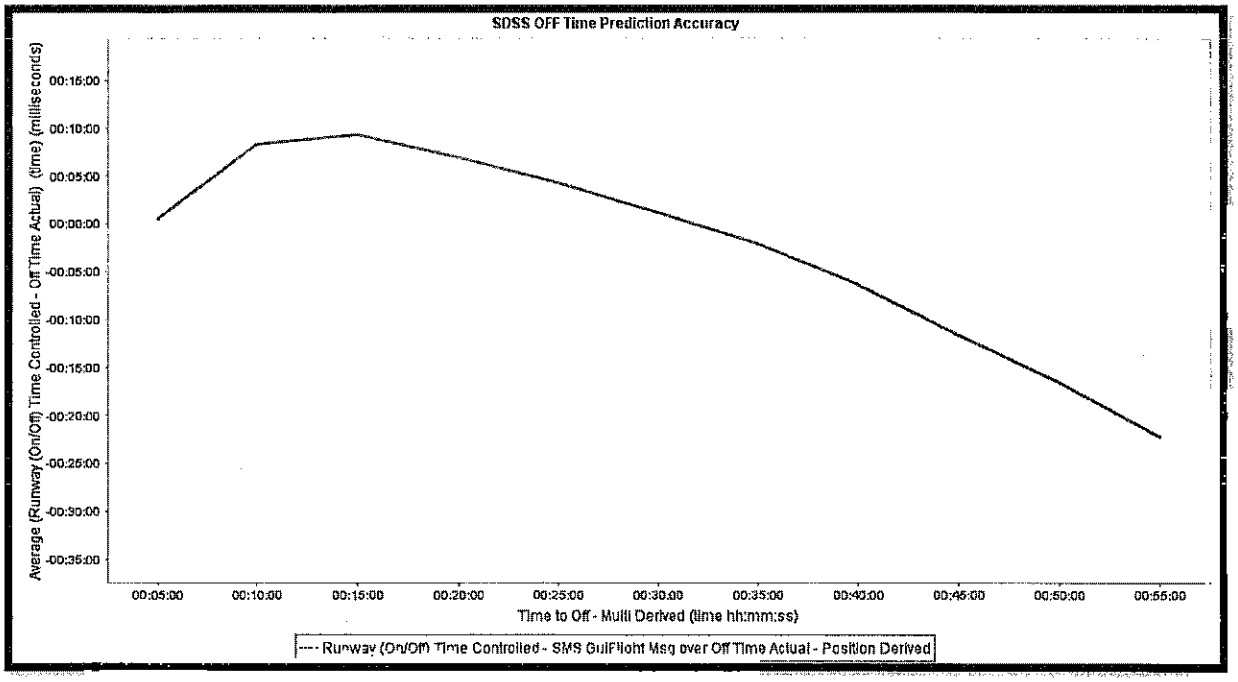




Taxi-time reports by runway and as a histogram as generated using SODAA

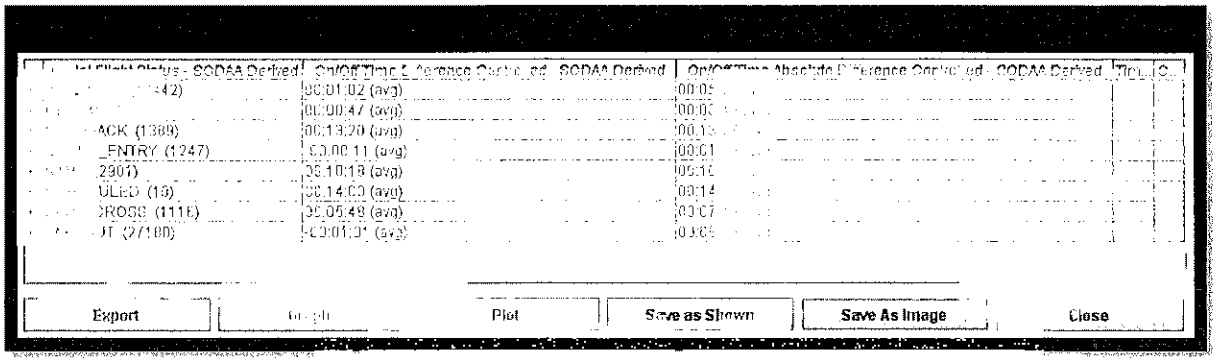


Sample runway occupancy time report



Sample prediction accuracy report

SODAA allows the user to analyze and troubleshoot sources of errors in departure time predictions. The above plot shows that an SMS configured to produce zero-mean off-time error contains biases induced by its reliance on scheduled departure times. The PASSUR SMS will avoid such biases through use of additional airline data obtained through its partnership with ARINC and through calibration of scheduling errors in GA and other non-participating flights.

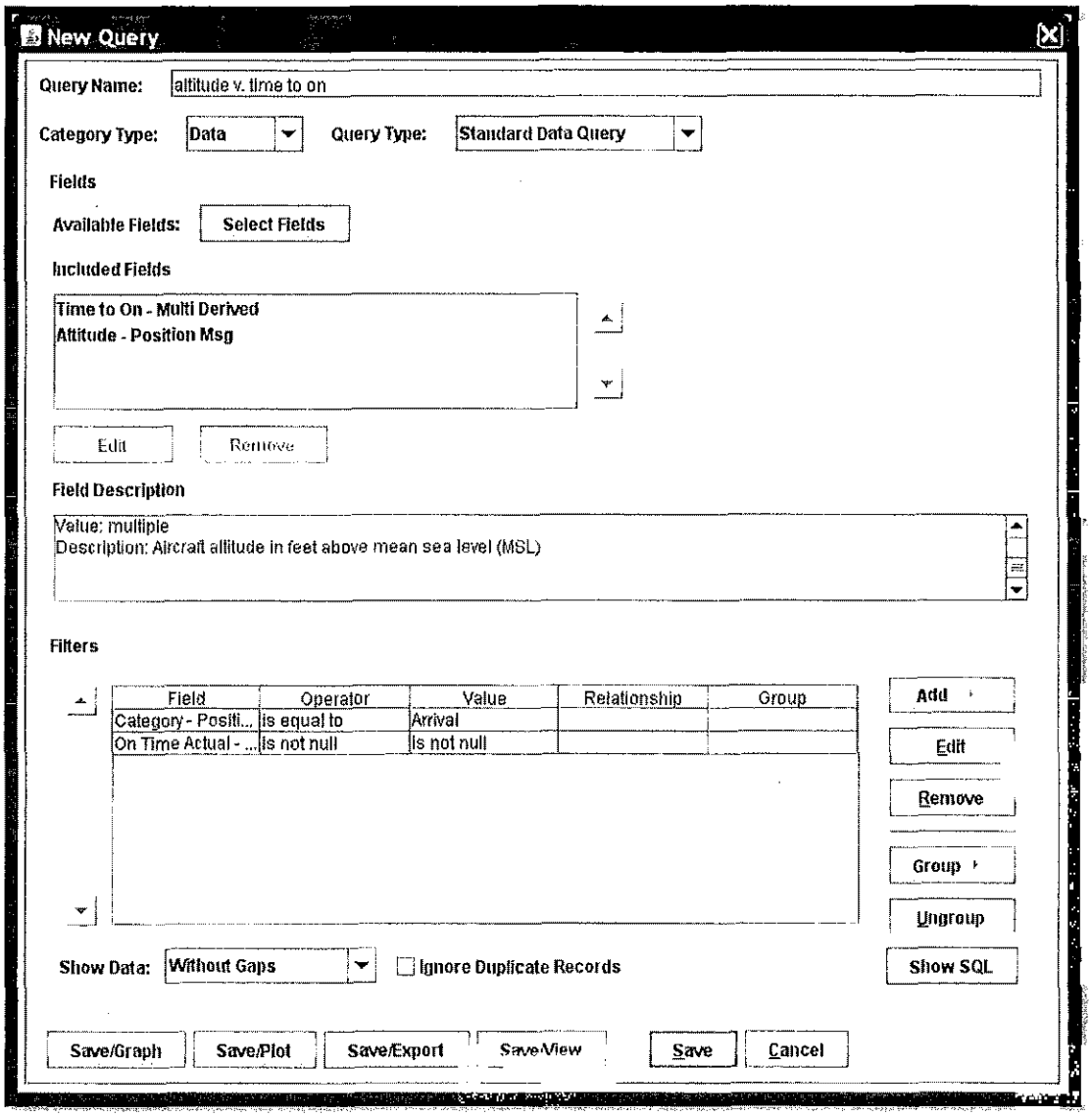


Tabular SODAA data presentation allows users to drill down to find and correct error sources.

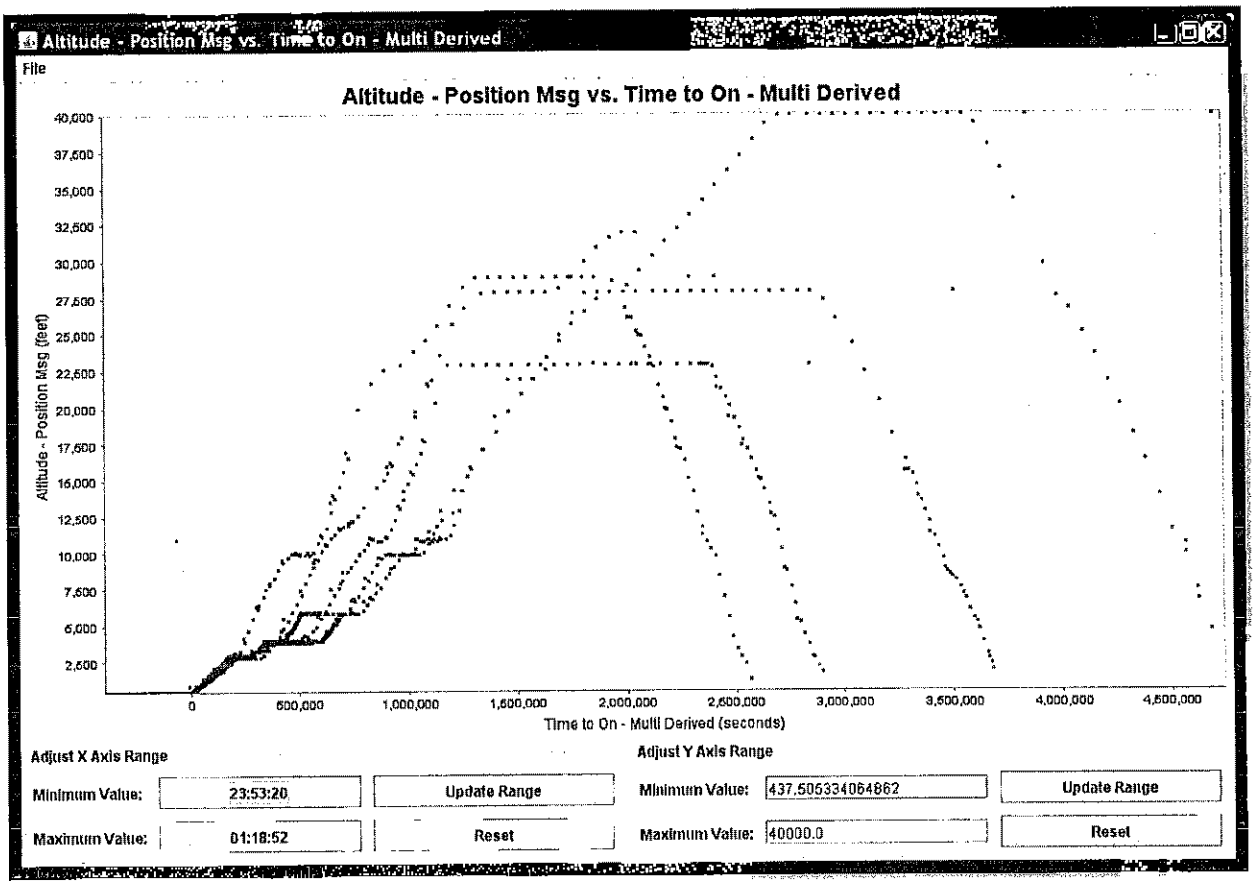
In the PMJV SMS, SODAA will be configured to generate the following reports automatically, supplementing other existing SMS reports (shown above). Reports can be automatically e-mailed to stakeholders or accessed through the PASSUR portal.

- Arrival and Departure Summary
- Movement Area Taxi Time
- Total Taxi Time
- Gate Utilization
- Departure Delay
- Arrival Delay
- Runway Utilization
- Metering Area Usage

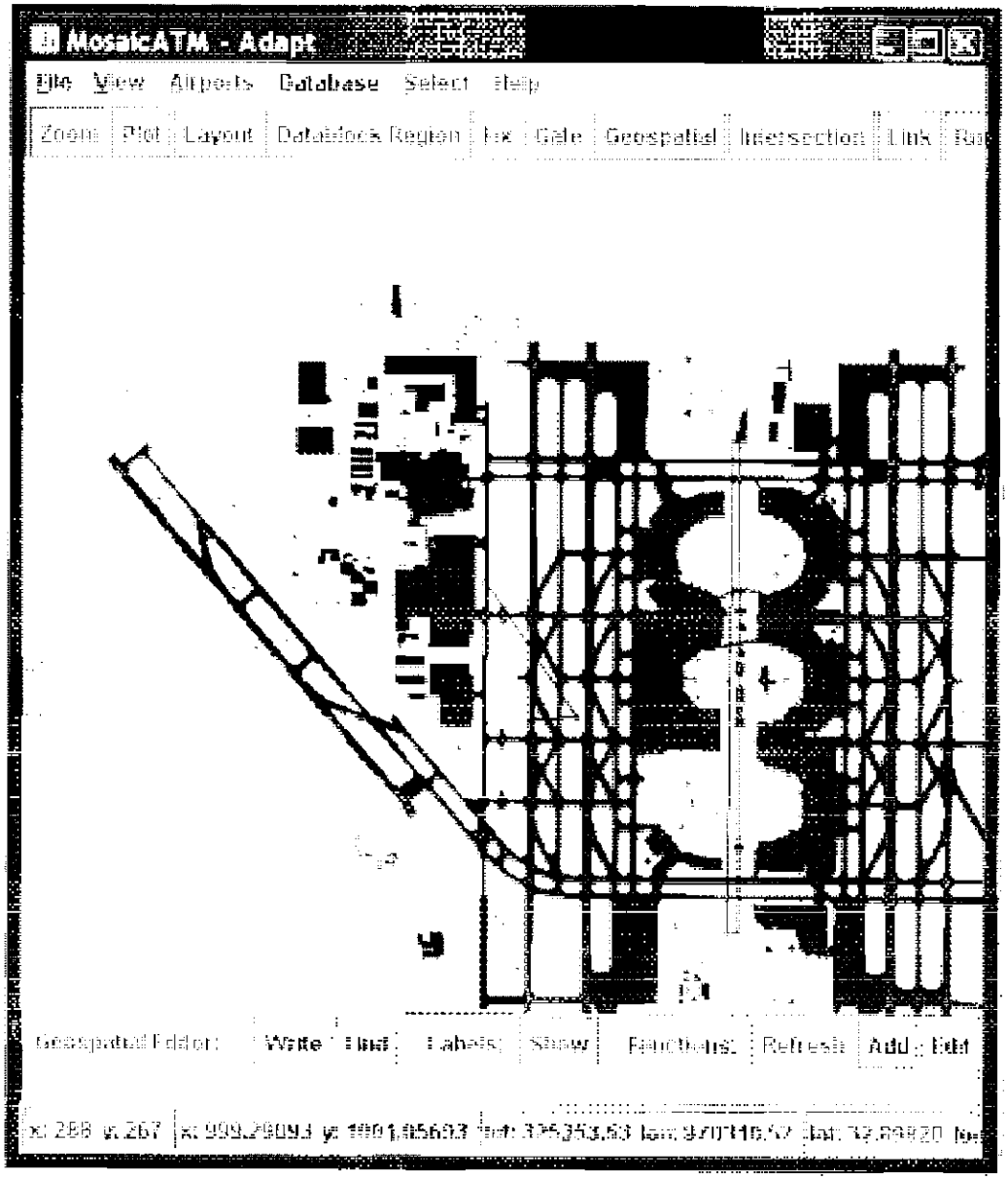
The SODAA tool contains a number of ways to build custom queries, which can be used to view relationships not anticipated by pre-formatted reports. A query construction dialog is shown in the figure below.



Constructing custom queries with SODAA is easy; it provides user-friendly interfaces to allow the user to explore the data without an extensive technical education.



Results of a custom query in SODAA displaying several flights' altitudes versus time from wheels-on.



Arbitrary (user defined, not static) "Regions of Interest" can be defined graphically (blue polygon) through the SODAA interface and then queried for flight events. This will be displayed on the PASSUR Integrated Traffic Management web tracker display.

SODAA supports export of query results in csv and text formats and will be extended through the PASSUR interfaces to export into the formats identified in the RFP:

- Microsoft Word (*.docx)
- Microsoft Word 97 – 2003 (*.doc)
- XML
- Web pages (HTM, HTML, MHT and MHTML)

- Microsoft Excel (*.xls)
- CSV (MS-Dos)
- Text (MS-Dos)

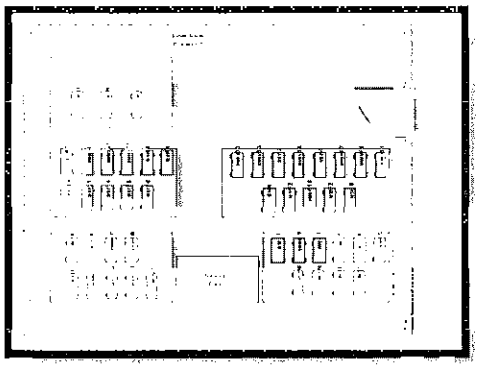
1. **Hosting the System**

The PASSUR Data Center

Physical Environment

The PASSUR Data Center is located in Bohemia, NY. The building and infrastructure are physically protected by a monitored alarm system and key access. The server room within the facility is also protected by a numeric keypad code entry system that logs all entries into the server room. The room is appropriately air conditioned and protected from fire by a Halon fire system.

The server room consists of approximately 40 servers, which service the multiple commercial products produced by PASSUR. All servers are connected to UPS systems. An engine generator system provides backup power in case of commercial power failure.



Data Inputs
The PASSUR data center is fed by multiple external data inputs, which power the many products supported. These inputs include but are not limited to:

- Redundant Internet ISPs, which allow the PASSUR products to remain online in the case of a single ISP outage
- FAA ASDI data feed
- Inputs from over 150 PASSUR radar systems around the world
- Multiple feeds from airlines
- Multiple feeds from airports

- FAA ASDE-X surface movement feeds

C. Functional Overview of Initial Implementation – Phase A

PHASE A Requirements	Summary of essential components for delivering capability
Departure management capability utilizing rationing principles	Calculator that automatically assigns and populates flight-time assignments based on rates and ration by schedule; interactive with carriers for dynamic/iterative process after initial calculation. Includes new automated swap/substitution capabilities and FOSA interface for integration with user automation systems.
Allocate call for taxi times	Automatically allocates taxi-time assignments and subsequent adjustments.
Automatically populate scheduled flight information	The departure metering module currently auto-populates scheduled flight information, and also allows for manual addition of flights not in the schedule. Flight plan information is automatically updated as available from ETMS.
Manually insert flight including ad hoc, ferry, and GA	The departure metering module allows for manual addition of flights not in the schedule.
Automatically populate call for taxi times	This is already in place in the current version of the departure metering module.
Process substitution requests based on rationing principles	Planned automation will allow airlines to model different substitution plans; and once a substitution is requested, the SMS operator can automatically adjust all flight times.
Instant communication function	Current functionality allows users to dialogue online in real time.
Distribute forecasted operational plan	Current functionality on PASSUR OPSnet FCR, used by the Port Authority and all carriers at JFK – web-based field condition reporting.
Distribute forecasted airspace plan	Current functionality on PASSUR OPSnet FCR – web-based field condition reporting.
Distribute forecasted arrival/departure rates	Current functionality on PASSUR Airport Performance predictive dashboard; will be migrated onto SMS primary interface.

PHASE A Requirements	Summary of essential components for delivering capability
Distribute forecasted runway usage	Current functionality on PASSUR Airport Performance predictive dashboard; will be enhanced with MPE and migrated onto SMS primary interface, and will include predicted runway by call sign.
Distribute forecasted expected/known delays	The MPE's predictions of taxi route and timing, calculated through fast-time simulation, combined with surface segment capacity models in the adaptation, are used by the surface saturation predictor to recognize and predict congestion, saturation, and delays.
Distribute forecasted weather	Various forecasted weather feeds are already in place; will be migrated to primary SMS interface.
Distribute forecasted challenges by participants	This is covered through a variety of means: the bi-hourly SPT, forecasted imbalances from the Airport Performance dashboard, and will be supplemented by the forecasted surface delays added by the MPE.
Monitor queues by runway	The MPE monitors and predicts the evolution of each queue - for each runway and for each departure fix - over time as well as queue entry and exit times for each flight. The enhancements to PITM will display both types of information through load graphs and timelines, as well as through discrete time fields in flight-specific data, in terms of queue length and in terms of queue (and taxi) time.
Monitor queues by departure fix	
Monitor queues by taxi out times	
Predict queues by runway	
Predict queues by departure fix	
Predict queues by taxi out times	
Mitigate queues by runway	The use of PASSUR's virtual departure queue, based on predictive arrival and departure rate limits the size of actual departure queues. PASSUR's predictive capability provides the airport users a planning horizon several hours in advance of actual taxi times. PASSUR OPSnet collaborative platform allows for fine-tuning the size of the departure queue based on actual performance of the ATC system.
Mitigate queues by departure fix	
Mitigate queues by taxi out times	
Predict and mitigate imbalances prior to development	The Airport Performance dashboard predicts imbalances up to eight hours in advance in the terminal airspace; this will be supplemented by imbalance predictions on the surface through the MPE.

PHASE A Requirements	Summary of essential components for delivering capability
Snapshot of actual departure demand	These will be displayed in flight tables and flight timeline graphs on the surface tracking screen, filtered by departures. In addition, aircraft icons will be color-coded to reflect departure activity.
Snapshot of forecasted departure demand	Same as above but for forecasted demand.
Current and forecasted configurable delay criteria	The MPE surface saturation predictor recognizes and predicts congestion, saturation and delays. The current and forecasted delays will be shown, and configurable by the user to determine delay parameters, determining what qualifies as a delay and how it alerts on the screen.
Taxi time alerts (exceeding time off gate or off stand; configurable alerts)	This will be user-controlled functionality to set alert parameters for inbound and outbound taxi-time parameters.
Provide carriers with current taxi time delays	This information will be displayed in a variety of places, including in tables, on flight tags and in flight timelines, and it will be distributed to participating users' automation through the FOSA interface. Color-coding will also be available for added alerting.
Recommend departure delay parking locations	This is handled in real-time chat functionality as well as in the messaging areas – both currently available.

PHASE A Requirements	Summary of essential components for delivering capability
Monitor departure delays at gate, movement areas, or non-movement areas	Delays are monitored using different capabilities: 1. Alerting – many of the critical surface metrics that need to be tracked by operators, such as taxi time durations, queue lengths, status of performance in certain defined "areas of interest" on the surface, and gate conflict alerts – are subject to user-defined alerts, so that operators can "manage by exception" rather than constantly monitoring a mass of information. 2. Filtering and color coding – much of the visual and tabular information available on the TMS can be filtered to reflect only a subset of information and aircraft traffic which is of interest to the operator, and then that subset can be further color coded to indicate different types of operational characteristics (e.g., arrival or departure, heavy or narrow body) and status (e.g., delayed by more than xxx minutes). 3. Various display options: delays by ROI (Region of Interest), filterable by multiple user-selected criteria; delays shown on individual flight data tags; delays shown in flight timeline graph; delays shown in master (global) delay list.
Warehouse and make accessible archive data	The flight table will show the current delay status of an aircraft regardless of location on the field. Delay from airline schedule or FAA delay can be displayed.
View live and archived data in reports	See archive, analytics and reporting descriptions above under "Description of work" (IV B above) and below under "Reporting."
Live tracking of flights	PASSUR existing integrated air-surface web tracking interface, to be supplemented with MPE capabilities. PASSUR flight tracking now encompasses gate-to-gate tracking for the entire flight on one interface.

PHASE A Requirements	Summary of essential components for delivering capability
Automate alerts for critical events	1) The MPE monitors current aircraft locations and predicts future locations using the fast-time simulation approach discussed above. Using this information, the surface saturation and gate conflict forecasting logic analyzes every part of the airport for which the adaptation contains an aircraft-holding capacity value. In the JFK SMS deployment, capacities will be set for gates, surface bottleneck areas such as alleyway entrances, and holding pad areas as well. Those areas where the forecast number of aircraft in the area approaches within the alerting threshold of the capacity will generate an alert. The surface map will have the capability to color the surface based on the forecast saturation level. 2) Current PASSUR airborne tracking monitors aircraft entering and exiting multiple key airspace segments, including fixes and holding. These will also be subject to user-defined alerts.
GUI for real time and playback of surface surveillance	PASSUR Integrated Web tracking is used for this capability. It has real-time and playback capabilities.
Automatic retrieval of airline schedules 48 hours in advance, and then save and audit any changes made by users	The current slot management module already provides airline schedules 24 hours in advance. PASSUR will adjust the retrieval forward. PASSUR will also add time and identity stamp for changes by users, leveraging same capability already present in the platform on other pages.
User input the earliest time that an aircraft can be ready for taxi, and then use the earliest time to allocate taxi	Already in place in departure slot request module.
User ability to swap flights to self-prioritize based on rationing principals	This is a manual process user entry in the current slot request module, that will become automated for Phase A.
Warehouse data and shared information as presented in the metrics section	See archive, analytics, and reporting descriptions above under "Description of work" (IV B) and further down in this document under "Reporting."
Use other supporting tools	The SMS operators are adept at integrating additional flight management tools.
Add flights to schedule	This is an existing capability in the slot request module.
Support and maintain adherence to the procedures established by the Port Authority	Agreed to.

PHASE A Requirements	Summary of essential components for delivering capability
Conduct quarterly meetings to review procedures established by the Port Authority	Agreed to.
Attend user meetings	Already a standing practice and will be continued.
Provide 24/7 helpdesk support	Already in place and fully discussed in the training section of the Technical Proposal Volume 2.
Administer new users	There are a variety of software tools and existing practices PASSUR has evolved over several years to manage both the SMS and PASSUR OPSnet. This includes extensive online tools for customer admin or "super users" to set up and administer new users through the web interface.
Track and report service irregularities	PASSUR can introduce an online service irregularity solution it uses internally to SMS users.
Support interoperability with current systems	Agreed to as specified in the RFP.
Issue Daily summaries	All of the metrics listed in this section are already tracked and stored in several different PASSUR modules that will be available to SMS users. They are being consolidated into a single reporting interface.

D. Functional Overview of Enhanced System and Services – Phase B

1. General Requirements for Enhanced Operation

PHASE B Requirements	Summary of essential components for delivering capability
Forecast airport capacity for next four (4) hours	This capability is already available in the Airport Performance module and will be made available in Phase A.
Provide alerts for specific operational events	Alerts can be designed for a variety of operational events/milestones/parameters.
Automatic alert for imbalance in capacity and demand for both arrival and departure traffic, and configure aural or visual alerts	This capability is already available in the Airport Performance module as a visual alert. It will be augmented with the addition of MPE surface prediction processes. Alerts will be migrated to the main SMS screen, and can also be expanded to include audio alerts.
Chat function	Already in place and will be made available in Phase A.
Instant replay synchronized with audio local radio frequencies, taxi time allocations, and playback in MPEG-2 format.	Instant replay of airborne and surface tracking is already a feature on Integrated Web tracking. Synchronization with radio, taxi time, and chat will be added. The Port Authority must facilitate access to frequency recordings.
Performance measure scorecard	PASSUR dashboards already contain several performance measurement scores. In consultation with the Port Authority these will be modified and/or enhanced.
Alternative methods of providing surface surveillance data if reliance on sources other than those listed is planned	PASSUR plans to rely on the sources listed in the RFP, with the supplement of PASSUR surveillance radar data (JFK and other PASSURs in the network) and "weight on wheels" aircraft positional update messages as needed from PASSUR's partner, ARINC, to cover "dark spots" in the ASDE-X (requires airline concurrence) and/or ADS-B coverage (via PASSUR radar).
Two year surveillance upgrade if wholly independent of FAA systems	PASSUR's JFK radar surveillance systems are routinely maintained. There are two PASSUR systems at both JFK and EWR. In addition, the EWR PASSUR system provides additional airborne tracking for JFK airspace.
Secure web based environment available to authorized geographically disbursed users	Already available and will be part of Phase A except for certain Phase B functionalities from Mosaic which are being migrated to the PASSUR web platform.
Forecast projected rates based on historical performance, current and forecasted conditions, including weather, flight schedule demand, traffic management initiatives, and other operational constraints	Already available on the Airport Performance dashboard and will be part of Phase A.
Estimate departure delay times during irregular	Departure delay times will be forecasted using MPE

PHASE B Requirements	Summary of essential components for delivering capability
operations	(see description in "Description of Work" IV B).
Meter to individual runways and departure fixes to optimize aircraft sequencing selection based on FAA programs, current constraints and opportunities.	A combination of capabilities will enable metering and sequencing as a function of current and predicted queues by runway and by fix to enable fix-load balancing. This includes current queue-by-runway and fix status on the System Metrics dashboard, as well as predictive capabilities to be added from the integration of the MPE. Please see narrative details in "Description of work" IV B.
Drop down menu of 20 delay types	This will be added as described, leveraging a very similar capability already present in the Tarmac Delay Management module.
Status window for each runway showing delay time and # of aircraft	To be added through the integration of MPE (please see narrative details in "Description of work" IV B).
User ability to swap flights	This is a manually available process today on the existing interface and will be automated for Phase A above.
Predict times for: runway touchdown to ramp, ramp to gate, gate to taxiway, taxiway to departure, and aircraft taxi times	Will be added through the MPE (please see narrative details in "Description of work" IV B).
Display taxi times including: gate to taxiway; taxiway to metering location and/or hard stand deice pads; from metering location and/or hard stand deice pads to departure; from gate to departure; monitoring and reporting for aircraft traveling through a defined region of interest	Will be added through the MPE (please see narrative details in "Description of work" IV B).

2. Integration with External Systems

All of the required information elements listed in Exhibit 6 of the RFP document, "External Systems," are currently present in the current PASSUR PITM system, or the Mosaic surface management system, or both. They will all be integrated into the PMJV SMS. In some instances there are already redundant or overlapping sources for the information required, including PASSUR independently generated data.

The Mosaic FOSA interface capability is based on the practice of data exchange in collaborative decision-making (CDM), which originated in the 1990s as FAA/industry effort to improve traffic management in cases of constrained capacity (e.g., weather) in a collaborative manner between FAA and airspace users.

The FOSA interface capability, based on the technologies adopted by the System Wide Information Management (SWIM) program, provides an application-independent capability for data exchange that doesn't require a custom interface for each connection. The FOSA services allow the flight operators to provide (via the FO messages) push readiness state, parking gate, spot, departure slot preferences, required runway, gate conflict action, and many other data elements to the PMJV SMS, and to receive (via the SO messages) the system predicted times (pushback, queuing, spot, runway, ETD, ETA, etc.), flight substitution request resolutions, gate conflict alerts, and other data, for automated ingestion and use by the flight operator's information systems. External System integration detail:

1. Data Source: Surface Surveillance
    a. Required Information: Aircraft position on airport surface
    b. PASSUR is an approved ASDE-X data integrator with a working real-time surface traffic tracking capability, "integrated web tracking". In addition, the SODAA and MPE, modules referenced above integrate ASDE-X data for live tracking, and record it for playback and analysis. ASDE-X is one of the data feeds fused in to provide predictions for various stages of surface and terminal area movement. Additional surface surveillance sources are ADS-B (via PASSUR radar) and ACARS.
2. Data Source: TFMS
    a. Required Information: Traffic Management Initiative (TMI) data
    b. PASSUR currently receives MIT restrictions for arrivals and departures and EDCTs from TFMS. This data is automatically collected and processed in various PASSUR products. MPE and SODAA also fuse data from TMA when it is

available and in use, including metering status, metering fix assignments and timing (ETA at Meter Fix, STA at Arrival fix).

3. Data Source: ATCT
    a. Required Information: Predicted runway for arrivals and departures
    b. Mosaic FOSA has an operational interface with TMA for arrival runway assignments. MPE provides a "decision-tree" for departure runway assignments. Additionally, PASSUR has a proprietary ETA algorithm that provides arrival runway predictions using PASSUR surveillance, independent of ATCT or any other FAA sources, widely used by all major carriers and many airports.
4. Data Source: FIDS
    a. Required Information: Gate/Stand assignment
    b. PASSUR currently has a working interface with airlines/airports to display gate assignments. In addition, the FOSA Interface provides the flight operators with the capability to integrate their systems to automatically send gate/stand information (via FO-005 message); this is useful for example for airlines without FIDS feeds. For example, Delta currently sends gate information at MEM through FOSA. Similarly, FedEx is sending ramp and stand information.
5. Data Source: FIDS
    a. Required Information: Gate/Stand delay
    b. PASSUR and Mosaic currently use a combination of surface surveillance and airline OOOI data to calculate delays associated with gate/stand wait. Individual gates/stands are identified and labeled providing occupancy and vacant times. Additionally, airlines connected through the FOSA Interface deliver gate conflict messages and are able to provide (via FO-006 message) assignment through this alternate means.
6. Data Source: Operator
    a. Required Information: Requested runway
    b. PASSUR chat allows an operator to convey intent to request a runway textually. The FOSA interface provides the functionality for a flight operator to request a specific runway (via FO-005 message) for a departure or arriving flight, and/or the required runway length that also indicates whether the flight could accept an intersection departure.
7. Data Source: Operator
    a. Required Information: Flight priority

b. Mosaic will add to FOSA a flight priority request for communication of this information from the flight operator that will allow a user to provide the relative priorities among its flights. In addition, FOSA already contains messages allowing automated substitutions, cancellations, and swaps among an airline's flights. In addition, the enhanced version of the PASSUR taxi-time allocation module, Phase A, permits airline flight swaps online, allowing airlines to "game" swap scenarios and then submit altered flight taxi-out requests that reflect their internal business priorities.

8. Data Source: Terminal Data Link System (TDLS)

   a. Required Information: Pre-departure clearance

   b. Currently, PASSUR receives flight plan information and amends through the TFMS data feed. The PDC is a one-way message from the FAA host to the aircraft via ACARS, responding to a message request from the aircraft. With FAA approval we can process the PDC message either through the ARINC pipe we will already have established for "weight on wheels" live aircraft position messages and/or the "flight ready state feed" pipe. Alternatively, this can be added as an element directly from the operator to PASSUR using the FOSA interface.

9. Data Source: Operator

   a. Required Information: Routing capabilities

   b. The FOSA Interface allows the flight operators to provide the routes acceptable to a flight in the Flight Update message (via FO-005 message).

   c. Through the Collaborative Trajectory Options Program (CTOP), ICD, the SMS would receive the airline's submitted Trajectory Options Set (TOS) indicating its desire to accept an alternate departure fix and route to avoid delay on the nominal runway and departure fix. The current implementation plan for CTOP/Collaborative Airspace Constraint Resolution (CACR) will allow airlines to submit TOS requests as early as spring 2012, although ATC will be unable to make use of them until spring 2013. The JFK SMS capability to use the TOS information may allow the CTOP/CACR effort to achieve some early success in collaboration with the Port Authority.

10. Data Source(s): Operator, Airport Operator, Surface Surveillance

    a. Required Information: "Off" block

    b. The FOSA interface provides the capability for a flight operator to submit the OFF block times (via FO-005 message) as follows:

i. Scheduled Off-Block Time – the scheduled off-block time (Out time) for a flight

ii. Actual Off-Block Time – the actual off-block time (Out time) for a flight

iii. Estimated Off-Block Time – the estimated off-block time (Out time) for a flight as determined by a flight operator without considering any ATC issued delays.

iv. Target Off-Block Time (TOBT) – the target off-block time for a flight as determined by the flight operator, taking in consideration all ATC delays issued.

v. Earliest Off-Block Time – the earliest off-block time (Out time) that a flight operator could accept for a flight.

vi. Data Sources: Operator, Surface Surveillance

vii. Required Information: Spot Information

c. The FOSA Interface provides the functionality for a flight operator to submit the Spot times (via FO-005 message) as follows:

i. Scheduled Spot Time – the scheduled Off-block time for a flight plus the pushback time plus the transit time to the spot.

ii. Estimated Spot Time – the estimated Off-block time for a flight as determined by a flight operator without considering any ATC issued delays plus the pushback time plus the transit time to the spot.

iii. Earliest Spot Time – the earliest Off-block time that a flight operator could accept for a flight plus the pushback time plus the transit time to the spot.

iv. Latest Spot Time – the latest time requested by a flight operator for a flight that is subject to departure metering but needs to exit the ramp area and enter the Airport Movement Area prior to its assigned spot time (e.g., for a flight which needs to vacate a gate/stand for an inbound aircraft and is unable to hold in the ramp area).

1. The actual spot crossing times are provided by the ASDE-X surveillance.

2. When flight operators are unable to provide spot times, the system uses pre-adapted values to determine pushback times based on aircraft type (e.g., B752, B763, CRJ9). Transit times from the gate/stand to the spot are determined based on the gate/stand location and historical transit times.

11. Data Sources: Surface Surveillance, Surface System
    a. Required Information: Taxi Data
    b. Our combined current surface surveillance capability provides data for "Out to Off," including dwell times or transit times at any designated "Region of Interest" (ROI). We will have "Out" and "In" time automatically added to flight records for all ARINC serviced aircraft. With access to the unfiltered ASDE-X feed we will also have surveillance at the gate area for Out and In times. Data are automatically archived through the SODAA system, and the results of analysis of taxi times from the data are used to update the taxi time predictions generated by MPE. Additionally, the system will use TAF and METAR data, including visibility, winds and breaking action reports, to adjust taxi predictions appropriate to the conditions. Furthermore, taxi predictions will be adjusted automatically by the MPE when taxiway, ramp, runway, or other surface elements are closed. The FOSA Interface provides the capability to request such closures to the JFK ATCT and to provide closure information to the stakeholders (via FO-008/SO-008 messages).
12. Data Sources: TFMS, SCS, Operator, Surface Surveillance, EFSTS, TFMS
    a. Required Information: "Takeoff time"
    b. MPE has an "Estimated Time of Departure" ETD that provides "predicted wheels Off" time before the aircraft is "Out" and an "estimated wheels Off" time after the aircraft is "Out." The ETD can be sent to a flight operator, airport operator, or ANSP. The PMJV has a demonstrated capability to deliver data feeds to the industry. Actual times will be derived from the best combination of PASSUR radar, ASDE-X, TFMS, ACARS, and operator FOSA messages, as appropriate to the flight, equipage of the operator and operational status of the feeds. Slot Credit Substitutions (SCS) submitted by flight operators via the TFMS CDM messages for traffic management initiatives such as Ground Delay Programs (GDPs) or Airspace Flow Programs (AFPs) will be reflected by a change in the EDCT for a flight. PASSUR currently receives EDCTs from TFMS. The FOSA Interface also allows flight operators to submit flight substitution requests for flights controlled by a departure metering restrictions, including similar SCS functionality, for operators which are not able to swap their flights directly and require bridging (via FO-007/SO-007 messages).

13. Data Sources: RAPT, ITWS, NTML, SWAP Hotline, ATCT, TRACON, NY Center
    a. Required Information: Fix availability and Route Restriction
    b. The following sources are used to determine Fix Availability and Route Restrictions for display in PASSUR user interfaces and for use in the MPE's predictions of operations times:
        i. Predicted: Restrictions forecasted by Weather Prediction tool.
        ii. RAPT- PASSUR has been using RAPT for more than a year. PASSUR employees received training on RAPT from MIT Lincoln Laboratory.
        iii. NWS weather- PASSUR has NWS weather presentation integrated in its tracking software (other weather sources can be readily ingested).
        iv. Actual: Restrictions communicated by FAA.
    c. The PMJV has a current automated capability to display FAA departure fix restrictions for JFK. The System Metrics module displays current "miles-in-trail" restrictions and the actual miles provided over the fix, including trend information for the restriction performance.
    d. PASSUR is authorized to monitor the FAA NY "SWAP hotline" and has been monitoring the hotline for more than a year.

Other data: PASSUR generates beacon code and tail number data for airborne aircraft independently of flight plan, operator or other sources. PASSUR also ingests FIDS data from airport operators to support single-source delivery of data elements such as gate assignment; data from fleet databases for detailed airframe technical and ownership specifications; eNOTAMs data from the FAA flight services (two-way data flow); TFMS data from the FAA (ASDI).

3. Function to Receive and/or Distribute Data Elements

Most of the data elements listed in this section are covered in the response to Section 2 ("Integration with External Systems," directly above). Here, by exception, are only those that were not covered:

- Data element: Aircraft Number
  Definition: Aircraft tail number
  Data sources listed: Operator
  Comment: The FOSA interface provides the capability for a flight operator to submit aircraft tail number; this is also be derived through PASSUR surveillance technology.
- Data element: Flight Status
  Definition: Active, proposed, cancelled, etc.

Data sources listed: Operator
Comment: The FOSA interface provides the capability for a flight operator to submit.

- Data element: airport time of arrival
  Definition: Estimated and actual wheels on time
  Data sources listed: TFMS, TMA, Surface Surveillance, Operator
  Comment: PASSUR surveillance systems and algorithms already generate both predicted On and actual On using the system installed at JFK. All of the above sources will also be available as backup.

- Data element: Gate/stand time of arrival
  Definition: Estimated and actual time of arrival at gate/stand (In time)
  Data sources listed: Surface Surveillance, Operator
  Comment: PASSUR ETA to On algorithm will be enhanced by Mosaic MPE prediction engine to ETA to In. This will use both surface surveillance and operator data.

4. **Graphical User Displays**

- Combine and process flight data: all of the data items listed on page 12-13 of 51, i-xxx, are currently provided by the PMJV systems, with the exception of (xvii), predicted gate conflict and length of conflict, which is in development.
- Base map: The PMJV SMS incorporates a detailed base map of the JFK operation which supports the user-controlled display of "information layers" of the airport's physical attributes, such as gates, stands, terminals, taxiways, throats, alleyways, runways, etc.
- Organize adaptation data to support the base map: The PMJV is prepared to ingest and display any updated airport adaptation data provided by the Port Authority
- Characteristics of the base map: All of the items requested, i-vi, are available on the PMJV SMS software, with the exception of iv, visual color coding of NOTAM closures on the base map. PASSUR has an existing specification for achieving this capability, connecting the visualization of the NOTAM information to the NOTAM data already managed today on the PASSUR Airside Operations screen (part of PASSUR OPSnet, which is also where several key elements of the SMS are accessed). The integration of the NOTAM visualization with the existing NOTAM and non-NOTAM content managed on PASSUR OPSnet provides for a more seamless information management process than if the interaction was strictly with the FAA Pilot Web site.
- User interface to base map: all items, i-iv, are available in the PMJV SMS, with the current exception of item iii ("rotate the display, by any angle" – we will do a 360 degree rotation.

- Situational displays and associated user interfaces:
- Runway configuration: already captured in multiple PASSUR applications but will be added to the map display
- Aircraft icons: already present
- Vehicle icons: to be added
- Gate/stand occupancy status: to be added
- Data tags: Items i-ix are currently available on the PMJV visual map display. Item x, dragging tag to reposition, will be added.
- Data tags and expanded detail window: all of the underlying data sets identified in this section are already ingested into the PMJV SMS. Additionally, the current surface/airborne visual display software includes a detailed user-defined tag filtering system, allowing the user to decide a) what information elements are included in the tag and b) what level of detail is to be shown on the tag (short version/long version). The PMJV will add the expanded detail window connected to the data tag as required in this section.
- Additional characteristics of the base map: Items i-viii are currently available on PMJV SMS software. Overlay windows representing performance indicators, predictive/forecasted data, etc will be added.
- Icons: The PMJV has extensive experience rendering different icons connected to live flight data/aircraft, and using different shapes to represent different types of aircraft and vehicles. These differentiated icons, identified in i), a-f, will be added to the SMS.
- Aircraft icon characteristics: Items a-c are already present in PMJV SMS. Color-coding of icons is already a distinct capability in PASSUR tracking software; the specific color-coding categories listed in d) i-vii will be added.
- Vehicle/Non Aircraft Icons: Items a-c will be added, based on existing PASSUR icon display technology
- Gate and Stands: status of gates and stands, and information about aircraft related to gates and stands, will be added to the SMS
- Timelines of pending flight arrivals and departures: Items a-e are already part of the PMJV capability and functionality and are being integrated into the SMS displays
- Weather display: all weather sources listed in items a-d are already integrated as part of the PMJV SMS capabilities and are being migrated onto the SMS displays

- Tabular display data: Items i, iv, v, vi, ix are all currently displayed on the System Metrics dashboard, a module of the SMS. The remaining items will be added and all consolidated onto the mapped display as well (the data and calculations to support the remaining displays is already present)
- Alerts to User: PASSUR systems already make extensive use of user-configurable, onscreen visual and audio alerting, as well as user-configurable email alerting, with functionality to segment alert events that trigger emails by user. Items i-iii are already present capabilities. The specific alerts envisioned in (iv) will be added.
- Configuration of alerts: PASSUR interfaces already enable users to save detailed information and display preferences to their personal login profile, for use on demand anytime they are logged in ("User Layouts"). The additional information sets identified here will be added to the User Layout capability. The data to support these is already present.

5. Transmit Modeled OFF Times

PASSUR SMS will develop the necessary data interface to transmit real-time, dynamic estimated Off times to TFMS, as required here. The PASSUR surface/forecasting prediction engine is described above in the section "Description of Work."

E. Reporting

PASSUR has a robust data archiving and reporting capability, supported by years of NAS data stored in specialized relational databases from its extensive surveillance network and multiple additional sources.

PASSUR reporting is compatible with, and exportable to, all the formats listed on page 19 under reporting requirements. Currently the options on the PASSUR reporting interface are for export to .xls and csv. PASSUR will add options for output to: MS Word, XML, web and text.

The PASSUR SMS reporting capability, supported by both PASSUR web reporting functionality and Mosaic surface analysis and reporting tools, will support detailed pre-formatted and ad hoc surface analysis reporting in tabular, graphical and mapped formats.

All of the sort options and report types identified in section E are fully supported by the PASSUR SMS capabilities.

1. General Reporting

General reporting requirements: items a-d are already current capabilities. Item e will be added.

2. Standard Reports

Standard Reports: reports a-l are already part of PASSUR SMS capabilities, and are being migrated to the new version of PASSUR SMS which will be delivered in Phase A.

3. Database Query Reports

The PASSUR SMS capability will support detailed ad-hoc reporting requests directly on the user interface, through the existing capabilities of the SODAA reporting engine. PASSUR will ensure that all the detailed information elements contained on the base map functionality are also reportable through the ad-hoc reporting/query interface.

4. Summary Windows

The data processing required to support all of the summary windows identified in items a-g is already present in the PASSUR SMS (though the SODAA engine), and many of the reports already exist. They will be migrated to the new version of the PASSUR SMS for Phase B of the project, as requested.

V. General System Design

A. Overview of Application

The PMJV Surface Management System is designed to the highest standards of data security to prevent unauthorized access to sensitive data and applications. Throughout its history of operating hosted solutions, PASSUR has neither experienced an unauthorized entry and/or access into its databases, systems or applications, nor has it experienced any successful external attempt to disrupt its services. PASSUR is audited annually by an independent auditing firm at the direction of the FAA in order to ensure the highest standards of data security, and consistently meets or exceeds the FAA auditing requirements. In addition, approximately five years ago, PASSUR expanded its data center in terms of physical security (access and fire), virtual security (rigorous internal access and change management controls), and redundancy, in order to successfully win a software and data services hosting contract with a Fortune 50 company by meeting its stringent technology security requirements.

For Phase A of the SMS implementation, PASSUR will continue with its current redundancy and fault tolerant infrastructure already in place for the Port Authority, which includes a redundant dedicated data center for the Port Authority at a geographically distinct location. For Phase B of the SMS implementation, PASSUR will be implementing a complete disaster recovery infrastructure.

The user interface proposed in the SMS is a single, seamless web-based software platform in which all capabilities outlines above, without exception, will be accessed. This will provide for a consistent user experience regardless of which functionality or module is being accessed.

The data and software hosting infrastructure accessed by the customer and end-users in the SMS solution is managed by directly PASSUR – as such, the following sections refer exclusively or primarily to PASSUR capabilities rather than joint PMJV capabilities.

B. Security

1. Data Security

The PASSUR systems are protected by multiple layers of data security including firewalls, access lists, and network segmentation rules. The system security is audited annually by the FAA, including intrusion testing, to make sure all systems are protected from outside threats. System logs are also monitored for any unauthorized system activity. For more detail on data security, please refer to "Data Integrity" below.

For a detailed review of geographic redundancy and fault tolerance, please refer to the General System Design response below (Section V).

2. Physical Security

Only authorized PASSUR employees are permitted access to the system to perform their designated assignments. All entry into the server rooms is controlled via a numeric keypad lock. All systems are backed up with uninterrupted battery backup systems allowing operations without commercial power. The server room is protected by a Halon fire system. The entire building is protected from theft and vandalism by a live camera system and a monitored alarm system during non-business hours.

3. Security Submittal

A description of all security features, policies, and practices will be submitted for approval.

C. System Architecture

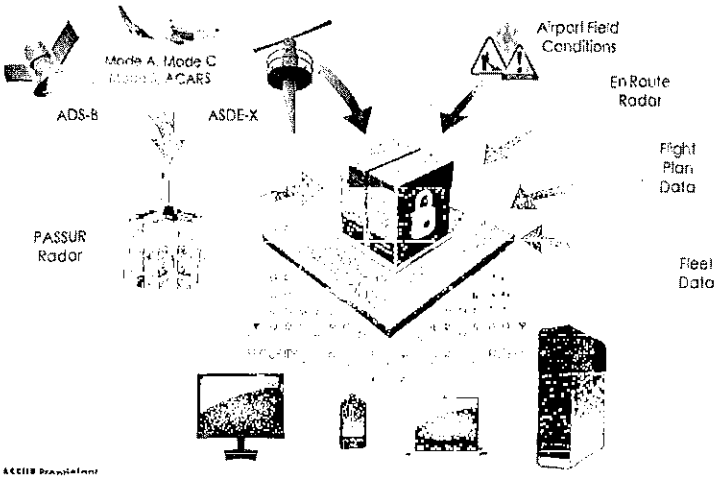
1. Redundancy

There are many elements in the Phase A configuration of the SMS which are already or will be redundant by the Phase A launch. The application servers that receive external data from the FAA and PASSUR radars are duplicated to provide for immediate switchover should a hardware failure occur. All database servers are set up with hot standby redundancy. Finally, application/web servers are also redundant allowing the end user to log into several web servers in case of failure. This includes a geographically diverse server hosted at JFK, which works as a backup server in the event that connectivity to the data and software hosting center in Bohemia is dropped. Backup to the geographically redundant JFK application server (including application databases) is currently accomplished in a three-minute timeframe. In phase B, we will have two fully geographically redundant data and software hosting centers, one in Bohemia, the other in

Orlando (where PASSUR already maintains a software development center). The Phase B Disaster Recovery Site (DRS) will also be built with backup servers for all needed applications to provide similar redundancy, with automatic hot-standby rollover. The Orlando data and software hosting center is SAS-70 certified; as such, on or before the start of Phase B PASSUR will provide full SAS-70 certification.

Data Sources

All PASSUR programs are powered by numerous external data sources such as FAA ASDI, PASSUR radar data, MODE S data, JFK ASDE-X, airline OOOI feeds, ADS-B (via PASSUR radar) and other aviation related databases to enable a user interface rich with relevant information.

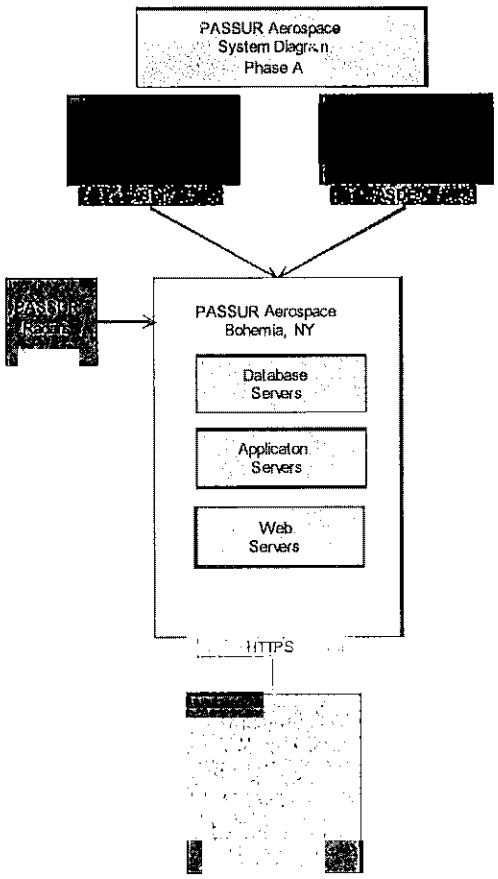


Data Flow Diagram

The two major sources of FAA data come from ASDI and JFK ASDE-X. The ASDI data consists of flight plan and position data from the FAA en-route ARTCCs around the country. This data is consolidated and shipped to PASSUR from the William J. Hughes Technical Center (WJHTC) in Atlantic City, NJ, via VPN. The data is then processed, archived, and fed into multiple databases for access by application and web servers.

The JFK ASDE-X data is fed to PASSUR via a direct line from the DD box located in the JFK FAA tower. This raw ASDE-X data is also processed, archived, and fed into multiple databases that provide the basis for the PITM surface programs.

The data derived from the PASSUR at JFK adds another rich source of movement data to the databases. This proprietary data comes from the PASSUR radar antenna that listens to the FAA radar and receives the 4.6-second updates on aircraft positions. The high-level data flow diagram is below.



All SMS products are browser based and sent via secure HTTPS protocol – no software needs to be loaded. Only access to the servers at Bohemia, via the Internet, is needed.

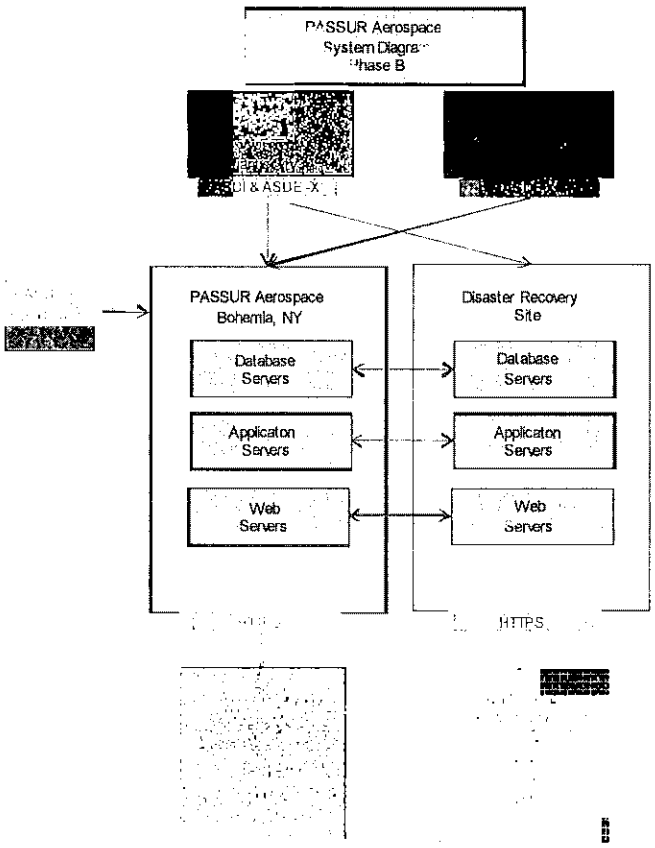
2. Fault Tolerance

The Phase A system architecture is capable of manually switching to secondary servers with a maximum of a three (3)-minute loss of data by simply changing web site addresses. This uses the current redundant system installed at a geographically distinct location, which is dedicated to JFK applications. All systems are monitored and notifications are sent to administrators when outages occur. In addition, switching back from secondary to primary can be done without a loss of data.

In Phase B, with the addition of a DRS, automatic system switchover from primary to secondary servers will also be possible without loss of data. Any failures occurring in the primary application server will cause the system to automatically switchover without operator intervention. Note: In most cases, the system can detect an error and switch to a backup server; however, 100% automatic application switchover is not always possible, depending on the type of outage.

3. Diversely Located Secondary/Redundant System

The requirement for a disaster recovery site will change the system diagram slightly in Phase B. Here is the overall flow graphic:



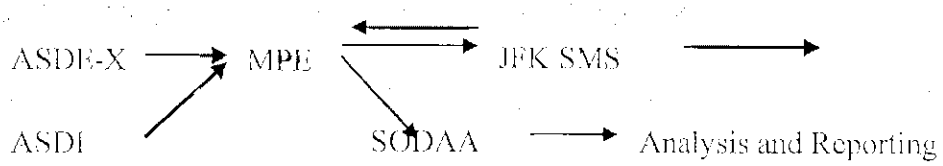
There are several changes to the basic data flows to allow for a Disaster Recovery Site (DRS). First, the ASDE-X data from JFK will come from two locations. The existing direct line from the FAA JFK Tower will remain in place as the primary feed. The second source of data will be the WJHTC in Atlantic City, NJ, which will provide a backup for the primary site in Bohemia as well as a feed for the DRS.

The ASDI data from the WJHTC will also be fed directly to the DRS providing the needed flight plan data to populate the backup servers in real-time.

Finally, the JFK PASSUR data will be sent from the JFK radar site directly to both Bohemia and the DRS. These three major external sources of data will provide the needed data to populate the DRS databases and power the applications. Replication servers will be added to allow for near real-time replication of internal Bohemia databases, such as the departure metering database. This replication minimizes the loss of data should the primary site go down.

Mosaic components in system architecture

The Mosaic components are the Mosaic Prediction Engine (MPE) and the Surface Operations Data Analysis and Adaptation (SODAA) toolset. Each will reside in the secure data centers (primary and backup). Each will automatically provide information through the PITM interfaces.



MPE incorporates position, flight and clearance data from the ASDE-X and ASDI feeds, plus information from the JFK SMS database concerning slot assignments, ACARS data, and other inputs to predict gate departure time, spot used, spot time, taxi route, departure runway, queue time, Off time and departure fix time for each departure. It uses runway time from the JFK SMS database as provided by the PASSUR Right ETA and its internal model of surface congestion to predict taxi route, spot, spot time and gate arrival time for each arrival.

MPE also produces data that is ingested by SODAA. SODAA automatically identifies key events such as observed spot crossing times, queue entry times, departure times, taxi paths, and runway times and stores them in the Analysis and Reporting Database, such that they can be queried by the reporting engine. The reporting engine provides a user interface that allows the user to view routine automatically generated reports or to design and view custom queries, including an interactive visual query engine that allows the user to select aircraft by their plotted taxi and flight paths, or to create ad-hoc areas on the surface against which to run queries.

4. Web-Enabled

All PASSUR Systems are browser based. For Phase A, the SMS will support Firefox, Internet Explorer Chrome, Safari and Opera 11.5 for all modules except for the integrated web tracking (air and surface visual flight tracking), which will be supported only on Internet Explorer. For Phase B, all applications will run on Firefox, Internet Explorer, Chrome, Safari, and Opera 11.5.

D. Database

1. Data Ownership

PASSUR's data ownership policy is that all data generated by the SMS for use by the subscriber (customer) remains the property of the subscriber during and upon termination of the contract. This includes all reports, replays, and other data downloads from the system. PASSUR retains the exclusive ownership rights to the PASSUR applications, the underlying code used to develop the applications, and the data generated from the PASSUR system.

2. Data Integrity

The PASSUR systems excel in both real-time and historical data integrity on multiple levels:

- Databases are strictly sequestered from access, with stringent data access protocols and preventions for developers.
- All machines have remote access that is disabled from outside networks. PASSUR undergoes strict security audits of the machines by the FAA yearly, and uses third-party software to verify we are safe from intrusion. SSH logins are only allowed to a few pre-specified IP addresses, and only to a single server.
- Most PASSUR applications use a User ID and password authentication. For the most sensitive applications, PASSUR uses an additional login protocol employing the apache mod_auth authentication. In addition, we 256-bit AES client certificates are required, to prevent unauthorized users.
- Annual FAA audit of data and systems security (PASSUR is in good standing)
- Multiple password rules for end users, including forced password changes on a regular schedule, strict lost-password/lost-username authentication, forced shut-out after a pre-determined number of failed attempts to login.
- Unix back-end password management (all encrypted; no possibility of username/password decryption).
- Strict logon policies for internal software developers to development servers.
- Production servers use RAID-1, RAID-6, or RAID-10 to protect against disk failure.
- Integrity of files is validated using the MD5 checksum method. Secure feeds use checksums for each record.
- Corporate users are on a separate network, not connected in any way to the Web Services or application network.
- TCP mechanisms use internal checksums while delivering packets via the Internet.
- No external access to developers to production servers or production databases.
- No outside person (end user) is ever directly accessing PASSUR databases, which are sequestered behind layers of preventive security from outside penetration.
- PASSUR has a variety of automated internal data-quality checks designed to ensure that the most accurate and definitive data item, among frequently competing/overlapping items, is stored and reported as the definitive "data event." Examples of these data types are ETAs, On times, Off times, arrival and departure runway ID, aircraft tail number, etc.

- PASSUR stores multiple layers of historical data, including different "competing" captures of the same event, for data quality review and analysis.
- Algorithms, data rules, and smoothing filters have been developed to ensure that data "noise" is minimized.
- Predictive, real-time and post-operational data accessed on PASSUR applications has been tested and used over years of operational use by airports, airlines, FBOs, corporate flight operators and the U.S. government, ensuring real-world "vetting" of PASSUR data integrity (accuracy, accessibility, timeliness).

3. Database Setup

The PASSUR system has been configured, operational and collecting data for over a year. The new PMJV SMS will provide the requested configuration, data entry, and fine-tuning to meet the requirements of the contract.

4. Database Replication

During Phase A, all data is replicated to backup servers at the primary PASSUR server location. This ensures no loss of data should a hardware failure occur. A geographically redundant PASSUR server is also maintained for JFK applications, which offers a separate, mirrored redundant database. With the introduction of the DRS in Phase B, all data will be replicated to the DRS as well.

5. Data Storage, Archive and Restore

All data will be available for five years of online storage. All data beyond two years will be available via an off-line disk system.

6. Database Backups

PASSUR's backup systems and procedures meet the standards set out below:

(a) Use standby database servers being loaded with user-specific data every 15 minutes from the primary servers to the standby database servers.
(b) Weekly-to-disk backups are manually backed up to tape library.
(c) Use a third-party tape management service that stores tape backups in an offsite storage facility.

7. Testing the Restore Procedure

PASSUR will demonstrate that data can be restored from the backup systems.

8. Data Analysis

Data analysis will be accomplished through a variety of tools on the SMS, including:

- Visual playback of aircraft movement

- Archived reporting (see above) through templated reports (tables and graphical data displays)
- Summary windows (see above)
- Database queries rendering tables and graphical displays of data, including detailed user-defined "deep queries" beyond templated reports (see above)

9. Data Playback

Data playbacks will be in sync with recorded radio transmissions, when available.

10. Data Extraction

PASSUR will propose an appropriate xml structure.

E. Screen Display and User Control

The PMJV SMS is designed with maximum "human factors" in mind, to ensure ease of use, repeatable processes, minimal workload, and common look and feel across diverse modules and toward ensure a seamless user interaction with the information provided by the system. Reports will have a standard design and information presentation, both real-time and post-operations. All Mosaic functionality will be directly and seamlessly integrated into the SMS Graphical User Interface (GUI) for a single, transparent user experience. The SMS, which is 100% browser-based, will support multiple instances of open windows on any number of workstations, laptops, and monitors.

F. Access Privileges

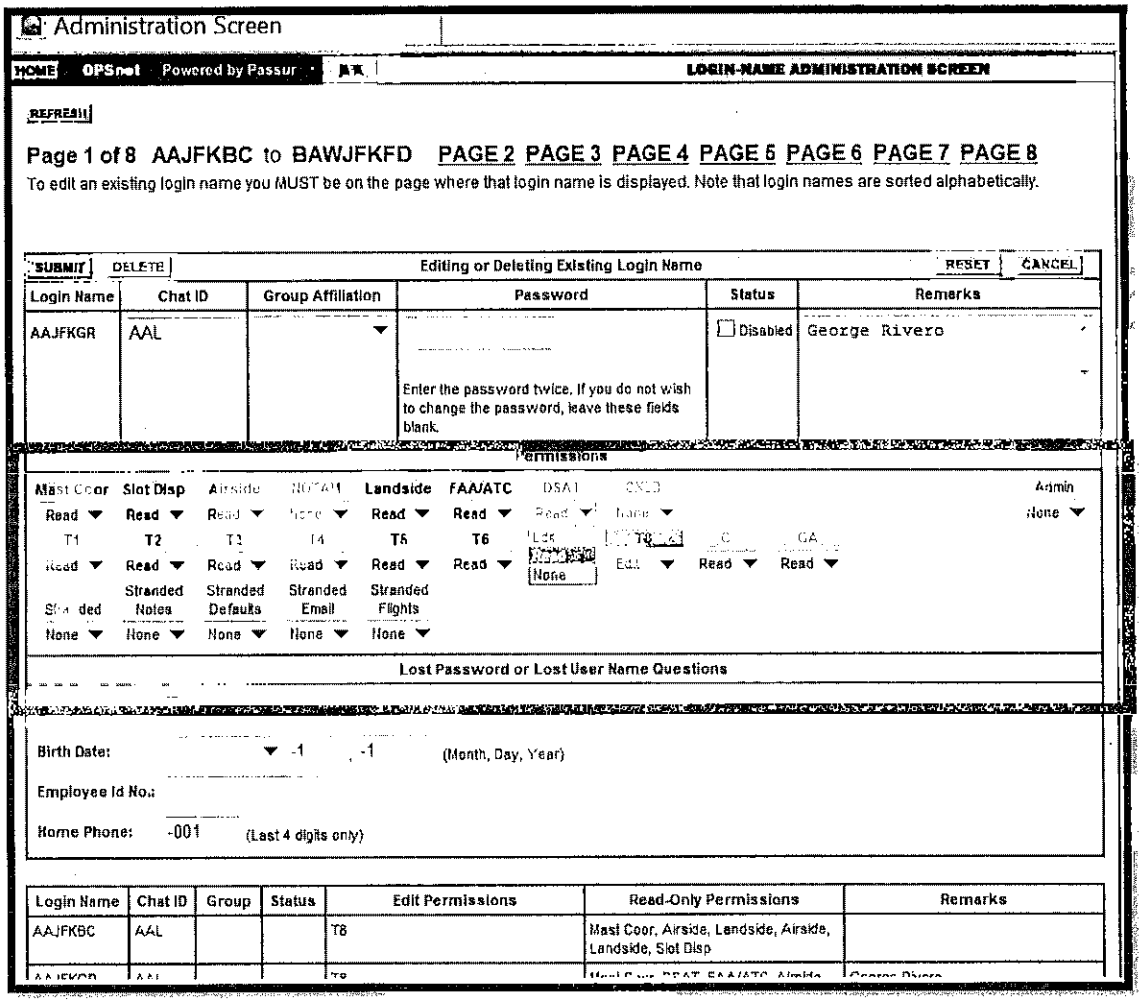
1. Application Access Levels

PASSUR has an extensive interface already in place to allow administrative users of its SMS to designate varying levels of access permissions based on individual user profiles, including all nine levels identified in this section. Access levels can be customized to customer needs.
Each user profile is built with specific permissions in place for different content areas within specific pages of an application (fields), or for the entire page (screen), or for an entire module. Typically, the hierarchy includes:

- No access
- Read-only access
- Edit access
    - Sometimes this is only for certain subsets of capabilities or content.
- Administrative access

In addition, PASSUR has developed collaborative messaging technology which enables the airport operator, or the SMS operator, to determine which groups of users will get messages relating to different operating conditions (for example, extended tarmac delays).

Example of user-directed access permissions screens:



G. Event Logging

The PASSUR system will handle all event logging as outlined in the RFP.

H. State of Common Usage

All PASSUR equipment, hardware, software, database, and communications meet industry standards and are open architecture.

I. Graphical User Interface

PASSUR web-based products facilitate user-friendly GUI design. The GUIs facilitate easy data entry and general viewing. Navigation is quick and intuitive with a minimum number of mouse clicks.

J. Start Up

The PASSUR systems will automatically execute all site-specific configuration parameters required to start up and enter the operational mode upon system initialization.

K. Orderly Shutdown

The PASSUR systems will shut down in an orderly fashion without anomalies or the loss of data. Prior to shutdown the system will notify connected workstations that a system shutdown is imminent.

L. Change Management

Change code management with the Port Authority

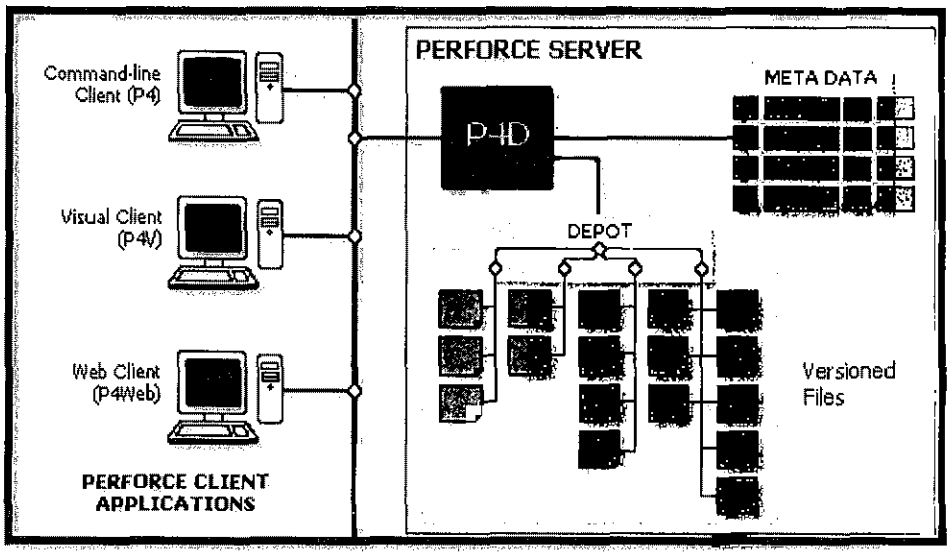
Developers at PASSUR are not permitted to roll out new production versions of any software outside of the strict Perforce process outlines below. This ensures that all changes are documented first, reviewed by PASSUR personnel other than the programmer, and strictly tested and controlled before release.

The SMS Manager will provide an additional procedure, whereby changes cannot be made to the system without prior knowledge and sign off from the Port Authority. This will include written notification of all changes being proposed and when they are intended to occur.

PASSUR Internal source code management

PASSUR uses Perforce Software Configuration Management (SCM) System described below:

High throughput and a small footprint characterize the software components of the Perforce SCM System. At the core is the Perforce Server (P4D), a stand-alone, connection-based program that manages access to a central file repository, or "depot", on the server's machine. Users access the P4D through efficient client programs, invoked locally on workstations located anywhere on a short- or long-haul network.



P4D stores file revisions in depot(s).
File status and change metadata are maintained in the built-in database.

Typically each user has their own client workspace and may also use other special purpose or project workspaces. The client workspace specification defines a view, or subset, of files from the repository that are of interest to the user. The workspace itself contains physical copies of the files in its view.

P4D comprises three main sub-components: a request handler, a data manager, and a file librarian. The request handler acts as an executive, sequencing actions to carry out client requests and managing communication with the client. The data manager implements database services optimized for multi-user SCM operations. It maintains a meta-database describing the status and history of versioned files in the depot and transactions against the depot. The librarian is a highly efficient file archiver that stores repository files on disk local to the server. It writes text file versions in an RCS-compatible, reverse-delta format; binary file versions are stored in a standard compressed format.

- Heterogeneous Local or Wide-Area Networking

Perforce client and server programs are loosely coupled using a simple TCP/IP-based streaming file transfer protocol tuned to minimize network latency. Perforce does *not* rely on shared file systems such as NFS, and works well on a LAN or around the world. Once fetched, client files are stored on the user's machine; no network access is needed for ordinary user activity such as editing or compiling. All Perforce client programs are compatible with the Perforce server, regardless of OS platform, providing 100% interoperability in heterogeneous networked environments.

Because of its network architecture, Perforce is unique among SCM systems in its ability to function well in wide-area as well as local network environments. In situations where offshore or

offsite developers are forced to endure restricted or expensive network bandwidth, the Perforce Proxy (P4P) is available for remote site file revision caching. With P4P, remote users experience quicker response times while still retaining access to real-time updates from Perforce servers.

- Portability and Supported Platforms

P4D runs on most Unix and Linux platforms, Mac OS X (Darwin), and Windows Server 2003, Windows XP/2000; no kernel support or special file system is required. Perforce client programs are available on a wide variety of platforms.

- Tracking Client State and Working Remotely

A Perforce client workspace consists of normal files on the developer's local disk. Perforce records all client workspace activity. It tracks workspace file versions, workspace file locations, workspace file state, pending merges with newer depot files, and pending file submissions. Perforce also indicates to the user which files other users are working on and which changes need to be merged. Perforce can compare client revisions against any revision in the depot, or compare any two depot revisions.

Perforce lets users detach a client machine from the network, work locally, and later resume interaction with the server, with full source integrity.

- Atomic Change Transaction Model

In the Perforce model, multi-file changes can be treated as atomic transactions. Database integrity is assured at each server transaction, and each logical change is uniquely and permanently identified. The inherent data aggregation of atomic changes provides an implicit relationship between file versions and external representations of work such as bug fix orders, eCos, or program specifications. Perforce tracks, adds, deletes, renames files, as well as updates.

Perforce allows users to selectively synchronize their client workspace(s) with submitted changes as desired.

- Parallel Development and Branching

Perforce supports two forms of parallel development. Users can work simultaneously on files in a common code line in the depot. For example, two programmers may work concurrently on the same project, including working on the same files. Additionally, Perforce supports multiple parallel or related codelines in the depot. e.g., a released product code line can co-exist with an experimental development code line. Perforce tracks changes integrated between code lines and automates merging between code lines, enabling users to work in parallel development or release projects and to reconcile changes between projects.

Perforce provides a uniquely elegant branching model called Inter-File Branching that simplifies creation and maintenance of related code lines based on the natural hierarchies of the directory name space.

- Ease of Administration

The Perforce architecture allows for straightforward administration. Server and client programs require no third-party or add-on software. All Perforce products and upgrades are available by download from the Perforce web site. Perforce's per-user licensing uses no license server and never locks out existing users.

Minimal system administration involves scheduling checkpoints and backups, and monitoring resources. No downtime is needed for backups, as Perforce provides continuous journaling and online checkpoints.

- Configuration Labels

Perforce provides the ability to store a named specification of the exact configuration of file revisions on a client. This provides a mechanism for labeling a release and for reproducing the exact file configuration needed to build that release. In addition, atomic change transaction records provide implicit labels for points of integrity in the depot, reducing the need for user-created labels.

- Reporting and Change Review

Perforce provides for reporting from the depot on the status of client workspaces, file change histories, work in progress, currency of workspaces with respect to depot code lines, and the currency of depot code lines with respect to each other.

Perforce supports a simple, flexible change review mechanism, and offers sample programs for notifying designated teams via email for review and comment upon changes. This same mechanism can be used for automated uploads into defect tracking systems.

- Defect Tracking

Perforce maintains associations between "changelists" (atomic change transactions) and "jobs" (externally meaningful units of work, such as bug reports, ECO's or enhancement requests). Perforce "job" metadata can be used as-is for basic defect tracking, or in conjunction with independent defect tracking systems for integration with external processes.

- Flexible Client API

Perforce supports a client API, making customized front-ends easy to develop. Perforce can be embedded as a component or subsystem of a larger application which requires controlled check-in/check-out or versioning of files. For an example, see the WebKeeper module, which uses the

Perforce C/C++ API to enable an Apache HTTP web server to act as a Perforce client and request versioned files directly from a Perforce server.

- Web Content Management

As described in Web Content Management with Perforce, Perforce's architecture is well suited for versioning and configuration requirements of Web Content Management (WCM). Using the Perforce Command-Line Client in automated procedures to populate web site filesystems, the need for users to access web sites directly is eliminated. Perforce's client workspace tracking can be used to identify and audit web site configurations. Web publication staging can be controlled with Perforce labels and Inter-File BranchingTM. Perforce is compatible with all file-based web server architectures and web authoring environments.

- Implementation of Engineering Process

Perforce supports a wide spectrum of source management policies, although it imposes no engineering process rules or restrictions itself. Inter-File Branching facilitates the evolution of concurrent project code lines throughout all stages of the software development life cycle (see Perforce Software Life-Cycle Modeling). Changelist and job metadata supply an inherent association between file versions and user-defined process stages. Six types of server side triggers allow for the validation and manipulation of changelist, file, and form specifications. Post-submit reviewing enables automatic email and status reporting. External project management and defect tracking systems can interface with Perforce through either the command interface or through the client API.

M. System Sizing

System sizing will meet all requirements set forth in the RFP.

VI. General System Performance

A. General System Performance

General system performance will meet all requirements set forth in the RFP.

B. System Availability

SMS system availability will meet or exceed all requirements set forth in the RFP. During outage periods PASSUR customer service will make timely notifications highlighting the impact to services.

Availability

- Target availability of the products and services under this agreement is 99.99% for any given month. Availability will be determined as an average of actual circuit availability as a percent of total potential circuit availability measured on a monthly basis.

Credits

- PASSUR calculates network outage commencing on the date and time of the opening of a trouble ticket and ending at the close of the same trouble ticket. Subscriber must contact technical support to report outages or performance issues. Upon resolution of the problem and the close of the trouble ticket, subscriber must contact PASSUR within five (5) business days to request a credit and reference the trouble ticket assigned. Any credits determined to be due subscriber will be credited towards the next months charges and may not be deducted from any current outstanding charges.
- The amount of the credit to be issued will be determined as follows: Should a network outage occur, a credit of 1/30th of the monthly rate charged subscriber will be issued for each consecutive eight hour increment of the outage, to a maximum of 50% of the monthly billing rate for any given month.
- Limitation: in the event subscriber is entitled to multiple credits under this provision arising from the same event, such credits shall not be cumulative and subscriber shall be entitled to receive only the maximum single credit available for such event per month.
- The maximum credit that may be issued during the contract year is 20% of the total annual billing for the service.
- Exclusions and limitations: credits will not be issued for a) network downtime that is not reported by subscriber or requests for credit not made within five business days of the event; b) service outages or performance issues not documented by trouble tickets; c) network maintenance performed during the standard maintenance window (12:00am to 5:00am EST); d) emergency maintenance; e) failure of subscriber equipment; f) any reasons of force majeure such as natural disasters or acts of god; g) any outage caused SOLELY by events beyond PASSUR's control; h) any delays or limitations which are SOLELY a result of user access through local telephone companies to the subscriber.

VII. Users and Training

The training services delivered to the customer and end-users in the SMS solution is managed directly by PASSUR – as such, the following sections refer exclusively or primarily to PASSUR capabilities rather than joint PMJV capabilities.

In the PMJV, PASSUR will retain the direct responsibility for training. As such, this section refers exclusively or primarily to PASSUR

A. Types and Quantity

PASSUR has a corporate commitment to training – for its employees, contractors, and customers. PASSUR has developed extensive training programs in collaboration with professional training organizations. The goals common to all programs include:

- The objectives of a training program are always clear and stated upfront.
- There are many ways to get trained: in person with PASSUR Subject Matter Experts (SMEs), on webinars with experts and shared presentations, online through web-delivered training courses and instructor recordings, and through printed materials.
- Training is always about operational best practices, how to achieve desired business outcomes, process change management, and software functionality – never just software alone.
- Knowledge retention is always tested.
- Subject Matter Experts, not simply "professional trainers", are used.
- Training materials are visually engaging and designed with the best "human factors" in mind.
- Training is "scenario based" whenever possible – lessons that are put into the context of the trainees work/business environment, with specific examples of how they will put to use the knowledge and tools they have acquired and been trained on.

In this RFP response, there are two distinct training plans discussed: training for internal SMS management and service delivery team, and training for the customer "end users," primarily employees of the Port Authority and of the tenant airlines.

PASSUR has been delivering training to both of the above constituencies at JFK (and other Port Authority facilities) for many years. This has included:

- Detailed training for the current departure metering program staff, including onsite demonstrations, online web courses, and Standard Operating Procedure manuals.
- Onsite, hands on training for each of the airline terminal operators in the business processes, best practices and software functionality of the slot allocation/request program. Several of these sessions have been delivered onsite at the individual terminals.
- Annual training on PASSUR OPSnet for both Port Authority employees as well as airline operators, which includes slot allocation functionality, as well as numerous other capabilities, including field condition reporting.

Training for end users – The Port Authority and Airline Operators
PASSUR is fully prepared to deliver training to all of the classifications and numbers of users identified in the RFP (up to 50 staff in all Port Authority facilities, and up to 300 representatives of the various air carriers who will be using this system).

This training will build on, and take advantage of, the extensive familiarity that these users have with existing elements of the SMS platform, to which they have been exposed, and trained on by PASSUR for years, through a combination of on-site training seminars given annually at Port Authority facilities and/or airline training centers, and in smaller groups at individual terminal operator operations facilities.

End-user training plan

1. Onsite (JFK) training classes/seminars are conducted with SMEs from the PASSUR professional services group (SMEs means both airspace/surface operations specialists as well as specialists in the software functionality). Onsite classes include live software demonstrations with attendees able to interact with the software during the class, as well as view the instructors screen on a large display.
2. Classes include training syllabus, goals, scenario-based training in best practices, business outcomes, process changes and software functionality, retention quiz, and distribution of printed material.
3. Printed training material, which includes:
    a. Goals of the program
    b. Scenario-based training sections, with detailed visual screen shots for functionality training components
    c. Best practices, business outcome, and software functionality training
4. Live webinars: for those who cannot attend the onsite training, but who would like instructor-led live training, a version of the above is offered at set dates as a live webinar training class. This involves the same course material as the above in-person training but is conducted by having participants log onto a live webinar to follow the instructors' audio and visual presentation of the training.
5. Web-based training for those who need or want to pursue training offsite and individually: these are interactive courses that replicate a combination of the instructor led training and the printed training material, but in a fully interactive online environment, including:
    a. Goals
    b. Training in best practices, business outcome, and software functionality training

c. Scenario-based training

d. Retention quizzes

6. The above are designed using state-of-the-art web-based training principles (e.g., modularized presentation of information, extensive use of graphical presentation, user-driven progression through the course, frequent retention quizzing, progress-bar indicators, and user login for ability to stop and return where left off, etc.).

SMS Operations team training plan

It is important to note that the current SMS operations team has already received extensive training in all aspects of the current departure metering program, which has included the following elements:

- One-week orientation and training in PASSUR technology and specifically in airspace and surface management best practices, processes, outcomes, software, and JFK-specific contexts such as airline-airport-FAA collaboration and coordination. Topics covered include:
    - Introduction to PASSUR
    - Dress code
    - Behavior
    - Schedule
    - Principals and tools of departure metering
    - Resolution of decisions of controversy
    - PASSUR tools used
    - Other tools used
    - URLs to visit
    - Overview of main job requirements
    - What to do when you report to work
    - SWAP events
    - Determining the departure rate
    - Division of labor
    - Resolution of unresolved flights
    - Using the departure slot calculator
    - Ongoing meetings

- Analysis and reports
- Customer service
- Work schedule

Training concludes with a written examination of retention of key concepts. This is followed by one week of on-the-job training in real-world scenarios.
The training already received by the current PASSUR departure metering group covers many of the items that are expected in the final delivery of requirements after award of this contract, including:

- Airport Operations – the SMS team has a thorough understanding of the airport operation, predating the commencement of the metering program, resulting from their previous roles at FAA and/or airlines operating at JFK.
- Airline operations – the SMS team is very familiar with the airline operations at JFK, as well as with elements of the larger network/system operations at the airlines. This knowledge derives from a combination of past experience, PASSUR training, and exposure and learning derived from the 18 months of operating the current departure metering operations center.
- Facility communication – including professional telephone conduct, airport terminology, the phonetic alphabet, effective and appropriate oral and interpersonal communications, handling customer complaints, conflict resolution. The team dealt with the many understandable "learning pains" associated with the initial deployment of the departure metering program, and in so doing developed extensive capabilities in the area of effective communication the operational plan, communication during IROPS where plans are changing, and dealing with multiple system users (airlines) and their different operational requests as well as differing levels of capability in interacting with the metering program.
- Familiarization with, and applicable procedures related to, required forms and reports – the SMS team has delivered daily and weekly all the reports and forms required.
- Ethics and Conduct training has been conducted.
- Professional appearance standards have been issued.
- The SMS team has been trained in the appropriate emergency procedures and notifications required by the Port Authority.
- The SMS team has been trained in Port Authority security policy by the Port Authority security office. Two Issuing Officers from PASSUR regularly enforce the policies of the Port Authority. Issuing Officers are PASSUR representatives who

serve as the official liaison between the PASSUR departure metering operations team and Port Authority security office.

- The Issuing Officers are responsible for documentation and issuance of all of the employee's IDs and work directly with the ID office.
- Issuing Officers are required to regularly audit PASSUR staff to ensure that they maintain the proper IDs (regularly enforcing the policies).
- Issuing Officers also take extra classes (annually) on procedures for the use of IDs at JFK.

The above training will be applied to all new members/hires of the SMS operations and management team.

In addition, all existing and new members of the SMS team will be given training to cover all of the new processes, business outcomes and software functionality that will be part of the SMS envisioned by this RFP, for both Phase A and Phase B.

B. Training

Both SMS operators and end users are already trained and competent on the existing software base and would only need to be trained in the new enhancements.

PASSUR is fully prepared to perform all of the elements in the project implementation specified in the Scope of Work, Attachment C, Sections VII and VIII, and has submitted a plan reflecting full adherence to that schedule. However, in conjunction and consultation with the Port Authority and other relevant stakeholders, a number of the elements specified in these sections may be eliminated, to the benefit of all users, through a more speedy and rapid deployment (and seamless transition from the current SMS/Metering program).

1. Training Schedule

PASSUR will follow the training schedule required in the RFP. In addition, as described above, there will be a schedule published for live Webinar training to supplement the in-person training, or for those who cannot attend the in-person training; as well as online on-demand interactive web training, as identified above.

2. Training Coach

The training program will be directed by the Manager of Client Relations at PASSUR, and will include the participation of the appropriate subject matter experts in each of the key areas of the SMS program as teachers.

C. Training Time Constraints

Training will be completed prior to the operational test.

VIII. Acceptance and Testing

It is anticipated that several elements of the project delivery timeline can be accelerated, allowing earlier deployment of Phase A, because of the extensive exposure of both the SMS operators and the end user community to the existing PASSUR software platform, departure metering rationing and management protocols and practices, and the existing software platform deployment in the actual operating environment for one and a half years (and in some instances eight years),
These elements include:

A. System Inspection & Tests

Pre-acceptance and acceptance tests can be limited to only those enhancements and new capabilities that PASSUR will develop to existing software for Phase A. The customer has already accepted all other operational parts of the software that has successfully been running for more than 1.5 years.

B. 14-Day Operational Test

The 14-day operational test (changed according to addendum #2 from 30 days) may be further reduced to reflect only new capabilities, since the core platform has been successfully operational for the existing program.
For Phase B, all pre-acceptance and acceptance tests are planned as scoped in the RFP
The above applies to all sections under V111, Acceptance and Testing, pages 33-37.

IX. Submittal and Documentation Requirements

The PMJV acknowledges all the submittal and documentation requirements in this section. Where appropriate these are reflected in the project schedules, which are appended.

X. Maintenance of the System

The PMJ acknowledges all requirements in this section and intends to meet them without exception.

XI. Exhibit 1

(FAA Audit)

Exhibit 1

PASSUR AEROSPACE

KNOW NOW™

Executive Offices
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Stamford, CT 06901
203.622.4086: tel
203.629.2970: fax

Research & Productio
35-1 Orville Drive
Bohemia, NY 11716
631-589-6800: tel
631-589-6858: fax

August 8, 2011

The Port Authority of NY&NJ
Purchasing Service Division
Attn: Lesley Brown
One Madison Avenue, 7th FL
New York, NY 10010

Re: Requirement to provide SAS-70 Audit or Equivalent

Dear Ms. Brown,

On or before the commencement of Phase B, PASSUR will have activated its second fully redundant data and software hosting center in Orlando, FL, where it already has one of its software development offices. The new center in Orlando is SAS-70 certified, so PASSUR will provide SAS-70 certification by Phase B or sooner.

In the meantime, PASSUR is providing the attached certified audit report of its current data and software hosting center. This audit is conducted annually at the direction of the FAA, as part of its standard security process for recipients of the FAA ASDI data feed. The audit results show that PASSUR is in compliance with FAA data security requirements.

Regards,

Jeff Devaney
Chief Financial Officer

HB&P
HALT BUZAS & POWELL, LTD
CERTIFIED PUBLIC ACCOUNTANTS
MANAGEMENT CONSULTANTS

Independent Accountant's Report on Applying Agreed-Upon Procedures

To Federal Aviation Administration
David J. Hurley Air Traffic Control Systems Command Center
Manager, Systems Requirements
ATTN: ASDI/NASSI POC, AJR-43
3701 Macintosh Drive
Warrenton, VA 20187

Halt, Buzas & Powell, LTD. (HB&P) and The Legnem Group, Inc. (LGI) have performed the procedures enumerated below, which were agreed to by Passur Aerospace, Inc. (Passur), solely to verify that Passur has internal controls in place to ensure that only authorized users receive the FAA Class 1 (Near Real Time) data feed; and that Passur's software and hardware architecture are sufficient to provide the FAA's Class 1 ASDI data feed to Passur's authorized Customers.

This agreed-upon procedures engagement was conducted in accordance with the FAA's ASDI Full Audit Guidelines, Version 1.3 of October 2010; and attestation standards established by the American Institute of Certified Public Accountants. The sufficiency of these procedures is solely the responsibility of those parties specified in this report. Consequently, we make no representation regarding the sufficiency of the procedures described below either for the purpose for which this report has been requested or for any other purpose.

Our procedures and findings are as follows:

Overview

The audit team has worked with Passur since early February 2011 to complete the Full Audit Guidelines for the FAA ASDI Class 1 data feed. This report is a final report prepared to submit to the FAA.

Passur has completed the Full Audit Guidelines for the Q1 2011 audit period. This report will provide details for the specific items that FAA requires of a Full Audit. The audit team was onsite to complete the audit requirements on March 16, 2011.

99 Canal Center Plaza Suite 230 Alexandria, VA 22314 p: 703-836-1350 f: 703-836-2159
1525 Pointer Ridge Place Suite 303 Bowie, MD 20716 p: 301-218-8950 f: 301-218-8960 www.cpas4you.com

Passur provides their product to their customers without blocking the BARR list tail numbers. Passur intends to apply for a waiver to allow them to distribute their product in this manner.

Details Based on FAA ASDI Class 1 Checklist

The near real time ASDI feed is provided to Passur by the FAA and enters the Passur network through an AES 256 bit encrypted VPN tunnel, terminating at a Cisco ASA 5510 firewall. Several internal servers then process the ASDI feed, and only authorized Passur employees have access to the data. Passur has developed proprietary software that must be downloaded and installed before any subscriber can access Class1 or Class 2 data. A subscriber must first download the software from Passur's website over an encrypted SSL connection. Afterward, the subscriber must complete an authorization form and forward it to Passur for verification. Once the verification process is complete, Passur provides the subscriber a user ID and password, which grants access to the ASDI data (Class 1 or Class 2).

The proprietary application that Passur has developed establishes a 256 bit encrypted SSL connection to the Passur website, where the ASDI data is accessed. The web server then forwards the subscriber's authentication credentials to a database server that resides on a secure network not accessible from the internet. The database server then validates the subscriber's credentials and passes them back to the web server to complete the authentication process. The subscriber does not have access to the database.

Passur has an extensive and detailed security policy that conforms to industry standards. Passur distributes this policy to all employees through an employee handbook. All employees with access to sensitive systems and data are required to sign a document acknowledging they understand and will follow all procedures and policies (Items 9 thru 12).

Entry into the Passur main office is only accessible through an exterior door that remains locked at all times. A receptionist must electronically unlock the door before any guest can enter the facility. All guests are escorted throughout the building and surveillance cameras monitor all sensitive areas. Passur protects the ASDI feed from unauthorized physical access by utilizing a cipher lock on the entrance to the computer

room where the ASDI systems are stored. Only authorized Passur employees have the cipher lock combination to enter this room, and surveillance equipment monitors this area (item 13).

Passur has 2 Internet connections via 2 separate ISPs. The Vastnet Internet connection is controlled by a Cisco 3845 router that utilizes the Cisco advanced security firewall feature set. The second connection is through Optimum Online, and is controlled by a Cisco ASA 5510 firewall. In addition, all ASDI servers are running Redhat Enterprise Linux 4 and 5, and utilize host based stateful firewalls. The audit team performed an external vulnerability scan that proved the router and firewalls utilize restrictive rule bases. The audit team verified the router and firewall policies to ensure Passur uses a deny-all type policy. Passur uses nonroutable addresses on the inside networks, and the router ensures that nonroutable addresses do not enter from the internet (Items 15 & 25 thru 28).

Passur follows a strong password policy that is enforced on all Linux ASDI systems via the PAM module configured on each device. Passwords must contain a minimum of 8 alphanumeric characters, and must be manually changed every 90 days. In addition, password aging requires that no password can be repeated in any 12-month period (Items 29 thru 32).

Passur controls access to the ASDI data by supplying proprietary software to its customers. This enables Passur to control the user ID and password that authenticates the subscriber, and grants access to the specific class of data the subscriber is authorized to receive. In addition, all connections are made via a 256 bit encrypted SSL session (Items 1 thru 4 & 14).

The syslog service manages firewall system logging and analysis for all Linux and Cisco ASDI systems. Servers log locally, and network devices log to an internal syslog server. The log messages are monitored daily as part of the network administrator's defined duties. This provides Passur the ability to track, search, and correlate logging across all ASDI related systems for a minimum of 4 weeks (Item 33).

On February 17, the audit team performed an internal scan of the Passur network. The results of the internal scan showed that all ASDI Class 1 security requirements were met. The stateful firewall installed on each ASDI system functioned properly, and no unnecessary services were running on these systems (Items 11 thru 13 & 18).

On February 24, the audit team performed an external scan on the Passur address range using the Nessus Scanner. The scan showed that Passur was using self signed certificates for SSL encrypted traffic, and that certificates issued by an external certificate authority had to be installed. The results of the second external scan showed that correct certificates are now in use, and all ASDI Class 1 security requirements were met. The stateful firewall installed on each ASDI system functioned properly. (Items 16 & 38).

Passur does not use anti virus software on its ASDI systems (Antivirus packages are not commonly available for Linux systems) (Item 23).

Passur does not provide wireless access to any ASDI data, and has a policy to address this restriction (Item 31).

Passur has patch update policies and procedures that are followed to ensure critical updates are installed on all ASDI related systems. The network administration staff is responsible for manually downloading and installing the most recent updates from Cisco and Redhat Linux. Every thirty days the staff is required to check for updates as defined in the Passur company security policy. All ASDI related systems currently have the latest service packs and patches applied (Items 20 thru 22).

Passur distributes Class 1 and Class 2 data only to authorized subscribers. The audit team verified that Passur's Class 2 subscribers were not able to access Class 1 data. Additionally, the audit team verified that Class 2 data was delayed by the FAA's five-minute requirement (Items 7 and 8).

As noted above, Passur does not block tail numbers from the NBAA BARR list. Passur intends to file a waiver request to allow them to provide their products that include all tail numbers. Passur presents the position that certain of their Indirect Subscribers require all aircraft tail numbers for operational safety and other business requirements. In all cases where the BARR listed aircraft tails numbers are not blocked to Customers, those Customers do not share tail numbers or other aircraft identification information with the general public.

Passur receives the London feed, and was able to demonstrate to the audit team the ability to restrict access to this feed information to those eligible customers. These restrictions are configured within the Passur application (Items 6 & 8).

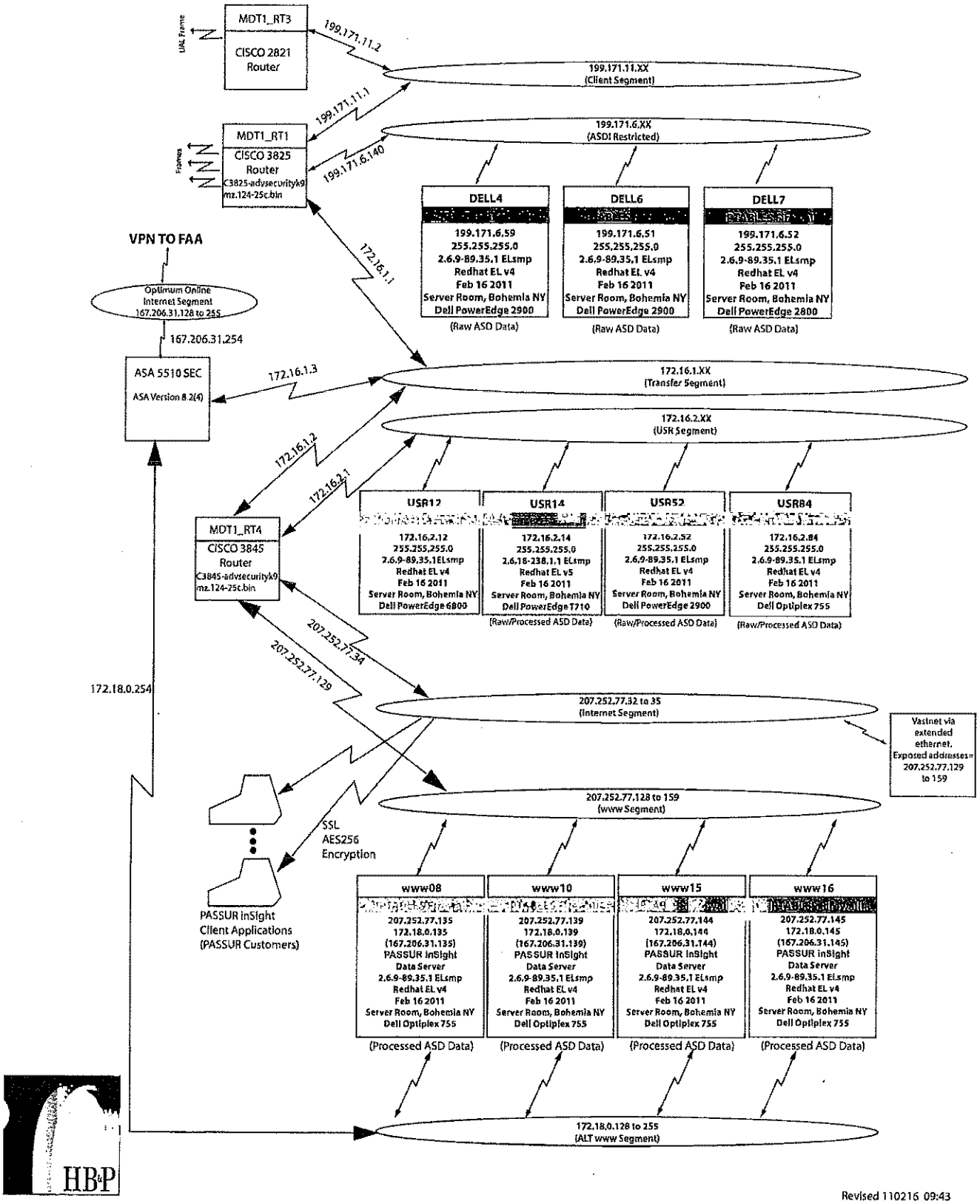
We were not engaged to, and did not; conduct an examination, the objective of which would be the expression of an opinion on the overall internal controls of Passur. Accordingly, we do not express such an opinion. Had we performed additional procedures, other matters might have come to our attention that would have been reported to you.

This report is intended solely for the information and use of Passur and the FAA, and is not intended to be and should not be used by anyone other than these specified parties.

Alexandria, VA
March 28, 2011

Halt, Buzas & Powell, LTD.
HALT, BUZAS & POWELL, LTD.

ATTACHMENT A: PASSUR 2011 ASDI NETWORK DIAGRAM



Revised 110216 09:43

ATTACHMENT B: PASSUR Aerospace Network CLASS 1 CUSTOMERS

A. AirFlite, Inc. – Display Only – Self Audit
B. Alliance Air Aviation Services – Display Only – Self Audit
C. Avports SWF Stewart – Display Only – Self Audit
D. Bradley International Airport – Display Only – Self Audit
E. Central Flying Service, Inc. – Display Only – Self Audit
F. Charleston County Airport – Display Only – Self Audit
G. Colorado Springs Airport – Display Only – Self Audit
H. Denver International Airport – Display Only – Self Audit
I. Department of Homeland Security – Display Only – Self Audit
J. Eastern Regional Helicopter Council – Display Only – Self Audit
K. Galaxy Aviation – Display Only – Self Audit
L. General Mitchell International Airport – Display Only – Self Audit
M. Little Rock National Airport – Display Only – Self Audit
N. Massachusetts Port Authority – Display Only – Self Audit
O. Miracle Strip Aviation – Display Only – Self Audit
P. Pentastar Aviation – Display Only – Self Audit
Q. Ross Aviation – Display Only – Self Audit
R. Stuart Jet Center – Display Only – Self Audit
S. Westchester County Emergency Services – Display Only – Self Audit

Response to Request for Proposal No. 24997

Surface Management System at John F. Kennedy International Airport

Section 1

Technical Proposal

Volume 2

Management Programs

Technical Proposal Vol. 2
Management Programs

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I. Technical Expertise and Experience

This submission in response to Request for Proposals for a Surface Management System (SMS) at John F. Kennedy International Airport is tendered as a Common Law Joint Venture between PASSUR Aerospace, Inc. (PASSUR) and Mosaic ATM, Inc. (Mosaic), referred to for the purposes of this proposal as the PASSUR Mosaic Joint Venture, or PMJV.

The PMJV team leverages decades of technical contract management experience and proven processes to support the Port Authority of New York and New Jersey (the Port Authority).

The PMJV has assembled a modeling, analysis, operations, software development, and professional services delivery team that pulls together the technical and managerial strengths of the two firms. The team encompasses more than sufficient resources in surface and airspace management, products, systems, and operations. The team represents more than 100 employees who are dedicated to aviation systems operations, analysis, system engineering, hardware and software design, development and testing, and who support and operate operational systems. The team stands ready as "one" to work in partnership with the Port Authority and its stakeholders to develop and extend capabilities to accomplish the aims of the SMS program at JFK.

The PMJV companies both have extensive experience implementing, installing, operating, managing, and maintaining similar services, in a similar environment, using similar sized staff. PASSUR led the development of departure slot allocation procedures and software at the Port Authority, starting with the snow operations programs at JFK and LGA which were later expanded to IAD and Denver International Airport (self-managed). This program formed the basis – with significant software and staffing/management enhancements – for the full-time slot allocation management program ("departure metering") deployed by PASSUR at JFK for the Bay Runway construction closure in 2010, and then extended to the present day. The

The PASSUR Mosaic Joint Venture brings the best of industry knowledge and skill to support the Port Authority's needs and requirements

- Experience installing, operating, and maintaining surface management systems at four airports (including JFK), at airlines, and at air traffic control facilities (including hands-on direct operating experience, uniquely associated with the JFK departure metering program, unlike any other surface program in the U.S. to date).
- Experienced, proven team of aviation professionals who have successfully managed the first phase of surface management at JFK and who bring a thorough understanding of the New York and national airspace, JFK surface operation, and organizational relationships at JFK – and who can respond to any situation in a complex environment with extensive training and experience.
- All airlines at JFK have extensive exposure to PASSUR processes, staff, and systems
- Experience in airspace optimization solutions for multiple airlines.
- Experience delivering live, mission critical systems to airlines, airports, and the U.S. government.
- Technical expertise and experience implementing and managing similar services.

collaborative field condition reporting module and protocols initially developed with the Port Authority for JFK and LGA have now been expanded to 16 U.S. airports, and are accessed daily by thousands of aviation operations professionals worldwide.

PASSUR has also delivered (and continues to deliver) extensive airspace management and decision support technology and professional services to the largest airlines in the U.S., including many of the airline operators at JFK, in order to address key constraint points in the lifecycle of a flight. These solutions include predictive analytics, real-time situational awareness and decision support, and post-operational analysis tools.

PASSUR Subject Matter Experts (SMEs) are at the core of PASSUR's solution delivery. The SMEs are drawn from airlines (SOC/OCC) and hub control management, operations finance, operations analysis, and pilot groups), air traffic management (FAA), airports (operations, environmental, and finance), and aviation fleet management. These SMEs are focused exclusively on solving customer challenges in the area of aviation operational constraints, inefficiencies, and opportunities for optimization. They are involved in every step of the PASSUR solution delivery cycle: onsite analysis of customer challenges, operating environment, and business processes; product development; implementation; and training. This SME involvement helps to ensure the solutions achieve the desired customer outcome.

Mosaic is the recognized leader in the study and development of the Surface Decision Support System (SDSS) and of its precursor technologies and systems, including Surface Management Systems (SMS). Three of the four recognized inventors of SMS are employees of Mosaic (the fourth is retired) and lead the continuing surface decision support tool analysis and research. Mosaic personnel led the SMS development and deployment efforts from Technology Readiness Level (TRL) 1 through TRL 9. In addition to employing the inventors and developers of SMS, Mosaic ATM as a corporate entity has been responsible for maintaining the FAA's software baseline of the SDSS system since 2005.

Mosaic has been instrumental in the delivery of several of the most definitive and successful surface management system programs to date, including Memphis, TN, Louisville, KY, and Orlando, FL. It has also been involved in the development of several seminal and related traffic management programs for the FAA and NASA, such as Surface Trajectory Based Operation (STBO), Collaborative Departure Queue Management (CDQM), and the Flight Operator Surface Application (FOSA).

The companies' combined professional service teams provide an extensive resource of SMEs in airport operations, airspace and surface optimization, National Air Space (NAS) operations and process design, air traffic management, airline operations, and technical implementations into complex operating environments.

Sample of Relevant Projects

JFK Departure Metering:

PASSUR led the implementation, installation and operation of the current departure metering program at JFK, which has been in place, as of this writing, for one and a half years. The implantation and installation included:

- Full-time (24/7) management of onsite departure metering staff (four staff members)
- Attendance at and participation in airport-wide metering program management meetings, as scheduled
- Interaction with FAA ATCT and TRACON, and airline hub control centers daily during metering program
- Generation of daily performance and compliance reports
- Enhancement of the slot management software modules from their original use for snow operations to ensure they met the requirements of daily assignment of taxi times (included enhancements to the slot calculator, airline slot request functionality, and slot manager functionality)
- Introduction of airspace optimization forecasting tools on PASSUR software, which added a critical element of airport demand and capacity forecasting to help make the departure metering program successful
- Deployment of a full-time (daily) onsite team of professionals to staff and manage the metering operation center onsite at JFK, which includes individuals with extensive ATC and airline experience
- Training of the onsite professional services staff in detailed Standard Operating Procedures (available upon request), conducted by PASSUR's Senior VP Technology and Air Traffic Management (a former senior NY-area FAA TRACON and tower manager)
- Recurrent training of end-user community (airlines) in the detailed execution of the slot request and management program, including training on software, processes, protocols, and best practices
- Provision of the required computer infrastructure to manage the slot allocation/metering program
- Installation of the PASSUR radar surveillance system to provide many of the underlying technological capabilities instrumental in the JFK program
- Integration of the ASDE-X feed at JFK into PASSUR systems

Snow operations management, JFK, LGA, IAD for approximately five years (PASSUR):

- Deployment of the departure metering module for snow and deicing operations (precursor to the full-time departure metering modules)

- Leadership role in helping to coordinate the development of rules and protocols to manage departure metering during deicing
- Recurrent training and orientation for airline end-user community in software, processes, protocols, and best practices
- On-call staffing of departure metering allocation desk for approximately five consecutive years
- Management of on-call staff schedule for each airport (onsite and/or remote)
- Management of on-call activation of stand-by staff
- Hands-on management of the departure metering program during snow events

Deployment of airline system and hub operations decision support solutions (PASSUR):

- Software modules and business process improvement programs to address key constraints and opportunities for operational optimization at multiple airline carriers, including American Airlines, British Airways, Delta Air Lines (which includes pre-merger Northwest Airlines), JetBlue Airways, United Airlines (including pre-merger Continental Airlines), and US Airways. Capabilities include:
    - Deployment of modules for diversion management, GDP/TMI management, arrival and connections management. Predictive, live and post-operational/reporting modes
    - Integration of multiple data sets to support the above modules
    - Onsite and remote training on software, process enhancements, and industry best practices

Development, implementation and maintenance of Surface Decision Support System (SDSS) at UPS in Louisville, KY since 2005 (Mosaic)

- Design and Implementation of SDSS for UPS
- Provision and management of support services, 24/7
- Collaboration with customer on business process enhancements required to achieve benefits
- Deployment of three new major software releases into operational use
- Integration of multiple proprietary airline data feeds to support the surface management functionalities, including ACARS
- Integration of site-specific FAA data feeds
- Development of the playback functionality used daily to review the previous night's operation, to find weaknesses and to address them in the next day's plans

- Training of airline and ATC tower personnel in new software and processes to support surface management and metering

Mosaic surface management operational test program at Memphis and Orlando since 2007 and 2010, respectively (Mosaic):

- Configuration and development of SDSS for MEM and MCO site-specific features
- Provision and management of SDSS support, 7 days per week
- Training of ATC tower and TRACON personnel in new software
- Development of Collaborative Departure Queue Management (CDQM) approach to departure metering
- Coaching, experiment design and operation of CDQM operational trials
- Design and development of Collaborative Departure Sequencing (CDS)

Installation and configuration of SDSS for JFK at FAA Laboratory in Washington, DC (Mosaic):

- Adaptation of SDSS tool to JFK airport characteristics and layout
- Adaptation for JFK and New York TRACON area operating procedures
- System is in regular, non-operational use

Deployment of Collaborative Decision Making software (Field Condition Reporting and related) at 16 U.S. airports, including (PASSUR):

- Development of live CDM software
- Training and orientation provided to airport operator, flight operator (airline, cargo, and corporate aviation) and FAA in new protocols and procedures
- Direct integration with FAA eNOTAM system

Deployment and management of airport operational statistics and landing fee management programs at 40+ U.S. airports, including (PASSUR):

- Detailed audits of airport landing fee programs
- Implementation of landing fee audit, landing fee billing, and airport operational statistics software modules
- Implementation of detailed operational statistics data feeds into Airport Operational Databases
- Training on software, process improvement, and data management

Development and deployment of Surface Operations Data Analysis and Adaptation (SODAA) for NASA at DFW (Mosaic):

- Development from Phase I SBIR concept through Phase III deployment
- In regular use by NASA for terminal area and surface analysis

II. Experience of Project Senior Management Team

A. Contract Manager – Tom White

Mr. White will serve as the Contract Manager on this project. He is currently Senior Vice President for Air Traffic Management and Technology at PASSUR, responsible for PASSUR's Air Traffic Management product lifecycle.

Mr. White has extensive experience in:

- Hands-on air traffic management in multiple controller and management positions at the FAA, including heading up New York Metropolitan area traffic management operations, managing daily air traffic resources for New York Metropolitan area, and serving as the FAA lead representative for CDM TFM (Collaborative Decision Making/Traffic Flow Management) group, 1996-2000
- Developing requirements and capabilities programs for technological advances in NAS efficiency, including:
    - Leadership of an aviation systems software development team with MIT Lincoln Laboratory and FAA
    - Design and implementation of one of the most significant delay reduction efforts in New York traffic flow management ("auto off-loads")
    - Primary FAA partner with MIT Lincoln Laboratory for development for ITWS/RAPT (weather constraint products) improvements
    - Development, with airline partners, of Airspace Optimization module of PASSUR Integrated Traffic Management to enhance throughput through management of GDPs and other TMIs
    - Development, with airline partners, of Diversion Management module of PASSUR Integrated Traffic Management designed to prevent, prioritize and/or optimize diversions
- Managing staffing plans, including:
    - Current JFK metering program – designed and implemented staffing plan
    - Managed FAA tower and TRACON staff rotations

- Maintenance Plans: Mr. White has overseen the maintenance of the entire current departure metering program, including development of training regimes, recurrent training, software fixes and enhancements, and data integrations and interfaces.
- Contract Management: Mr. White has been the primary contact with the Port Authority in ensuring that the current departure metering program is delivering on its stated goals and mission, and in adjusting the deliverables, processes, protocols, and staffing as needed to ensure that the program has continued to meet and, in some cases, exceed expectations.

B. SMS Manager – Andre Merling

Mr. Merling has over 17 years of professional experience, including nine years experience in systems engineering and project management supporting the Federal Aviation Administration (FAA), National Aeronautics and Space Administration (NASA), and EuroControl (EC) and eight years experience in airline operations planning, command, and control.

Developing requirements and capabilities programs for technological advances in NAS efficiency, including:

- Generating the functional requirements for the FAA Collaborative Air Traffic Management Technologies (CATMT) Work Packages 2 and 3 Programs for the Traffic Flow Management System (TFMS)
- Generating the functional requirements for the FAA Time Based Flow Management (TBFM) program
- Generating the Concept of Use and functional requirements for the Flight Operator Surface Application (FOSA)
- Generating the functional requirements for the FAA Collaborative Departure Sequencing (CDS) prototype
- Generating the Concept of Use and functional requirements for the FAA Airport Surface and Terminal Airspace Adaptation System
- Generating functional requirements for the Enhanced Substitution System (ESM) used by major and regional airlines to manage arrival slots during Ground Delay and Airspace Flow Programs
- Managing staffing plans, including:
    - Tower Air flight dispatch staff rotations
    - JetBlue Airways system operations and flight dispatch staff rotations
        - Maintenance Plans
            - System maintenance, training, and support for the FAA Departure Flow Management (DFM) prototype system during the ZLA trials

    - System maintenance, training, and support for the Enhanced Substitution System (ESM)
    - System maintenance, training, and support for airline flight operations, flight dispatch, crew scheduling, crew planning and weather systems (Sabre, Jeppesen, WSI, Meteorlogix, Spirent)
- Contract Management
    - Primary contact for all airlines (14) using the Enhanced Substitution System (ESM)
    - Primary contact for joint air traffic management research and development contracts with Lockheed Martin, Thales ATM and EuroControl

C. Other Senior Management Resources:

Jeffrey P. Devaney, PASSUR CFO – Contract Management

- Mr. Devaney has served as the main contract structure and management representative for PASSUR as relates to the current JFK departure metering program, including ensuring the legal, financial, and employment structures are in place to deliver on all the staffing requirements for that program.
- Mr. Devaney has performed the same function for the snow operations staffing requirements at JFK, LGA, and IAD.
- Mr. Devaney has managed several of PASSUR's largest and most complex contracts from the legal and financial perspective, including PASSUR OPSnet at 16 U.S. airports, operations, and marketing software contracts for Exxon Mobil Aviation, system-wide deployments at US Airways and American Airlines of PASSUR Integrated Traffic Management modules, and deployment of data services for Air Cell, LLC onboard internet services.

Dr. William D. Hall, Mosaic ATM Managing Director, Commercial Applications and Services

- Dr. Hall oversees the management and execution of the PMJV for Mosaic, ensuring technical and contractual performance from the Mosaic perspective.
- Dr. Hall also serves as the main management representative for Mosaic's interactions with other commercial clients, such as UPS.
- Dr. Hall has orchestrated the development, deployment, maintenance and impact assessment of a number of highly successful operational decision support tools that have saved their operators many tens of millions of dollars annually.

III. List of Relevant Contracts:

A. Surface Systems

JFK Departure Metering Program

- Contracting party: Aviation Development Council, 141-07 20th Avenue, Suite 404, Whitestone, NY 11357
- Location where work is performed: JFK International Airport
- Duration of contract: 2/1/2010-present
- Approximate dollar value: $89,000/month

Snow Operations Management Program (software and staffing) and Field Condition Reporting

- Contracting party: Aviation Development Council, 141-07 20th Avenue, Suite 404, Whitestone, NY 11357
- Locations where work is performed: JFK International Airport and LaGuardia Airport
- Duration of contract:
  - Software systems: 12/1/2002-present
  - Onsite staffing and management program: 12/1/2007-present
- Approximate dollar value: $17,000/month

Snow Operations Management Program (software and staffing) and Field Condition Reporting

- Contracting party: Metropolitan Washington Airports Authority (MWAA), 1 Aviation Circle - Washington, DC 20001
- Location where work is performed: Dulles International Airport (IAD)
- Duration of contract:
  - Software systems: 9/1/2004-present
  - Staffing and management program: 8/1/2008-present
- Approximate dollar value: $22,000/month

NextGen Surface Trajectory-Based Operations (Mosaic)

- Contracting party: FAA AWA; 800 Independence Ave SW, Washington, DC 20591
- Locations where work is performed: Memphis Tower, Orlando Tower, Orlando TRACON, FAA Washington D.C. Lab for JFK Airport

- Duration of contract: 8/1/2008 – 7/31/2013
- Approximate dollar value: $9,275,446

UPS SDSS Support (Mosaic)

- Contracting party: United Parcel Service; Global Operations Center; 825 Lotus Ave, Louisville, KY 40213
- Location where work is performed: Louisville International Airport (SDF)
- Duration of contract: 3/8/2007-present
- Approximate dollar value: $5,000/month

Surface Operations Data Analysis and Adaptation (Mosaic)

- Contracting party: NASA Ames Research Center, Mail Stop 210-10 Moffett Field, C 94035-1000
- Locations where work is performed: Leesburg, VA, and Dallas/Fort Worth International Airport (DFW)
- Duration of contract: 8/28/2009-10/31/2011
- Approximate dollar value: $932,573

Development of weather translation models for traffic flow management (Mosaic)

- Contracting party: NASA Ames Research Center, Mail Stop 210-10; Moffett Field, CA 94035-1000
- Locations where work is performed: Leesburg, VA, and San Francisco International Airport (SFO)
- Duration of contract: 12/15/2010-9/15/2013
- Approximate dollar value: $1,443,048

Tower Flight Data Manager (Mosaic)

- Contracting Party: MIT Lincoln Laboratory; 244 Wood Street, Lexington, MA 02420 (for FAA)
- Locations where work is performed: Cambridge, MA, and Leesburg, VA
- Duration of contract: 12/1/2009 – 5/13/2011
- Approximate dollar value: $1,381,345

B. Airborne Systems

Delta Air Lines (including pre-merger Northwest Airlines) – Hub Management, Diversion Management, Airspace Optimization

- Contracting party: Delta Air Lines, P.O. Box 2070, Atlanta, GA 30320-6001
- Locations where work is performed: Delta OCC Atlanta; hub operations in BOS, JFK, MEM, SLC
- Duration of contract: March 2001-present
- Approximate dollar value: $50,000

United Airlines (which includes pre-merger Continental Airlines) – Hub Management, Diversion Management, Airspace Optimization

- Contracting party: United Airlines, 77 West Wacker Drive, Chicago, IL 60601
- Locations where work is performed: UAL SOC ORD and IAH; hub operations at IAD, ORD, SFO, DEN, JFK, LGA, LAX, NRT, EWR, IAH, CLE
- Duration of contract: July 2002-present
- Approximate dollar value: $100,000/month

American Airlines – Hub Management, Diversion Management

- Contracting party: American Airlines
- Locations where work is performed: AAL SOC Dallas/Fort Worth; hub operations at ORD, MIA, LGA, LAX, JFK, DFW
- Duration of contract: February 2009-present
- Approximate dollar value: $85,000/month

US Airways – Hub Management

- Contracting party: US Airways
- Locations where work is performed: US Airways hubs at LGA, BOS, PHL, CLT, DCA
- Duration of contract: June 2006-present
- Approximate dollar value: $30,000/month

JetBlue Airways – Hub Management, Airspace Optimization

- Contracting party: JetBlue Airways

- Locations where work is performed: JetBlue SOC, New York, NY; JetBlue hub operations at JFK
- Duration of contract: January 2006-present
- Approximate dollar value: $30,000/month

IV. Customer Service Program and Training

PASSUR will be the lead company of the PMJV for training and customer service. PASSUR has an institutional commitment to, and a corporate culture of, training – for its employees, contractors, and customers. Over the years, PASSUR has developed an extensive training program, collaborating with professional training organizations, with several goals common to all programs:

- The objectives of any training program are always crystal clear and stated upfront.
- Many options for training – in person with SMEs, on webinars with experts and shared presentations, online through web-delivered training courses and instructor recordings, and through printed materials.
- Training is always about operational best practices, how to achieve desired business outcomes, process change management, and software functionality – never just software alone.
- Tests are administered for knowledge retention.
- Subject Matter Experts (SMEs), not simply "professional trainers," administer all training.
- Training materials are visually engaging and designed with the best "human factors" in mind.
- Training is "scenario based" whenever possible – lessons that directly reflect are the trainees' work/business environment, with specific examples of how they will put to use the knowledge and tools they have acquired and learned.

PASSUR's customer training programs are an integral part of its solution delivery. PASSUR solution training classes, online live webinars, and online on-demand interactive training programs have been widely accessed by thousands of users over the years. The PMJV companies will work together to incorporate information about MPE and SODAA into the PASSUR training materials, and will rely on PASSUR's training programs for all aspects of training delivered under this proposed effort.

Both companies in the PMJV have well-established training procedures and policies incorporating best practices that apply to internal staff training. Staff is encouraged to seek external training opportunities. Hands-on workshops, thorough documentation, and a highly team-oriented environment are used to ensure that knowledge about broad technical topics as well as company-developed software specifics are disseminated. In addition, Mosaic employees participate in a formal mentoring program and conduct code reviews of software to share knowledge of general and technical nature.

Customer service functions for the JFK SMS will be provided by the PASSUR customer support team. The PASSUR customer service function is well established and highly competent. PASSUR's manager of customer service has been in that position for five years. The excellent level of customer service is maintained through a number of professional management techniques, including provision of company-wide customer service training, with mandatory attendance for all PASSUR employees, regardless of their job function.

PASSUR's existing 24/7 live customer service will remain the single point of contact for all SMS users, to ensure seamless and simple service response. PASSUR will use Mosaic's own 24/7 live technical support capabilities to supplement the front line technical response and troubleshooting.

PASSUR has a deep and longstanding corporate culture of customer service – it is at the core of the company's values and product delivery:

- PASSUR has offered 24/7 live, U.S.-based customer support, provided by direct PASSUR employees for many years. These dedicated staff members are well trained in all aspects of PASSUR solution delivery and operate from defined, well practiced internal escalation protocols and customer communication procedures.
- PASSUR is both a radar surveillance and software solutions company. It is unusual in that both of these core company assets are maintained by a direct in-house team of engineers and service technicians, not outsourced. This provides our customers the assurance of the highest level of maintenance service, delivered by a team that is deeply knowledgeable about the underlying technologies, both the hardware and software that power PASSUR solutions.
- The entire PASSUR surveillance network is 100% remotely monitored and managed through ATT.

A. PASSUR Customer Response Escalation Program

Help Desk/Support Availability

PASSUR Direct Customer: 24/7 live Customer/Technical Support.

- End User: Working hours (9am-5pm US EST) phone and email support.

Service Level Response and Objective Table (response times, resolution times, escalation policies):

Contractor Support Coverage			
Hours	Direct customer: 24 hours per day– Priority 1 and 2 Cases 8:00am - 8:00pm US EST ("Normal Working Hours") – Priority 3 & 4 Cases End User: 9 am - 5 pm US EST phone support and working hours email support **Following SLA descriptions are for direct customers and end users:**		
Rating	**Service Response**	**Service Level Resolution**	**Description**
Priority 1 Error	60 minutes between hours 8am-10 pm US EST. Next Business day between 10pm-8am US EST (except in cases where direct customer contacts PASSUR 24/7/365 live customer support line).	4 hours during Normal Working Hours and 8 Hours during other times (for technical issues under PASSUR's control).	Means a catastrophic error that causes: (a) any significant component of the subscription services or PASSUR software to be unusable; (b) a system or product malfunction that has major impact on client or its customers; (c) frequent failure of an important service that utilizes the contractor subscription services or PASSUR software; or (d) material data loss or corruption. A Priority 1 Error significantly impacts client business and is considered "service affecting."
Priority 2 Error	60 minutes between hours 8am-10pm/US EST. Next business day between 10pm-8am US EST (except in cases where direct customer contacts PASSUR 24/7/365 live customer	24 hours (for technical issues under PASSUR's control).	Means an error that causes:(a) a major failure to an important feature in the contractor subscription services resulting in significant inconvenience to client or its customers; (b) a system or subscription services and PASSUR software malfunction that has a frequent

	support line).		impact on client or its customers; or (c) a major feature of the contractor subscription services and PASSUR software to perform materially differently from the description of that feature in the Agreement and provided documentation. A Priority 2 Error requires significant attention of Client's operations staff to keep the Contractor Subscription Services and PASSUR Software functioning.
Priority 3 Error	1 business day	5 business days	Means an Error that: (a) has minimal current impact on Client; and (b) causes a malfunction of a non-essential feature of the contractor subscription services and PASSUR software.
Priority 4 Issue	1 business day	Variable	Means an issue that: (a) has minimal or no impact on Client; and (b) causes an inconvenience to operations staff; or (c) enhancement requests.
Support Classifications			
Level 1	Means those support services offered by Contractor to Client(s), consisting of the following elements: (a) configuration (b) assistance/troubleshooting, (c) information collection (e.g., traces, dumps) relating to problems, (d) first diagnosis of reported problems, (e) delivery of error correction(s), and (f) answer general subscription services and PASSUR software/technical questions		
Level 2	Means those support services offered by contractor to client(s), consisting of the following elements: (a) analyzing reported problems in depth, (b) problem duplication, (c) answering high-level subscription services and PASSUR software/technical questions, (d) providing troubleshooting guidance to first-level support, and (e) providing hardware-device diagnose/verification		
Level 3	Means those support services offered by contractor to client, consisting of the following elements: (a) performing final problem diagnosis, (b) remote diagnosing and		

	reporting of Errors, (c) provision of Workarounds and (d) working with development engineering to establish Error Correction(s), delivery, verification and closing of reported Case.

Escalation Guidelines for Support Services Requests				
Elapsed Time	**Priority 1**	**Priority 2**	**Priority 3**	**Priority 4**
>60 minutes	Technical Support Lead	N/A	N/A	N/A
> 8 hours	Director IT	Technical Support Lead	Technical Support Lead	N/A
>24 hours	SVP Technology	Director IT	Director IT	Technical Support Lead
>48 hours	CEO	SVP Technology	Director IT	Director IT

B. Security Awareness & Response

The PMJV will rely on PASSUR's security infrastructure and processes for operational systems and data security of the JFK SMS, since PASSUR will host all the data and software. As an integrator and distributor of sensitive National Air Space (NAS) and flight movement data, security underlies and permeates the entire culture at PASSUR. This is magnified by the special responsibility PASSUR has because of its proprietary radar surveillance network, which gives PASSUR unique access to independently generated NAS and flight movement data. To date, PASSUR has never experienced an unauthorized breach of its data gathering systems, databases, or software programs. PASSUR is audited annually by the FAA (using an independent accredited auditor) to ensure the highest levels of information security and compliance with data distribution restrictions.

Mosaic's security infrastructure and processes are well suited to the role Mosaic will play in the delivery and operation of the JFK SMS. As a trusted developer of systems that handle terabytes of sensitive NAS data for the FAA, NASA and UPS which have passed numerous FAA security audits as part of operational deployments, and with administrative access to and responsibility for many systems used by the FAA in operational facilities, Mosaic upholds the corporate culture and reliability required to ensure that security processes are effective.

Physical Security – JFK Departure Metering Operation

PASSUR conducts work at a secure location at JFK (building 145). All employees are, and will continue to be required to have, proper Port Authority identification to gain access to this location. The PMJV companies do, and will, adhere to the security policies as set forth by the Port Authority. This includes a security check and SIDA training. Each of the companies' employees who work onsite at JFK will have satisfactorily completed security training. PASSUR has its own issuing officers to ensure that the policies, as set by the Port Authority, are adhered to at all times.

Physical Security – Bohemia, NY Data Center

Only authorized PASSUR employees are permitted access to the system to perform their designated assignments. All entry into the server rooms is controlled via a numeric keypad lock. All systems are backed up with uninterrupted battery backup systems allowing operations without commercial power. The server room is protected by a Halon fire system. The entire building is protected from theft and vandalism by a live camera system and a monitored alarm system during non-business hours.

Physical Security – Leesburg, VA Data Center

Mosaic's data center is protected by key-pass entry and camera surveillance. Access is only to authorized personnel, and is attempted only after passing through the Mosaic office key-pass entry system.

Software and database security

There are numerous layers of data and software security at both companies, including:

- Databases are strictly sequestered from access, with stringent data access protocols and preventions for developers.
- All machines have remote access that is disabled from outside networks. The company undergoes strict security audits of the machines by the FAA yearly. The company uses third-party software to verify it's safe from intrusion. SSH logins are only allowed to a few pre-specified IP addresses, and only to a single server.
- Most PASSUR applications use a User ID and password authentication. For the most sensitive applications, the company also has an additional login protocol using the apache

mod_auth authentication. In addition, the company requires 256-bit AES client certificates to prevent unauthorized users.

- Annual FAA audit of data and systems security (PASSUR is in good standing).
- Multiple password rules for end users, including forced password changes on a regular schedule, strict lost-password/ lost-username authentication, forced shut-out after a pre-determined number of failed attempts to login.
- Unix back-end password management (all encrypted, no possibility of user name/password decryption).
- Strict logon policies for internal software developers to development servers.
- Production servers use RAID-1, RAID-6, or RAID-10 to protect against disk failure.
- Integrity of files is validated using the MD5 checksum method. Some of the company's secure feeds use checksums for each record.
- Corporate users are on a separate network, not connected in any way to the Web Services or application network.
- TCP mechanisms use internal checksums while delivering packets via the Internet.
- No external access to developers to production servers, nor to production databases.
- No outside person (end user) is ever directly accessing PASSUR databases, which are sequestered behind layers of preventive security from outside penetration.
- PASSUR has a variety of automated internal data-quality checks designed to ensure that the most accurate and definitive data item, among frequently competing/overlapping items, is stored and reported as the definitive "data event." Examples of these data types are ETAs, On times, Off times, arrival and departure runway ID, aircraft tail number, etc.
- PASSUR stores multiple layers of historical data, including different "competing" captures of the same event, for data quality review and analysis.
- Algorithms, data rules, and smoothing filters have been developed to ensure that data "noise" is minimized.
- Predictive, real-time and post-operational data accessed on PASSUR applications have been tested and used over years of operational use by airports, airlines, FBOs, corporate flight operators and the U.S. government, ensuring real-world "vetting" of PASSUR data integrity (accuracy, accessibility, timeliness).

C. OSHA Safety Training

Neither of the PMJV companies provides OSHA Safety Training.

The PMJV is committed to the safety and health of all employees and recognizes the need to comply with regulations governing injury and accident prevention and employee safety. Maintaining a safe work environment, however, requires the continuous cooperation of all employees.

The companies maintain safety and health practices consistent with the needs of the industry.

D. Motivation & Incentive Training

The PMJV companies strive to create challenging and rewarding work environments for all employees. Employees are compensated according to their efforts and contribution to the success of each company. The companies provide high quality healthcare benefits plans, vacation, and holidays to all eligible employees. All employees from both companies receive incentive stock options in their company. Through these incentive programs the companies' employees are highly motivated.

E. QA/QC Programs

Quality and reliability are at the center of everything the companies do. They passionately protect their reputation for product integrity. Therefore, it is formal policy at both companies that any employee, from any department, can halt a software release if he or she feels something exists that compromises the companies' reputation for product integrity. There is no exception to this policy– and it has been invoked many times to prevent a software release.

PASSUR employs a five-step quality assurance program for all customer products:

- Step 1 – Developer review of product specification: spec documents include customer objectives, main attributes and use-cases envisioned for the product, and a detailed functionality and capabilities description. Primary developer team ensures clarity on all of the above, and adjusts the specification as needed, frequently after additional customer interaction.

- Step 2 – Primary Developer Review of the Application/Product. The primary developer or development team reviews the product and documents changes required, bugs, enhancements, and fixes, along with recommended initial testing, steps needed to verify proper functionality. Results are documented.

- Step 3 – Developer Peer Review – A different developer or development team that was not involved in the coding takes the documentation and thoroughly tests the product. Feedback is documented and given to the primary developer (s) on results. Reviewers include both technical employees (developers) and non-technical employees (sales and marketing).

- Step 4 – Once the development team has completed steps 2 & 3 the testing is passed to the Quality Assurance Department where the product is tested from the end-user perspective, using detailed testing protocols (defined functions to be tested and logged to capture results). All results are documented and any issues are sent back to the development team for resolution. Once the QA department has passed the testing, it is ready for Step 5.

- Step 5 – Customer Review – All product enhancements/fixes are placed on a test server available for the customer to review prior to going operational. Documentation of the changes is provided along with the URL to the product for testing. This test site is usually used by customers to train the users on the new changes prior to going operational.

Mosaic's QA process is an activity that is performed throughout the life of the project, not merely a testing activity that is done at its conclusion. The Mosaic ATM development process ensures that quality is built in from the very beginning of the company's projects. Mosaic accomplishes this with an iterative approach to developing software, which promotes frequent interaction and collaboration with all members of the project team. Mosaic supports a dynamic, research-driven environment that embraces changing requirements and accommodates these changes with ease.

As seen in Figure 1, Mosaic takes a test-first approach to projects. Testing begins at the start of the project with requirement reviews and test plan development. These activities continue throughout the life of the project as requirements are refined, changed, and improved. As requirements are developed, testing occurs immediately instead of at the end of the project. This allows Mosaic to build a robust regression testing suite during the project, thus reducing the traditional end of life lengthy regression testing phase.

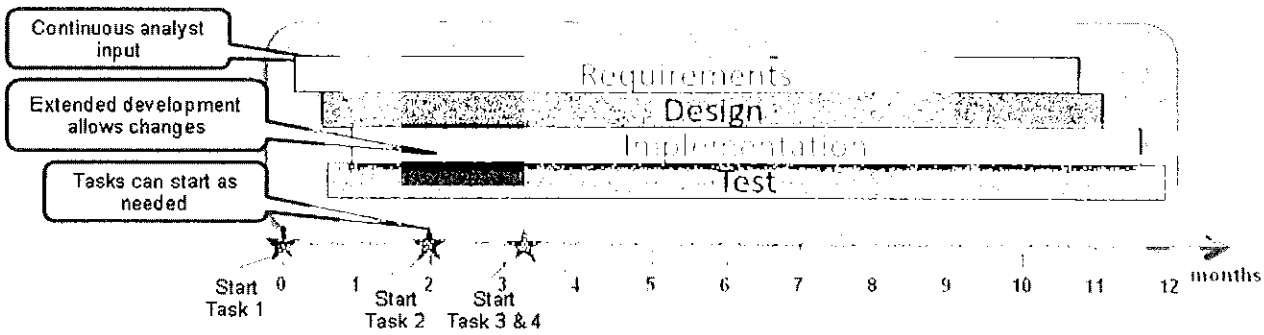

Figure 1. Development Process

Mosaic's development process promotes feedback and change from the analysts and end users.

Mosaic's Quality Assurance team, along with the project team, review requirement and design documents prior to starting development. These reviews are conducted to ensure clarity, completeness, and comprehensiveness of the requirements. The knowledge gained during the reviews is then used to create detailed test plans.

Different test plans are created to serve different audiences and needs during the project. At the beginning of the project, a testing strategy document is created that outlines the testing schedule, test environments, procedures, testing software used on the project, risk and mitigation strategies, and high level test scenarios. During the life of the project, detailed test plans that include specific test cases with expected results for each requirement are documented and tracked.

High level test plans are written during the requirement review process and are reviewed by the project team prior to starting development. By building and reviewing test plans early, Mosaic is able to avoid several pit-falls that many software projects face. First, it helps the team to ensure that the requirements are interpreted the same way across the team. When developers and analysts review the test cases before writing code, it gives the entire team a clear goal to work towards; development for that requirement is done when all of the test cases are passing and the entire team has agreed on a set number of test cases that validate that the requirements is being satisfied.

Another benefit with this approach guarantees that Mosaic is building software in a highly testable fashion. The developers know what the testing needs are (both automated and manual tests) before building the software. This allows them to architect an application that will support the testing needs easily without re-work in a "testing phase" later in the project.

Automated testing is an integral part of Mosaic's Quality Assurance approach. Throughout the life of the project, the team builds automated unit and functional tests in parallel with development. These tests are then incorporated into the Continuous Integration process. This provides continuous automated regression testing every time code is checked in to Mosaic's version control system, SVN. This regression testing then provides the team with the ability to accommodate late changing requirements without resulting in a lengthy manual re-test of the software or delay to the schedule.

F. Disciplinary Procedures – PASSUR

This Disciplinary Actions Policy applies to all regular employees who have completed the Introductory Period.

V. Policy

This policy pertains to matters of conduct and of the employee's competence. However, an employee who does not display satisfactory performance and accomplishment on the job may be dismissed, in certain cases, without resorting to the steps set forth in this policy.

In general, PASSUR's corporate policy is sensitive to the circumstances of each case on an individual basis and strives to be fair and reasonable in harboring a safe and professional work environment for everyone. PASSUR is dedicated to, and subscribes to, a zero-tolerance policy, ensuring a professional workplace environment that is:

- Free from discrimination
- Free from unethical conduct
- Free from sexual harassment and workplace violence
- Free from substance abuse

Under normal circumstances, executive officers are expected to follow the procedure outlined below. There may be particular situations, however, in which the seriousness of the offense justifies the omission of one or more of the steps in the procedure. Likewise, there may be times when the company may decide to repeat a disciplinary step.

VI. Discipline Procedure

Unacceptable behavior, which does not lead to immediate dismissal, may be dealt with in the following manner:

- Oral reminder
- Written warning
- Termination

To ensure that PASSUR business is conducted properly and efficiently, the employee must conform to certain standards of attendance, conduct, work performance and other work rules and regulations. When a problem in these areas does arise, the manager will coach and counsel the employee in mutually developing an effective solution. If, however, the employee fails to respond to coaching or counseling, or an incident occurs requiring formal discipline, the following procedures occur.

Step One: Oral reminder

- The supervisor will meet with the employee to discuss the problem or violation, making sure that the employee understands the nature of the problem or violation and the expected remedy. The purpose of this conversation is to remind the employee of exactly

what the rule or performance expectation is and also to remind the employee that it is his or her responsibility to meet PASSUR's expectations.

- The employee will be informed that the oral reminder is the first step of the discipline procedure. The supervisor will fully document the oral reminder, which will remain in effect for a one (1) month period. Documentation of the incident will remain in the confidential department file and will be placed in your personnel record.

Step Two: Written warning

- If the employee's performance does not improve within the one (1) month period, or if the employee is again in violation of PASSUR practices, rules or standards of conduct, the supervisor will discuss the problem with him or her, emphasizing the seriousness of the issue and the need for the employee to immediately remedy the problem. The supervisor will advise the employee that he or she is now at the second formal level of disciplinary action. After the meeting, the supervisor will write a memo summarizing the discussion and the employee's agreement to change. A copy of the memo is sent to the employee's personnel file.
- The written warning will remain in effect for three (3) months.
- If the employee commits any of the actions listed below, or any other action not specified but similarly serious, the employee will be suspended without pay pending an investigation of the situation. Following the investigation, the employee may be terminated without any previous disciplinary action having been taken.
    - Theft.
    - Falsification of PASSUR's records.
    - Breach of Confidentiality Agreement.
    - Threat of, or the act of, doing bodily harm.
    - Willful or negligent destruction of property.
    - Use and/or possession of intoxicants, drugs or narcotics.
        - The provision of this Disciplinary Policy is not a guarantee of its use. PASSUR reserves the right to terminate employment at any time, with or without reason. Additionally, PASSUR reserves the right to prosecute any employee for any of the above infractions.

Mosaic applies a very similar process to PASSUR's Disciplinary Policy, however, that process is not formalized. Mosaic relies on the experience and judgment of its management team to apply discipline as necessary, and on Mosaic's legal status as an "at will" employer in the State of Virginia. Employees who do not perform for any of the reasons cited in the description of

PASSUR's policy are provided feedback orally, in writing, and/or by termination or immediate dismissal as appropriate to the circumstances.

Response to Request for Proposal No. 24997

Surface Management System at John F. Kennedy International Airport

Section 2

Cost Proposal

Cost Proposal

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I. PASSUR's Proposed Pricing

PASSUR's pricing is all-inclusive and firm for the term of the agreement. The prices include all delivery, installation, labor, equipment, training, communications, insurance and administrative services as set forth in this Proposal.

Per the Port Authority's specific request, the pricing provided herein is PASSUR's "best price" to deliver all of the products and services described in PASSUR's Technical Proposal, commencing on or near December 1, 2011.

PASSUR's pricing is based on the detail summarized above and the Assumptions below.

A. Table 1 – Phase A

B. Table 2 – Phase B

C. Table 3 – Operational Usage (Through Commencement of Phase A)

D. Table 4 – Operational Usage (Through Commencement of Phase B)

E. Table 5 – Supplemental Work (November 1, 2012 – Termination)

F. Table 6 – Estimated Total Costs

II. Assumptions

COST PROPOSAL FORM

IMPLEMENTATION PERIODS
PHASE A AND PHASE B

TABLE 1

PHASE A: SERVICES PAYMENT SCHEDULE **Commencement of Contract to on or before January 15, 2012, payment for all services to Implement Phase A**				
	Project Timeframe	Fractional Payment	Payment	Deliverables
Project Plan and Schedule Submittal	11/5/2011	5.00%	$10,277	Deliverables as described in SOW
System Diagrams, Security Practices and Policies, and Systems Documentation Submittals	11/16/2011	5.00%	$10,277	Deliverables as described in SOW
Acceptance Test Plan Submittal	12/19/2011	5.00%	$10,277	Deliverables as described in SOW
System Hardware Documentation and Manuals Submittal	11/30/2011	5.00%	$10,277	Deliverables as described in SOW
Training Plan, Change Management and Database Documentation Submittals	1/19/2012	5.00%	$10,277	Deliverables as described in SOW
User Training	2/9/2012	25.00%	$51,387	Deliverables as described in SOW
Successful Completion of System Acceptance Test	1/26/2012	25.00%	$51,387	Deliverables as described in SOW
Successful Completion of 30 Day Operational Test	2/14/2012	25.00%	$51,387	Deliverables as described in SOW
Total Cost to Implement Phase A			$205,546	

Implementation Costs shall include but are not limited to the following:

- All Labor, Equipment and Miscellaneous Costs to Setup Primary and Backup Data Centers to Host Applications Software,
- Labor to Modify the Applications Software to Meet Contract Requirements
- Labor to Install Applications Software in Contractor's Hosted Environment
- Labor to Configure Applications Software for Operational Usage at JFK

- All Administrative Activities
- Labor to Conduct Acceptance Testing
- Labor and Materials for Training
- 1 Year Warranty for System and Services

TABLE 2

Phase B: Services Payment Schedule **Completion of Phase B on or before July 1, 2012, payment for all services to Implement Phase B**				
	Project Timeframe	Fractional Payment	Payment	Deliverables
Project Plan and Schedule Submittal	11/5/2011	5.00%	$7,555	Deliverables as described in SOW
System Diagrams, Security Practices and Policies, and Systems Documentation Submittals	4/30/2012	5.00%	$7,555	Deliverables as described in SOW
Acceptance Test Plan Submittal	6/1/2012	5.00%	$7,555	Deliverables as described in SOW
System Hardware Documentation and Manuals Submittal	5/17/2012	5.00%	$7,555	Deliverables as described in SOW
Training Plan, Change management and Database Documentation Submittals	7/2/2012	5.00%	$7,555	Deliverables as described in SOW
User Training	7/24/2012	25.00%	$37,774	Deliverables as described in SOW
Successful Completion of System Acceptance Test	7/6/2012	25.00%	$37,774	Deliverables as described in SOW
Successful Completion of 30 Day Operational Test	7/31/2012	25.00%	$37,774	Deliverables as described in SOW
Total Cost to Implement Phase B			$151,097	

Implementation Costs shall include but are not limited to the following:

- All Labor, Equipment and Miscellaneous Costs to Setup Primary and Backup Data Centers to Host Applications Software,
- Labor to Modify the Applications Software to Meet Contract Requirements
- Labor to Install Applications Software in Contractor's Hosted Environment
- Labor to Configure Applications Software for Operational Usage at JFK
- All Administrative Activities

- Labor to Conduct Acceptance Testing
- Labor and Materials for Training
- 1 Year Warranty for System and Services

OPERATIONAL USAGE

TABLE 3

MONTHLY FEE TO HOST, OPERATE, ADMINISTER AND MAINTAIN SYSTEM FOR INTERIM PERIOD		
Monthly Operation Commencing from Base Date of Operational Usage (Est. January 15, 2012)* Through the Commencement of Phase B (Est. June 30, 2012 at 11:59 P.M.)		
Total Lump Sum Cost Per Month*	**Estimated Number of Months**	**Total Estimated Cost for Period**
$ 74,250	X 6.5	= $482,625
*Monthly Charge shall be all inclusive and utilize fully loaded cost of staff to operate, administer and maintain the system in the JFK Operations Center within the calendar month; as well as fully loaded cost of labor, equipment and miscellaneous costs to host the Application in the Primary and Backup Data Centers.		

TABLE 4

Monthly Fee to Host, Operate, Administer and Maintain System For Operational Usage		
Monthly Operation Commencing from Phase B (Est. July 1, 2012 at 12:00 A.M.) through Contract End Date		
Total Lump Sum Cost Per Month*	**Estimated Number of Months**	**Total Estimated Cost for Period**
$ 90,000	X 28	= $2,520,000
*Monthly Charge shall be all inclusive and utilize fully loaded cost of staff to operate, administer and maintain the system in the JFK Operations Center within the calendar month; and also fully loaded cost of labor, equipment and miscellaneous costs to host the Application in the Primary and Backup Data Centers.		

TABLE 5

SUPPLEMENTAL WORK EFFECTIVE NOVEMBER 1, 2012 AT 12:00 A.M. THROUGH CONTRACT END DATE			
	A. Proposed Maximum Hourly Rate	B. Estimated number of hours for the first year of the base period	C. Total Estimated Cost (A x B = C)
Contract Manager (Information Technology)	$ 200	150	$30,000
Software Engineer (Analyst/Programmer)	$ 200	300	$60,000
Report Writer	$ 125	300	$37,500
Trainer	$ 75	300	$22,500
System Operator during Irregular Operations	$ 100	450	$45,000
TABLE ESTIMATED TOTAL			$195,000

ESTIMATED TOTAL COSTS

TABLE 6

	ESTIMATED BASE CONTRACT TOTAL	
Table 1:	Total Cost to Implement Phase A	$205,546
Table 2:	Total Cost to Implement Phase B	$151,097
Table 3:	Total Estimated Cost for First Operation Usage (Estimated to be 1/15/12 - 6/31/12 - 6.5 Months)	$482,625
Table 4:	Total Estimated Cost for Second Operational Usage (Estimated to be 7/1/12 to 10/31/14 - 28 Months)	$2,520,000
Table 5:	Estimated Cost for Supplemental Work	$195,000
	TOTAL ESTIMATED CONTRACT COST	$3,554,268

ASSUMPTIONS

Proposers should identify any underlying cost-related assumptions in this section in the space below or on additional sheets if the space provided below is insufficient.

TABLE 7

No assumptions

Response to Request for Proposal No. 24997

Surface Management System at John F. Kennedy International Airport

Section 3

Management Proposal

Management Proposal

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I. Overview

This submission in response to Request for Proposals for a Surface Management System (SMS) at John F. Kennedy International Airport is tendered as a Common Law Joint Venture between PASSUR Aerospace, Inc. (PASSUR) and Mosaic ATM, Inc. (Mosaic), referred to for the purposes of this proposal as the PASSUR Mosaic Joint Venture, or PMJV.

The PASSUR Mosaic Joint Venture brings the best of industry knowledge and skill to support the Port Authority's needs and requirements

- Experience installing, operating, and maintaining surface management systems at four airports (including JFK), at airlines, and at air traffic control facilities (including hands-on direct operating experience, uniquely associated with the JFK departure metering program, unlike any other surface program in the U.S. to date).
- Experienced, proven team of aviation professionals who have successfully managed the first phase of surface management at JFK and who bring a thorough understanding of the New York and national airspace, JFK surface operation, and organizational relationships at JFK (can respond to any situation in a complex environment with extensive training and experience).
- All airlines at JFK have extensive exposure to PASSUR processes, staff and systems.
- Experience in airspace optimization solutions for multiple airlines.
- Experience in delivering live, mission critical systems to airlines, airports and the U.S. government.
- Technical expertise and experience implementing and managing similar services.

The submission reflects the extensive experience both companies have in SMS – including the past 18 months of operation by PASSUR of the JFK departure metering program and the eight years of winter operations management and field condition reporting at JFK from PASSUR; and several of the leading surface management decision support programs instituted at other airports around the country by Mosaic. The current departure metering program at JFK has been a widely recognized success at many levels, and reflects a longstanding and successful partnership between PASSUR and the Port Authority. The success of the metering program was recently validated by an extensive study of its fuel and emissions reductions conducted by MIT Lincoln Laboratory. The PMJV believe they represent the team with the most experience implementing surface management operations, including complex surface management decision support technology (predictive analytics, live monitoring, post-operational analysis) and hands-on implementation of surface management operations.

PASSUR will be the lead company in the venture with respect to the software platform accessed by users, onsite staffing, operation of the system, and training. Mosaic will provide its technical expertise in surface decision support systems, including monitoring, predicting, and analyzing the movement of aircraft on airport runways and taxiways, as well as in the ongoing maintenance and technical support of these systems. The PASSUR Integrated Traffic Management (PITM)

software platform will be the single user interface representing the combined technical capabilities of PASSUR and Mosaic.

PASSUR Aerospace, Inc. is a New York corporation founded in 1967. A publicly traded company, it conducts its business in the United States, Canada, Europe, and Asia. PASSUR's offices are located at One Landmark Square, Stamford, CT, 06901, and 35 Orville Drive, Bohemia, NY, 11716. Mosaic ATM, Inc. is a Virginia S-corporation founded in 2004, with offices at 801 Sycolin Road SE, Suite 306, Leesburg, VA 20175. Working together as a common-law joint venture, the companies are collaborating to provide an advanced and effective surface management system.

PASSUR is a business intelligence company, which develops predictive analytics built on proprietary algorithms and the concurrent integration and simultaneous mining of multiple databases. The Company offers vertical expertise in the aviation market – providing data consolidation, information, decision support, predictive analytics, collaborative solutions, and professional services for aviation operations worldwide.

PASSUR's principal business is to provide business intelligence and predictive analytics solutions, which save money, enhance operational efficiency, increase safety and security, and improve the passenger experience. These analytics are derived from the Company's PASSUR® Proprietary Surveillance Network (the "PASSUR Network") of live flight information (updated every 4.6 seconds) and include decision support software, predictive analytics, and web-delivered collaborative decision solutions, enhanced by professional services provided by industry experts.

Serving most major airlines (including five of the top six North American airlines, as well as the top five hub and spoke airlines), approximately 50 airport customers (including 23 of the top 30 North American airports), approximately 200 corporate aviation customers, as well as the Port Authority and the U.S. government, including the Federal Aviation Administration (FAA) and the Transportation Security Administration (TSA).

PASSUR has been collaborating with the Port Authority for 10 years on innovative, workable, technical and organizational solutions, starting with the snow operations metering and field condition communications programs, operational statistics reporting, and leading up to the current first phase of the JFK departure metering program. The PMJV looks forward to building on that relationship, on the deep experience its team already has with the JFK operation and its many constituencies, and PASSUR's rapidly growing traffic management software platform, to deliver a state-of-the-art Surface Management Program (SMS) for JFK.

Mosaic conducts research and develops solutions for improving the efficiency and safety of air transportation. The Mosaic staff consists of industry-recognized experts who combine substantial operational knowledge of National Airspace System (NAS) with extensive capabilities and experience in computer science, operations research, systems engineering, and human factors. Mosaic maintains a strong, cooperative relationship with the FAA, ATC facilities and specialists, NASA, major airlines, and air cargo operators. Mosaic's headquarters in Northern Virginia provide significant access to numerous ATC facilities, including the ATCSCC in Herndon; the Washington ARTCC in Leesburg; the Potomac TRACON in Warrenton; and Washington-Dulles International Airport (IAD). Satellite offices are located near other FAA facilities and major airports, with employees nationwide.

Mosaic performs a combination of government-funded research and development, commercial services and product development, consulting, and internal research and development. Through these projects and internal efforts, significant corporate infrastructure has been developed to support future efforts. This infrastructure includes data repositories, software libraries, analysis tools, algorithms, and processes that are critical to the successful development of advanced systems for aviation, military, and commercial markets.

Mosaic's products feature new means for aviation users to collaborate with airport authorities and air traffic management and to understand systemic effects, enabling lower costs and greater productivity. Mosaic supports the FAA in the design, development, and deployment of the Surface Decision Support System (SDSS) in Memphis, TN; Orlando, FL; and Louisville, KY, and supports UPS' use of SDSS in Louisville. The capabilities of SDSS include the display of flight information and surface and terminal area aircraft positions to Air Traffic Controllers and Traffic Managers, Flight Operators, Airport Authorities, and other specialists at the operational facilities of aviation organizations involved in the airport surface operation. SDSS is used by UPS to drastically reduce the length of departure queues in UPS' nightly operation. It is also at the heart of the Collaborative Departure Queue Management (CDQM) trials conducted by the FAA in Memphis, Tennessee. The accuracy and reliability of SDSS' traffic predictions, produced by the Mosaic Prediction Engine (MPE), are unparalleled by any other solution anywhere.

II. Management Experience and Approach

PASSUR and Mosaic have teamed in a common law joint venture to provide a comprehensive SMS that will meet, and in several instances exceed, the requirements of this RFP. The PASSUR software platform will be the single user interface representing the combined technical capabilities of the PMJV. The PASSUR professional services team (the same team of technical, operational, and managerial subject matter experts

which has delivered the current JFK departure metering program for the past one and half years) will form the core of the management team delivering the new SMS, supplemented by Mosaic experts in surface management design, implementation and management.

The core of the PMJV SMS is the combination of PASSUR's extensive experience in providing airspace surveillance and predictive analytics capabilities, departure metering software and management, collaborative software platform for instant secure distribution of information, and new surface tracking display technology, supplemented by Mosaic's extensive experience in surface prediction models and tools, live surface monitoring ("region of interest" and constraint analysis), departure metering and sequencing decision support tools, and surface performance reporting and analysis. The Mosaic prediction algorithms, surface decision support logic, and reporting engine are being integrated into the PASSUR data and software architecture. Extensive work on this integration is already underway.

The PMJV team leverages decades of technical contract management experience and proven processes to support the Port Authority. The PMJV has assembled a modeling, analysis, operations, software development, and professional services delivery team that pulls together the technical and managerial strengths of both firms. The team encompasses more than sufficient resources that are well versed in surface and airspace management, products, systems, and operations. The team represents more than 100 employees who are dedicated to aviation systems operations, analysis, system engineering, hardware and software design, development and testing, and who support and operate operational systems. This team stands ready as "one" to work in partnership with the Port Authority and stakeholders to develop and extend capabilities to accomplish the aims of the SMS program for JFK.

The PMJV companies have extensive experience implementing, installing, operating, managing, and maintaining similar services, in a similar environment, using similar-sized staff. PASSUR led the development of departure slot allocation procedures and software at the Port Authority, starting with the snow operations programs at JFK and LGA that were later expanded to Dulles International Airport and Denver International Airport (self-managed). This program formed the basis – with significant software and staffing/management enhancements – for the full-time slot allocation management program ("departure metering") deployed by PASSUR at JFK for the Bay Runway construction closure in 2010, and then extended to the present day. The collaborative field condition reporting module and protocols initially developed with the Port Authority for JFK and LGA have now been expanded to 16 U.S. airports, and are accessed daily by thousands of aviation operations professionals worldwide.

PASSUR delivers extensive airspace management and decision support technology and professional services to the largest airlines in the U.S., including many of the airline operators at JFK, in order to address key constraint in the lifecycle of a flight. These solutions include predictive analytics, real-time situational awareness and decision support, and post-operational analysis tools.

PASSUR Subject Matter Experts (SMEs) are at the core of PASSUR's solution delivery. The SMEs are drawn from airlines (SOC and hub control management, operations finance, operations analysis, and pilot groups), air traffic management (FAA), airports (operations, environmental, and finance), business aviation, and aviation fleet management. These SMEs are focused exclusively on solving customer challenges in the area of aviation operational constraints, inefficiencies, and opportunities for optimization. They are involved in every step of the PASSUR solution delivery cycle: onsite analysis of customer challenges, operating environment, and business processes; as well as product development, training, and program implementation. This SME involvement helps to ensure our solutions achieve the desired customer outcome.

Mosaic is a recognized leader in the study and development of the Surface Decision Support System (SDSS) and its precursor technologies and systems, including SMS. Three of the four recognized inventors of SMS are employees of Mosaic (the fourth is retired) and lead the continuing surface decision support tool analysis and research. Mosaic personnel led the SMS development and deployment efforts from Technology Readiness Level 1 (TRL1) through TRL9. In addition to employing the inventors and developers of SMS, Mosaic has been responsible for maintaining the FAA's software baseline of the SDSS system since 2005.

Mosaic has been instrumental in the delivery of several of the most successful surface management system programs to date, including Memphis, Louisville, and Orlando. It has also been involved in the development of several seminal and related traffic management programs for the FAA and NASA, such as Surface Trajectory Based Operation (STBO), Collaborative Departure Queue Management (CDQM), and the Flight Operator Surface Application (FOSA).

The companies' combined professional service teams provide an extensive resource of SMEs in airport operations, airspace and surface optimization, National Air Space (NAS) operations and process design, air traffic management, airline operations, and technical implementations into complex operating environments.

A. ***Relevant Experience Past Three Years***

1. Surface Systems

1. JFK International Airport Departure Metering Program (PASSUR)

a. Contracting party: Aviation Development Council, 141-07 20th Avenue, Suite 404, Whitestone, NY 11357

b. Location where work is performed: JFK International Airport

c. Duration of contract: 2/1/2010-present

d. Approximate dollar value: $90,000/month

2. Snow Operations Management Program (software and staffing) and Field Condition Reporting (PASSUR)

   a. Contracting party: Aviation Development Council, 141-07 20th Avenue, Suite 404, Whitestone, NY 11357

   b. Locations where work is performed: JFK International Airport and LaGuardia Airport

   c. Duration of contract:

      i. Software systems: 12/1/2002-present

      ii. Onsite staffing and management program: 12/1/2007-present

   d. Approximate dollar value: $17,000/month

3. Snow Operations Management Program (software and staffing) and Field Condition Reporting (PASSUR)

   a. Contracting party: Metropolitan Washington Airports Authority (MWAA), 1 Aviation Circle, Washington, DC 20001

   b. Location where work is performed: Dulles International Airport

   c. Duration of contract:

      i. Software systems: 9/1/2004-present

      ii. Staffing and management program: 8/1/2008-present

   d. Approximate dollar value: $22,000/month

4. NextGen Surface Trajectory-Based Operations (Mosaic)

   a. Contracting party: FAA AWA; 800 Independence Ave SW, Washington, DC 20591

   b. Locations where work is performed: Memphis Tower, Orlando Tower, Orlando TRACON, FAA Washington D.C., Lab for JFK Airport

   c. Duration of contract: 8/1/2008 – 7/31/2013

   d. Approximate dollar value: $9,275,446

5. UPS SDSS Support (Mosaic)
    a. Contracting party: United Parcel Service Global Operations Center, 825 Lotus Ave, Louisville, KY 40213
    b. Location where work is performed: Louisville International Airport (SDF)
    c. Duration of contract: 3/8/2007-present
    d. Approximate dollar value: $5,000/month
6. Surface Operations Data Analysis and Adaptation (Mosaic)
    a. Contracting party: NASA Ames Research Center, Mail Stop 210-10, Moffett Field, CA 94035-1000
    b. Locations where work is performed: Leesburg, VA, and Dallas/Fort Worth International Airport (DFW)
    c. Duration of contract: 8/28/2009-10/31/2011
    d. Approximate dollar value: $932,573
7. Development of weather translation models for traffic flow management (Mosaic)
    a. Contracting party: NASA Ames Research Center, Mail Stop 210-10, Moffett Field, CA 94035-1000
    b. Locations where work is performed: Leesburg, VA, and San Francisco International Airport (SFO)
    c. Duration of contract: 12/15/2010-9/15/2013
    d. Approximate dollar value: $1,443,048
8. Tower Flight Data Manager (Mosaic)
    a. Contracting Party: MIT Lincoln Laboratory; 244 Wood Street, Lexington, MA 02420 (for FAA)
    b. Locations where work was performed: Cambridge, MA, and Leesburg,VA
    c. Duration of contract: 12/1/2009 – 5/13/2011
    d. Approximate dollar value: $1,381,345

2. Airborne Systems

1. Delta Air Lines (which includes pre-merger Northwest Airlines locations) – Hub Management, Diversion Management, Airspace Optimization (PASSUR)
    a. Contracting party: Delta Air Lines, P.O. Box 2070, Atlanta, GA 30320-6001

b. Locations where work is performed: Delta OCC Atlanta; hub operations in BOS, JFK, MEM, SLC

c. Duration of contract: March 2001-present

d. Approximate dollar value: $50,000/month

2. United Airlines (which includes pre-merger Continental Airlines locations) – Hub Management, Diversion Management, Airspace Optimization (PASSUR)

   a. Contracting party: United Airlines, 77 West Wacker Drive, Chicago, IL 60601

   b. Locations where work is performed: UAL SOCC Chicago and Houston; hub operations at IAD, ORD, SFO, DEN, JFK, LGA, LAX, NRT, EWR, IAH, CLE

   c. Duration of contract: July 2002-present

   d. Approximate dollar value: $100,000/month

3. American Airlines – Hub Management, Diversion Management (PASSUR)

   a. Contracting party: American Airlines

   b. Locations where work is performed:

      i. AAL SOC Dallas/Fort Worth;

      ii. Hub operations at ORD, MIA, LGA, LAX, JFK, DFW

   c. Duration of contract: February 2009-present

   d. Approximate dollar value: $85,000/month

4. US Airways – Hub Management (PASSUR)

   a. Contracting party: US Airways

   b. Locations where work is performed: US Airways hubs at LGA, BOS, PHL, CLT, DCA

   c. Duration of contract: June 2006-present

   d. Approximate dollar value: $30,000/month

5. JetBlue Airways – Hub Management, Airspace Optimization (PASSUR)

   a. Contracting party: JetBlue Airways

   b. Locations where work is performed: JetBlue SOC, New York, NY; JetBlue hub operations at JFK

   c. Duration of contract: January 2006-present

d. Approximate dollar value: $30,000/month

B. ***Nature and Quality of the QA/QC Programs***

Quality and reliability are at the center of everything the PMJV does. The companies passionately protect their reputation for product integrity. Therefore, it is formal policy at both companies that any employee, from any department, can halt a software release if he or she feels something exists that compromises the either of the companies' reputation for product integrity. There is no exception to this policy.

PASSUR employs a five-step quality assurance program for all customer products:

- Step 1 – Developer review of product specification: spec documents include customer objectives, main attributes and use-cases envisioned for the product, and a detailed functionality and capabilities description. Primary developer team ensures clarity on all of the above, and adjusts the specification as needed, frequently after additional customer interaction.

- Step 2 – Primary Developer Review of the Application/Product. The primary developer or development team reviews the product and documents changes required, bugs, enhancements, and fixes, along with recommended initial testing steps needed to verify proper functionality. Results are documented.

- Step 3 – Developer Peer Review – A different developer or development team that was not involved in the coding takes the documentation and thoroughly tests the product. Feedback is documented and given to the primary developer(s) on results. Reviewers include both technical employees (developers) and non-technical employees (sales and marketing).

- Step 4 – Once the development team has completed steps 2 & 3 the testing is passed to the Quality Assurance Department where the product is tested from the end-user perspective, using detailed testing protocols (defined functions to be tested and logged to capture results). All results are documented and any issues are sent back to the development team for resolution. Once the QA department has passed the testing it is ready for Step 5.

- Step 5 – Customer Review – All product enhancements/fixes are placed on a test server available for the customer to review prior to going operational. Documentation of the changes is provided along with the URL to the product for testing. This test site is usually used by customers to train the users on the new changes prior to going operational.

Mosaic's QA process is an activity that is performed throughout the life of the project, not merely a testing activity that is done at the end of a project. The Mosaic development

process ensures that quality is built in from the very beginning of all projects. The company accomplishes this with an iterative approach to developing software, which promotes frequent interaction and collaboration with all members of the project team. Mosaic supports a dynamic, research-driven environment that embraces changing requirements and accommodates these changes with ease.

As seen in Figure 1, Mosaic takes a test-first approach to projects. Testing begins at the start of the project with requirement reviews and test plan development. These activities continue throughout the life of the project as requirements are refined, changed, and improved. As requirements are developed, testing occurs immediately instead of at the end of the project. This allows the company to build a robust regression testing suite during the project, thus reducing the traditional end-of-life lengthy regression testing phase.

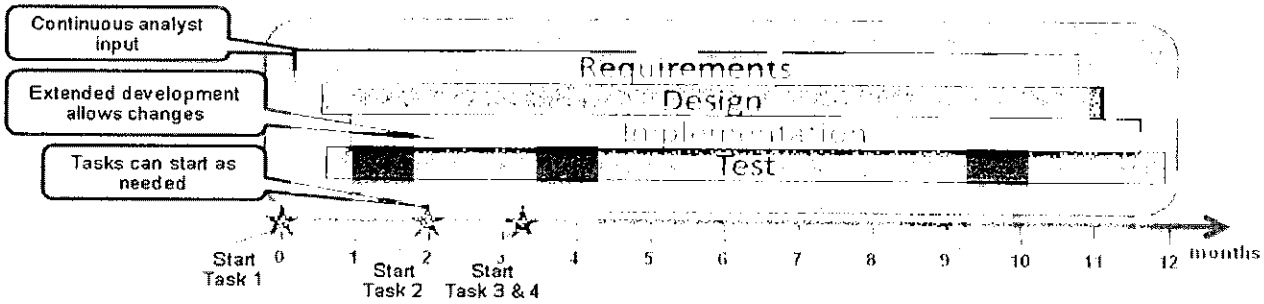


Figure 1.Development Process

Mosaic's development process promotes feedback and change from the analysts and end users.

Mosaic's Quality Assurance team, along with the project team, review requirements and design documents prior to starting development. These reviews are conducted to ensure clarity, completeness, and comprehensiveness of the requirements. The knowledge gained during the reviews is then used to create detailed test plans.

Different test plans are created to serve different audiences and needs during the project. At the beginning of the project, a testing strategy document is created that outlines the testing schedule, test environments, procedures, testing software used on the project, risk and mitigation strategies, and high-level test scenarios. During the life of the project, detailed test plans that include specific test cases with expected results for each requirement are documented and tracked.

High-level test plans are written during the requirement review process and are reviewed by the project team prior to starting development. By building and reviewing test plans early, Mosaic is able to avoid several pitfalls that many software projects face. From the start, it helps the team to ensure that the requirements are interpreted the same way across the team. When developers and analysts review the test cases before writing code, it gives the entire team a clear goal to work towards; development for that requirement is done when all of the test cases are passing and the entire team has agreed on a set number of test cases that validate that the requirements is being satisfied.

Another benefit with this approach guarantees that Mosaic is building its software in a highly testable fashion. The developers know what the testing needs are (both automated and manual tests) before building the software. This allows them to architect an application that will support the testing needs easily without re-work in a "testing phase" later in the project.

Automated testing is an integral part of Mosaic's Quality Assurance approach. Throughout the life of the project, the team builds automated unit and functional tests in parallel with development. These tests are then incorporated into the Continuous Integration process. This provides continuous automated regression testing every time code is checked in to the version control system, SVN. This regression testing then provides the team with the ability to accommodate late-changing requirements without resulting in a lengthy manual re-test of the software or delay to the schedule.

C. ***Customer Service***

PASSUR will be the lead company of the PMJV for training and customer service. PASSUR's existing 24/7 live customer service line will remain the single point of contact for all SMS users, to ensure seamless and simple service response. PASSUR will use Mosaic's own 24/7 live technical support capabilities to supplement the front line technical response and troubleshooting.

PASSUR has a deep and longstanding corporate culture of customer service – it is at the core of the company's values and product delivery. Details of PASSUR's technical customer service capabilities are listed below, but here are some of the key elements:

- PASSUR has offered 24/7/ live, U.S. based customer support, provided by experienced PASSUR employees. These dedicated staff members are well trained in all aspects of PASSUR solution delivery and operate from defined, well-practiced internal escalation protocols and customer communication procedures.
- PASSUR is both a radar surveillance and software solutions company. It is unusual in that both of these core company assets are maintained by a direct in-

house team of engineers and service technicians, not outsourced. This provides our customers the assurance of the highest level of maintenance service, delivered by a team that is deeply knowledgeable about the underlying technologies, both the hardware and software that power PASSUR solutions.

- The entire PASSUR surveillance network is 100% remotely monitored and managed through ATT.

D. ***Training***

PASSUR will be the lead company of the PMJV for training. PASSUR has an institutional commitment to and a corporate culture of training – for its employees, contractors, and customers. Over the years, PASSUR has developed an extensive training program, collaborating with professional training organizations, with several goals common to all programs:

- The objectives of any training program are always crystal clear and stated up front.
- Many options for training – in person with SMEs, on webinars with experts and shared presentations, online through web-delivered training courses and instructor recordings, and through printed materials.
- Training is always about operational best practices, how to achieve desired business outcomes, process change management, and software functionality – never just software alone.
- Tests are administered for knowledge retention.
- SMEs, not simply "professional trainers," administer all training.
- Training materials are visually engaging and designed with the best "human factors" in mind.
- Training is "scenario based" whenever possible – lessons that directly reflect are the trainees' work/business environment, with specific examples of how they will put to use the knowledge and tools they have acquired and learned.

PASSUR's customer training programs are an integral part of its solution delivery. PASSUR solution training classes, online live webinars, and online on-demand interactive training programs have been widely accessed by thousands of users over the years. The PMJV companies will work together to incorporate information about MPE and SODAA into the PASSUR training materials, and will rely on PASSUR's training programs for all aspects of training delivered under this proposed effort.

Both companies have well-established training procedures and policies incorporating best practices that apply to internal staff training. Staff is encouraged to seek external training opportunities. Hands-on workshops, thorough documentation and a highly team-oriented environment are used to ensure that knowledge about broad technical topics as well as company-developed software specifics are disseminated. In addition, Mosaic employees participate in a formal mentoring program and conduct code reviews of software to share knowledge of general and technical nature.

E. ***Maintenance***

The companies' professional approach to operations management extends to maintenance. Specific aspects of the combined experience are as follows:

- Full-time managed network – all PASSUR surveillance radar and integral communications infrastructure is remotely managed 24/7 by AT&T, with an established notification and escalation process to address outages and other issues.
- All PASSUR radar surveillance systems and related communications technology are subject to detailed, maintenance protocols, with regularly scheduled site visits to monitor and, as needed, to replace critical components.
- All PASSUR servers, which house data and/or deliver web-based applications such as the SMS, are subject to detailed, regular maintenance protocols.
- For customer reports of a problem, PASSUR has a 24/7 live technical support line. Once a problem is reported, it is funneled into the PASSUR escalation process (defined below) and assigned an internal "trouble ticket" through the Case Management System in Salesforce.com (PASSUR's internal CSR tool).
- PASSUR uses Salesforce.com for customer notification.
- PASSUR uses a number of tools to monitor critical systems including automated tools that generate emails to developers and customer service if an issue arises:
    - Internally, PASSUR uses standard Linux tools and scripts, such as Diskcheck, VM Stat, IO Stat, and Top. The company has also developed scripts that automatically e-mail the results of these processes should they exceed specified tolerances.
- PASSUR has written software programs that:
    - Monitor the health of data feeds and disk sizes.
    - Perform software and database auto-restarts.
    - Send auto e-mail alerts to PASSUR and customer technical and operational personnel to notify about outages.

- Databases are backed up daily; these are incremental backups to external disks.
- Databases are backed up with custom scripts developed internally.
- All data is retained (no destruction). Backup media are stored internally and with an external third-party storage provider.
- Mosaic has a 24/7 managed network with in-house and remote management capabilities.
- Mosaic's systems provide automated notifications of network and server outages.
- Mosaic performs regular hardware and software maintenance on all servers and network devices, internally and on behalf of customers including the FAA.
- Mosaic has a verified daily, weekly, and monthly backup rotation with offsite storage. Failures of any backups are automatically flagged, investigated and corrected.

F. ***Disaster Recovery Plan***

As detailed above, many aviation organizations rely on each of the companies for business-critical and mission-critical solution delivery. The companies' approach to disaster recovery is two-phased, corresponding to the two-phased rollout of the SMS.

In the first phase (Phase A of the deployment of the SMS), the Companies are relying on PASSUR's existing redundancy architecture, which includes a geographically redundant site specifically designed for JFK several years ago in relation to the PASSUR OPSnet system that is being delivered for field condition reporting, snow operations management, and other services. This also includes an existing disaster recovery plan.

In the second phase (corresponding to Phase B of the SMS rollout), an entirely new geographically redundant site will be set up (already planned prior to the SMS RFP). It will reflect an expanded redundant architecture, including automatic hot-standby rollover, as well as a new corresponding disaster recovery plan. The Orlando data and software hosting center is SAS-70 certified; as such, on or before the start of Phase B, PASSUR will provide full SAS-70 certification.

Details of both phases are outlined below in the Disaster Recovery section below.

G. ***Quality and Extent of Financial, Reconciliation and Auditing Procedures***

PASSUR is a publicly traded corporation and is audited in accordance with the standards of the Public Company Accounting Oversight Board (United States). Those standards require that auditors plan and perform the audit to obtain reasonable assurance about

whether the financial statements are free of material misstatement. PASSUR files all quarterly and annual SEC filings required of publicly traded corporations.

Mosaic, as an S Corp primarily in the business of contracting for the government, far exceeds the accounting standards required of it by law. Mosaic employs a full-time Chief Financial Officer whose job it is to ensure that the company exceeds DCAA auditing standards. These standards require not only that the financial accounting is accurate and complete, but also that controls such as automated time sheets and separation of controls are in place to ensure accuracy of the company's records.

H. Prior Experience Between PASSUR/Mosaic

PASSUR and Mosaic have been planning and preparing for a joint response to this RFP for more than five months. This includes the contractual, financial, technical, and product aspects of relationship. Detailed technical specifications have been exchanged between the two companies, and extensive work toward the technical integration of Mosaic capabilities into the PASSUR SMS platform has already begun. The PASSUR/Mosaic integration is planned to proceed independently of the JFK RFP, to become PASSUR's core SMS offering to the aviation market.

I. Quality and Effectiveness of the M/WBE Plan

As indicated below in the M/WBE response, the PMJV are requesting a waiver from the M/WBE requirements for the following reason:

- The overwhelming preponderance of this project is "self-performed" by the PMJV rather than outsourced, and is of a nature that is highly specialized requiring in-house expertise.

J. Mitigation and Elimination of Business Risk

There are several factors that contribute to the strong mitigation/elimination of business risk in selecting the PMJV for the SMS program. First, we're an established, known, successful provider – eliminating any risk inherent in selecting a new vendor. Both PMJV companies have adequate cash flow, reserves, and credit lines available to complete this work, and have in place succession plans to ensure that the work continues in the event that any of the principals of the PMJV become unavailable. The scope, effort, and financial resources required to complete this operation are not greater than work routinely undertaken by each of the companies, and the subject effort is a major strategic thrust that is top priority for the PMJV independent of this RFP. In addition:

- PASSUR has been delivering the current Departure Metering program at JFK – a precursor to the SMS required in this proposal – for one and a half years. In addition, PASSUR has delivered a winter operations program at the Port

Authority for the last eight years. The underlying departure allocation technologies, situational awareness technologies, airspace management technologies, and collaborative communication and coordination technologies, are all tested, vetted, and proven not only at JFK but at many other airports and airlines.

- The professional services team which has designed, implemented, managed, and operated the departure metering program is deeply knowledgeable about the specific JFK surface operation, terminal airspace operation, and all the institutional relationships at JFK (carrier, the Port Authority, FAA, and others). These professionals, as well as those who will be added to the team for the new SMS, have extensive histories in airport operations, airline operations, and ATC operations – including hands-on direct operating experience, uniquely associated with the JFK departure metering program, unlike any other surface program in the U.S. to date.
- The airline community at JFK is very familiar with PASSUR software, processes, and personnel, eliminating risks associated with the introduction of entirely new elements in each of these areas.
- Mosaic is recognized as the foremost provider of advanced surface management technologies, including the most advanced predictive, real-time and post-operational analytics of surface operations. It has been the lead developer on several of the most advanced and successful deployments of surface management decision support systems in the U.S., helping to pioneer many of these core capabilities for the FAA and NASA – capabilities which will be fully implemented into the SMS for JFK.
- PASSUR has more than 30 years of experience in aircraft and airspace surveillance systems and decision support technologies.
- PASSUR has an extensive, experienced customer support team and program, which mitigates risk associated with training, maintenance, and daily end-user support. The customer support and maintenance program also includes extensive remote monitoring and management of all critical system components, allowing PASSUR to prevent problems before they arise.
- The PASSUR collaborative platform, which is a core element of the PASSUR SMS program delivery, was pioneered jointly with the Port Authority, and now is used by 16 airports nationwide and thousands of users around the world, with broad industry support across multiple airlines and airports. This is a proven platform with which the Port Authority is very familiar, and which performs many other operational support functions outside the SMS.

Please see the separate "Business Risk and Succession Plan" submitted as part of this proposal.

III. Management

The commitment to training, customer service and response, and product development driven by commercial market requirements is set at the highest levels of each of the PMJV companies, starting with the President and CEO.

The PASSUR senior management team's history and experience are heavily weighted toward commercial enterprises, not government or R&D, and support a culture of:

- Workable, practical innovations with proven Return on Investment
- Customer-focused product development, highly responsive to the needs of the market
- Highly responsive and developed customer service (including training, maintenance, and technical support)

PASSUR is a commercial, Business-to-Business company. Its record is one of commercially viable, repeatable innovations that are proven in the real-world aviation environment and embraced by dozens of leading aviation organizations.

PASSUR senior leaders are hands-on managers who regularly interact with customers in their operational work environments, at industry conferences and seminars, and at annual user meetings. PASSUR's senior managers are frequent speakers at industry panels and are recognized leaders not only in aviation-related subjects, but also in information management and design, and in predictive analytics.

Similarly, whereas Mosaic principally is a government contractor and derives a large portion of its revenues from R&D projects focused on improving the NAS, one of the key factors responsible for its tremendous growth and success has been the dedication and customer-centric attitude adopted from the top down. The government continues to award contracts to Mosaic largely due to the fact that Mosaic has developed an enviable record of delivering on requirements. This attitude has been proven through Mosaic's ability to satisfy not only government but also commercial customers with demanding requirements.

IV. Technical Customer Service – Capabilities & Experience

Both companies provide live 24/7 customer service staffed by experienced employees, based in the U.S., who are knowledgeable about core company technologies. The PMJV companies' customer service staff:

- Receive regular training on new modules and technical capabilities
- Brief the company each week on key issues and/or initiatives related to customer service
- Have a fully developed technical infrastructure for alerts to outages and a defined escalation procedure, as well as a process for alerting customers through various communications systems

The customer service teams of both companies are supported by a technical infrastructure that:

- Monitors all systems that are critical elements in the delivery of the PMJV solutions, including the 150+ PASSUR radar surveillance systems and their related communications network, multiple additional data feeds, database and application servers, and communication networks into and out of PASSUR.
- Alerts them to critical system component issues automatically, through remote notifications, issue logging and support.

The PASSUR radar surveillance network and related communications infrastructure is 100% managed by AT&T network management services, 24/7.

Customer service functions for the JFK SMS will be provided by the PASSUR customer support team. The PASSUR customer service function is well established and highly competent. The excellent level of customer service is maintained through a number of professional management techniques, including provision of company-wide customer service training, with mandatory attendance for all PASSUR employees, regardless of their job function.

V. Financial Capability

- Both companies of the PMJV have been collectively serving the aviation industry for over 50 years.
- This contract will be a natural and seamless transition, financially and otherwise, for each company.
- With many of the resources already in place, and a well-established relationship and history between PASSUR and the Port Authority, the expansion of additional scope is a natural progression for PASSUR and for the Port Authority.
- PASSUR demonstrates its solid financial position and capability per its public filings. These documents are provided to the Port Authority with this proposal.
- Mosaic demonstrates its solid financial position and capability per its reviewed financial statements also provided to the Port Authority with this proposal.

- PASSUR's past performance and experience with the current SMS contract with the Port Authority has been a successful business venture for PASSUR and the Port Authority.
- Both companies expand on these statements in the Business Risk and Succession Plan section submitted with this proposal.

VI. Management Structure

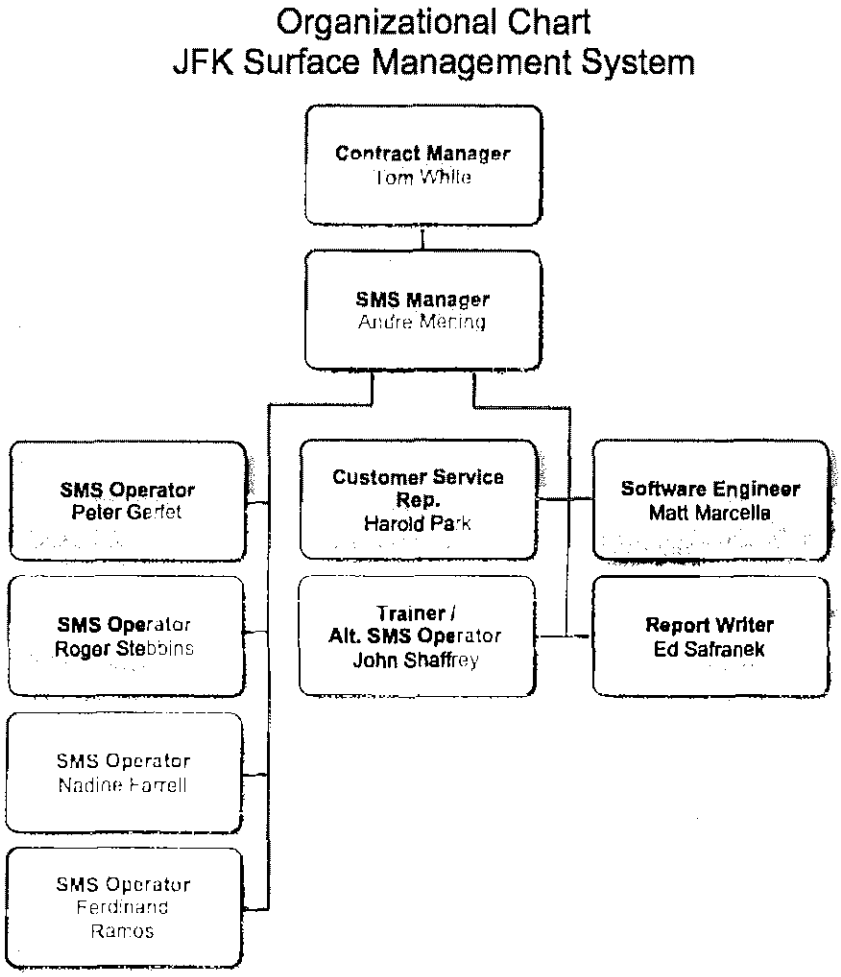
The PMJV companies have an extensive staff of experienced airline, air traffic, airport intelligence, and business aviation professionals, with specific expertise in the operational and business needs, requirements, objectives, and constraints of the aviation industry and surface management in particular. They:

- Understand the external environment in which they operate (the National Airspace System).
- Are able to translate these internal requirements and external conditions into targeted information solutions.
- Are complemented by a technical team of software engineers, data analysts, radar engineers, database architects, physicists, and statisticians, who have years of expertise in managing complex surveillance networks (hardware and software), as well as in interpreting and processing complex, live aviation data feeds into robust decision support software solutions.

A. Project Staff

- The technical staffs of both companies have a depth of experience unmatched in the aviation industry. Many of the companies' software developers, analysts and radar engineers have over 20 years of experience in the aviation market.
- The SMS management and operational staff also have a rich background in the aviation industry, including over 25 years of FAA experience in the New York area air traffic control facilities and the FAA Air Traffic Control System Command Center, and a rich experience in airline operations as well.
- The same managers and operators who designed, implemented, managed, and delivered the current departure metering program at JFK – the natural precursor to the new SMS – will be delivering the JFK SMS as outlined in this proposal.
- Specific experience and capabilities of the PMJV companies' staff supporting the Authority's JFK SMS operations are provided in Sections III and IV above.

B. *Organizational Chart – Project Resources and Support Staff*



VII. SMS Management Team

A. *Contract Manager – Tom White*

Mr. White is a former senior manager at the FAA's New York TRACON with extensive experience in all aspects of complex air and ground traffic operations. While at the Federal Aviation Administration (FAA), he gained extensive experience working with technology partners in developing and implementing delay reduction, airspace efficiency, and collaborative decision making programs. Mr. White brings experience implementing airline SOC technology and process improvement for diversion management and airspace optimization for PASSUR customers, and architecting integrated traffic management solutions for PASSUR. Mr. White is also the architect, in collaboration with the Port

Authority, of the current departure metering program at JFK, operational for the past one and a half years. Mr. White was a Special Operations Army helicopter pilot.

As the Contract Manager, Mr. White will handle all contractual issues and act as the primary point of contact, representing PASSUR to the Port Authority. Through Phase A, he will oversee and supervise the SMS Manager and maintain overall responsibility for all aspects of the implementation effort to ensure that the service is deployed on schedule. As Contract Manager he will work with the SMS Manager to assign team members, SMS Operators, and any other staff necessary, to complete all requirements of this contract and exceed the Port Authority's expectations about PASSUR's customer service and overall delivery of the services. He will ensure that the project scheduling and planning activities implemented in Phases A and B are consistent with the Port Authority's expectations. He will track and report the progress of the development and implementation activities, review the deliverables, and evaluate and mitigate project risks. Mr. White will communicate with SMS stakeholders as required. At the start of the project, Tom White will coordinate a program kick-off meeting to review the project schedules for Phase A and Phase B milestones and deliverables to ensure that PASSUR's priorities are aligned with the Port Authority's expectations.

*B. **SMS Manager – Andre Merling***

Andre Merling has extensive experience in the design and implementation of traffic flow management programs, both airborne and surface. As a core member and/or leader of many of the seminal traffic management design and engineering teams of the past 10 years, he developed key traffic management concepts and capabilities, including Time Based Flow Management (TBFM), Surface Trajectory Based Operations (STBO), Collaborative Departure Queue Management (CDQM), Collaborative Departure Sequencing (CDS), Flight Operator Surface Application (FOSA), Airport Surface and Terminal Airspace Adaptation, Traffic Flow Management (TFM), and Enhanced Substitution Module (ESM).

Mr. Merling also has extensive experience in hands-on management of flight operations and staff, including managing the ATC desk at the system operations centers for two airlines, and managing and deploying various airline ATC-related projects such as flight operations systems, flight planning systems, crew systems, aircraft routing and aircraft performance.

Mr. Merling has been directly involved with flight operations in the New York airspace, and the JFK air and surface operation in particular.

It is anticipated that once the service has been operationally tested and accepted, the SMS Manager will act as the primary point of contact for the Port Authority for all operational

items during the duration of the contract. The SMS Manager will act as the supervisor of the PMJV's highly qualified professionals, the SMS Operators. The SMS Manager is responsible for training the SMS Operators using Port Authority-approved Standard Operating Procedures and for implementing any changes to procedural protocols and/or Systems throughout the life of the Contract. For the initiative to be successful, the Port Authority believes that understanding the needs of the Users is critically important. The SMS Manager will participate in user group meetings at JFK throughout the life of the contract to gain feedback on the quality of the service, outstanding issues, product features, future enhancements, and so forth.

VIII. Staffing Plan, Qualifications & Training Requirements

To meet the requirements and ensure on-time delivery of the above milestone schedules, the PMJV companies have aviation professional resources with directly relevant skill-sets. All management and staff members (collectively, the "Project Staff") assigned to this project have the ability to deal with the customers in a courteous, enthusiastic, and professional manner at all times and will continue to maintain an effective working relationship with the Port Authority, the airlines, and other airport tenants or contractors. The Project Staff skill-sets include strong interpersonal skills to resolve problems and customer complaints with positive results. The Project Staff take pride in their work, their work environment, and in taking care of their customer. The PMJV companies foster a positive work environment that is productive and efficient, and free of workplace violence, harassment, and substance abuse.

A. ***SMS Project Staffing Plan***

The PMJV companies are uniquely qualified to provide an overall staffing plan for the JFK SMS program. Most of the team of SMS Managers and Operators have been working the current JFK metering program since March 1, 2010. These managers and operators understand the airport operation, including runway configurations, gate challenges, and arrival departure characteristics. The PMJV companies have developed extensive Standard Operating Procedures (SOP) for working with the users and operators of the airport.

Based on the hourly requirements stated in the proposal, it is estimated that staffing requirements will be:

Day shift, 7:00 a.m. -10:00 a.m., 3 hours @ 1 operator = 3 hours/day

Eve shift, 2:00 p.m.- 11:00 p.m., 9 hours @ 1 operator = 9 hours/day

Total hours/day=12

Total hours/month=372

Based on these proven staffing numbers the basic work schedule is shown below.

1. Sample Monthly Schedule

Day	1	2	3	4	5	6	7
[redacted]	AM	AM	AM	AM			
SMS Oper 2	PM	PM	PM	PM			
SMS Oper 3					AM	AM	AM
SMS Oper 4					PM	PM	PM

Day	8	9	10	11	12	13	14
[redacted]	PM	PM	PM				
SMS Oper 2	AM	AM	AM				
SMS Oper 3				PM	PM	PM	PM
SMS Oper 4				AM	AM	AM	AM

Day	15	16	17	18	19	20	21
[redacted]	AM	AM	AM	AM			
SMS Oper 2	PM	PM	PM	PM			
SMS Oper 3					AM	AM	AM
SMS Oper 4					PM	PM	PM

	22	23	24	25	26	27	28
[redacted]	PM	PM	PM				
SMS Oper 2	AM	AM	AM				
SMS Oper 3				PM	PM	PM	PM
SMS Oper 4				AM	AM	AM	AM

Day	29	30	31
[redacted]	AM	AM	AM
SMS Oper 2	PM	PM	PM
SMS Oper 3			
SMS Oper 4			

B. ***Qualifications - Project Staff & Supplemental Resources***

SMS Operator(s)

Former FAA Air Traffic Controllers from JFK or other radar facilities, as well as former airline operations specialists with extensive experience in JFK airline stations operations (JetBlue and Delta Air Lines). Extensive knowledge of the JFK daily operation on all runway configurations and weather conditions. Extensive knowledge of FAA traffic flow management and related tools. Excellent communication skills and knowledge of local tools.

Trainer

Air Traffic Flow Management specialist with a background in air traffic control procedures and traffic flow management modernization. Extensive experience as National Operations Manager at FAA command center (ATCSCC), operational lead overseeing all daily aspects of National Air Space (NAS); member of award-winning O'Hare Modernization Plan (OMP) working group.

Senior Software Lead

Vice President, Software Development, PASSUR; Senior programmer and database integrator with extensive experience in developing and overseeing flight tracking, airspace visualization, and key performance indicator dashboard software platforms. In addition, has architected data flow management from PASSUR databases to PASSUR software applications. Many years experience in software development and data management for the financial services industry.

Senior Software Engineer

Senior programmer and system analyst with more than 35 years experience in aviation systems, software, and databases. Extensive experience in complex data flow architecture, system integration, and software programming (back-end and user-interface). Has played central role in development of PASSUR web collaborative decision support platforms, as well as critical flight operations algorithms.

Database Design Engineer

PhD physicist responsible for managing PASSUR's master aviation database, including the output from the international PASSUR surveillance network, multiple additional aviation sensor technologies (ASDE-X, ADS-B via PASSUR Radar), and many other aviation data sources. Also responsible for the development of PASSUR flight tracking and airspace analysis algorithms.

Database Administrator

Programmer, database architect, and systems administrator with extensive experience in large integrated databases and systems. More than 10 years at PASSUR in flight tracking and airspace visualization coding, database management, and systems administration. Previous experience includes extensive work in telecoms and large system integrators.

Surface Management Technology Engineering Specialists

Chief Architect, ATM Systems and Software, Mosaic: Senior software engineer and engineering manager with extensive hands-on and leadership experience architecting, developing, and deploying Air Traffic Management models and decision support systems. Led development of TMA model within NASA's ACES simulation, developed the Flight Operator Surface Application (FOSA) interface, led re-architecture of SDSS model, and spearheaded commercial product development. Additionally manages the software development group at Mosaic.

Principal Analyst, Mosaic: Technical lead and principal software engineer specializing in modeling, analysis and software development. Extensive experience in technical management and in aviation data analysis. Lead for Surface Operations Data Analysis

and Adaptation (SODAA) product. Deep experience with SODAA and with aviation environmental impact software.

Principal Software Engineer, Mosaic: Inventor and lead software architect of NASA SMS, the tool that became SDSS when transitioned to the FAA. Developed core surface model software, and developed interfaces to ASDI, ASDE-X, ETMS, LCSS, STARS, ABESS, CDM, and other systems.

Report Writer

Senior aviation business analyst with extensive experience in airline and airport finances and business administration. Implemented resource and schedule management programs as analyst at a top five U.S. airline, and aviation revenue programs as analyst at a top 10 U.S. airport. Extensive experience analyzing airline flight operations, fleet and schedule data for financial models.

C. *Training Requirements for Technical Employees*

All operators (metering staff) must complete 40 hours of classroom training at the PASSUR technical center in Bohemia, NY. This includes PASSUR company orientation training and PASSUR product training.

It is a requirement that all team members have extensive experience in airport operations, including familiarity with the airport layout related to runways, taxiways, ramps, and all other areas on the Airport Operations Area (AOA), as well as with services provided at airport and airline locations. This includes understanding airline operations, knowledge of airline and airport codes, facility communication including professional telephone conduct, airport terminology – the phonetic alphabet, effective and appropriate oral and interpersonal communications, handling customer complaints, conflict resolution and dealing with irate customers. Team members must demonstrate their ability to understand the above in order to be assessed by careful examination.

The team is trained on required forms and reports. Ethics and Conduct training is conducted. Professional appearance standards are addressed. The team is trained on appropriate emergency procedures and notifications.

Employees have the option to take PASSUR web–based training, designed with the support of a company that specializes in e-learning.

All team members must be fully trained by the Port Authority security office. Two issuing officers regularly enforce the policies of the Port Authority.

Before working, all operators must spend one week observing the operation onsite at the intended place of work (hands-on training) before working live.

D. ***Roles & Responsibilities – Support Team & Supplemental Resources***

The SMS manager will:

- Supervise all activities and assume management responsibilities.
- Ensure that the staff are on post, in compliance with all rules and regulations, and are fulfilling their duties.
- Review operating logs and reports on physical conditions of operation.
- Transmit information between all parties.
- Notify Port Authority Project Manager of any significant problems and unusual or emergency situation.
- Be responsible for the optimum utilization of personnel and other resources on an assigned shift, including assistance in establishing scheduling patterns necessary to meet adequate service standards.
- Train personnel with respect to their functions and responsibilities and evaluate performance.
- Report any unusual incidents or circumstances to the Project Manager or its designee.
- Ensure a prompt compliance with orders, instructions, directions and information from the Port Authority, given in writing or orally regarding the performance of services.
- Manage staff on duty (SMS operators) ensuring that they perform their responsibilities as described below.

The contract manager will:

- Handle all contractual issues.
- Oversee the SMS manager.
- Maintain overall responsibility for all aspects of the implementation effort to ensure that the service is deployed on schedule.
- Work with the SMS Manager to assign team members, SMS Operators, and any other staff necessary.
- Act as primary interface to the Port Authority during the implementation of Phases A and B (as described in attachment C, Scope of Work, and Specifications of the RFP.

The SMS Operator will:

- Act as the primary System Operator during all times the System is in operation.
- Have a thorough working knowledge of Air Traffic Management in the New York Region, particularly with the impact fix and route availability in relation to the health of the surface operation at JFK.
- Allocate slots, based on the departure rate using the slot calculator. This is to be every 15 minutes and needs to be done for all flights two (2) hours in advance of the planned departure time.
- Look at the OIS page (note that a slot is a taxi time and an EDCT is a wheels time) for delay information and plan accordingly.
- Monitor the departure queue to ensure that, at all times, there are an appropriate number of flights.
- Make adjustments to future slots if necessary (e.g., if the queue becomes too long).
- Swap flights within a terminal (e.g., Delta asks to swap the slot given for DL138 with the slot given for DL79).
- Change slot times when requested.
- Initiate conversation, post information, and respond using the chat room window.
- Resolve flights manually that did not get automatically removed from the Departure Slot Allocator screen (this applies to flights that have a filed flight plan with a flight ID different from the airline's posted schedule).

The Trainer will:

- Implement a training plan.
- Conduct training in classroom settings for the PMJV staff based on the training plan to a proficiency level commensurate to specific job functions and designated system user level.
- Conduct training onsite at JFK for the PMJV staff based on the training plan.
- Conduct training for the airport (airline) community based on the training plan to a proficiency level commensurate to specific job functions and designated system user level.
- Administer examinations based on the training plan.

The Software Engineer will:

- Lead the project team in the design and management of changes to baseline SMS products and implementations.

The Customer Service Representative will:

- Be the primary point of contact for the users to communicate observed anomalies of degradations.
- Maintain 24/7 availability coverage via telephone on the PASSUR 24-hour customer support line.
- Answer technical and operational questions from both PMJV staff and the airport community.
- Train all existing and new customer service representatives on procedures for servicing users.
- Lead the administration of additions, deletions, or modifications to any User profile.

The Report Writer will:

- Provide end-user training on report writing software and support users in ad-hoc report creation.
- Work closely with end users to gather report requirements.
- Ensure proper testing/validation.
- Document created reports and changes to existing reports.

E. ***Location, Availability & Response***

The PMJV will utilize PASSUR's technical center, located in Bohemia, NY, less than one-hour away from JFK airport. The close proximity enables our skilled staff to be just minutes away from any repair needed at the customer site and enables us to easily meet the availability and response time requirements of the RFP. Senior PASSUR management is located in Stamford, CT, about one hour from JFK depending on traffic, and can also be deployed for onsite meetings or other supervisory management requirements of the SMS as needed.

IX. The Companies' Procedures & Policies – Pre-employment

The PMJV companies strive for all of their employees, officers, and directors to conduct business in accordance with applicable laws, rules, and regulations and to maintain the highest standards of ethical conduct, fair dealing, and honesty.

The pre-employment procedures of PASSUR will govern induction of employees onto the PMJV operational team. Prior to becoming an employee of PASSUR, a job-related background check is conducted. In support of PASSUR's zero-tolerance Violence in the Workplace Policy, PASSUR conducts a pre-employment criminal check. When appropriate, the criminal record is checked to protect PASSUR's interest and that of its employees and customers. A 10-year nationwide criminal background check is also performed, which consists of prior employment verification, professional reference checks, credit check, and education confirmation. For employees dedicated to the SMS project, whether full- or part-time, the PMJV will utilize the Secure Worker Access Consortium (SWAC) to perform the background screenings. Additionally, the PMJV companies will contract with third-party laboratories which are convenient to candidates and employees to complete an initial 10-panel drug screening prior to starting their position on the project, and as periodically requested by the Port Authority's Project Manager.

Upon successful completion of the relevant background and drug screenings, all employees, officers, and directors of the PMJV companies are given orientation training to ensure their understanding of the various corporate policies. PASSUR employees are trained to ensure understanding of the Code of Business Conduct and Ethics (the "Code") with which they are responsible for complying. PASSUR adopted the Code in order to ensure that the PMJV's employees, officers, and directors adhere to the company's standards of conducting its business and affairs in accordance with applicable laws, rules and regulations and of maintaining the highest standards of ethical conduct, fair dealing and honesty. Employees of both companies involved with the SMS will follow the Code.

X. Project Site Safety & Emergency Procedures

Along with the emergency procedures covered in the companies' orientations, the companies will rely on the section for Emergency Response Procedures written by PASSUR into the current JFK SMS Standard Operating Procedures document, available upon request.

XI. Disaster Recovery

The PMJV will address disaster recovery in a two-step approach, coinciding with commencement of Phase A and Phase B. PASSUR's current Disaster Recovery Plan (DRP) is provided below. Please note that this plan will only be in place for Phase A, as a separate disaster recovery system will be employed for Phase B, which will include the PASSUR main hosting facility being SAS-70 certified.

The details of the Phase B DRP can be found in the system architecture document. The JFK SMS Standard Operating Procedures shall be updated to reflect the appropriate Disaster Recovery Plan in effect during each Operational Phase.

All data and software for the SMS is hosted at PASSUR facilities.

A. ***Disaster Recovery Plan – Phase A***

PASSUR's Disaster Recovery Plan (DRP) has been developed and will be relied on by the Companies in Phase A to provide that they are fully prepared for, and are able to respond to, any natural or manmade business interruption. Good planning and preparation will enable a rapid return to normal business should an interruption occur.

One important element of the DRP is the existing geographic redundancy at the Port Authority-dedicated secondary PASSUR OPSnet server located at the AT&T facility in New York, NY. This provides automated rollover to a mirrored server in the event that the primary server located in Bohemia is disabled.

Other elements of the existing PASSUR redundancy infrastructure – including redundant Internet Service providers and fully backed-up databases and servers – are detailed in the technical proposal document, and also form part of the current DRP.

Person in Charge of Disaster Recovery Plan

The Chief Financial Officer (CFO) of PASSUR is in charge of the DRP. PASSUR's Chief Executive Officer is the alternate should the CFO not be available.

Emergency Response Team

Below is a list of PMJV's Emergency Response Team. In the event of a disaster, all team members will be contacted, in the order they appear in the following contact list.

Emergency Response Team		
Name	**Title**	**Contact Number**
Jeff Devaney	CFO, PASSUR	203-969-4031 (c)
Jim Barry	President & CEO, PASSUR	203-215-7047 (c)
Jim Cole	Sr. Vice President and the Director of R&D, PASSUR	631-751-4927 (c)
Matt Marcella	Vice President Software Development	516-481-1344 (h)
John Keller	Executive Vice President and a Director	516-527-6326 (h)

Tom White	Senior Vice President of Technology and Air Traffic Management	516-662-5331 (c)
Tim Grovac	Director, IT	703-622-5771 (c)
Ron Dunsky	Senior Vice President of Marketing	917-587-9672 (c)

Critical Business Risks

- Windstorm
- Hurricane
- Winter storms
- Lighting
- Flood
- Fire
- Terrorism

Equipment

PASSUR will provide sufficient hardware should a duplicate system be required.

In the event that the Bohemia location becomes disabled

1. **Contact Emergency Response Team and meet at Bohemia location to determine the following:**
    - Determine which systems are out of service.
    - Conduct a detailed analysis of the extent of damage to server room and entire facility.
    - Determine how long it will take to restore service to customers.
    - Determine when software development team will be operational.
    - Contact other emergency contacts, to include AT&T, realtor, Dell, and as determined by the Emergency Response Team.
2. **Notify status of SMS services to customers through our emergency response system.** Several people in the company are trained on this system.

3. **Make decision to repair existing location or move to a new location:** If the decision is to repair the Bohemia, NY, facility:
    - First, consult with Technical team. Then, with their approval, order necessary computer equipment.
    - Order any communications equipment and lines necessary.
    - Check that electrical power, heat, air conditioning, and security are operational.

4. **Decision to move to another facility local to the Bohemia office:**

    After consulting with Emergency Response Team, contact realtor (See Resources) with the following building requirements:

    1. Loading dock and/or bay door
    2 Power - 500 Amp service minimum
    3. A/C & heat throughout
    4. Restrooms
    5. Internet wired offices
    6. Conference room
    7. Bldg. security system
    8. Sprinkler system
    9. Telecommunication –Fiber lines in place provided by Verizon
    10. Electrical drops and power for workbenches
    11. Telephone system
    12. Access to the roof from inside the building to mount PASSUR antennas
    13. Server Room

    Following the above, select new facility that best fits our list of criteria, as determined by Emergency Response Team.

5. **Purchase of replacement computer equipment**

    Dell computer has a list of computer equipment in PASSUR's customer file.

    In the case of an emergency, Dell will expedite machines through the manufacturing process and ship all equipment next day (should the equipment be available for shipment).

6. **AT&T frames – getting the frame network up and running ASAP**

   Highest priority, because of the long lead-time, is getting the frame relay/and or MPLS network up and running as soon as possible.

7. **Offsite software**

   a. All critical software will be kept offsite and immediately accessible.

   b. The following people have access to the storage vault:

      Jim Cole

      Matt Marcella

      Jeff Devaney

      Rich Pawson

   c. Storage company: Underground Vaults & Storage, Inc.

B. ***Disaster Recovery Plan – Phase B***

The Disaster Recovery Plan as described and in place for Phase A will continue in effect until the PMJV has provided for the additional capabilities in the system architecture as provided in the Technical Proposal to support redundancies, have tested the new system, completed the documentation, and acquired the Authority's approval.

XII. Anticipated Resources Provided by the Port Authority

The PMJV does not anticipate that any additional Port Authority resources shall be needed, other than what is currently provided.

A. ***Human Resources***

None.

B. ***Equipment & Facilities***

Per the project site tour on June 17, 2011, the PMJV anticipates that the facility, which the Port Authority is currently providing, inclusive of utilities, will continue to be provided for the PMJV companies' employees to perform the SMS operations. In addition, this proposal assumes that the Authority will continue to provide PASSUR OPSnet access via its existing contract for such.

XIII. Project Schedules (Gantt Charts)

It is anticipated that several elements of the project delivery timeline can be accelerated, allowing earlier deployment of Phase A, since there is already extensive familiarity of both the SMS operators and the end-user community with the existing PASSUR software

platform, departure metering rationing, management protocols and practices, and the existing software platform. These elements include:

- Pre-acceptance and acceptance tests can be limited to only those enhancements and new capabilities that the PMJV will add to existing software for Phase A. The customer has already accepted all other operational parts of the software that has successfully been running for more than one and a half years.
- Operational test – The 14-day operational test can be reduced to reflect only new capabilities, since the core platform has been successfully operational for the existing program.
- Training – Both SMS operators and end users are already trained and competent on the existing software base and would only need to be trained in the new enhancements.

The project plans appended below show the performance of *all* of the elements in the project implementation specified in the Scope of Work, Attachment C, Sections VII and VIII. However, in conjunction and consultation with the Port Authority and other relevant stakeholders, a number of the elements specified in these sections may be eliminated, to the benefit of all users, through a more speedy and rapid deployment (and seamless transition from the current SMS/Metering program).

The Contract and SMS Managers will work together to plan the resources, manage performance of the tasks, develop the enhanced capabilities, produce the documentation, and perform training as further defined in the Scope of Work and per the project milestone schedules below.

A. ***Milestone Schedule - Phase A***

See Exhibit A attached hereto.

B. ***Milestone Schedule - Phase B***

See Exhibit A attached hereto.

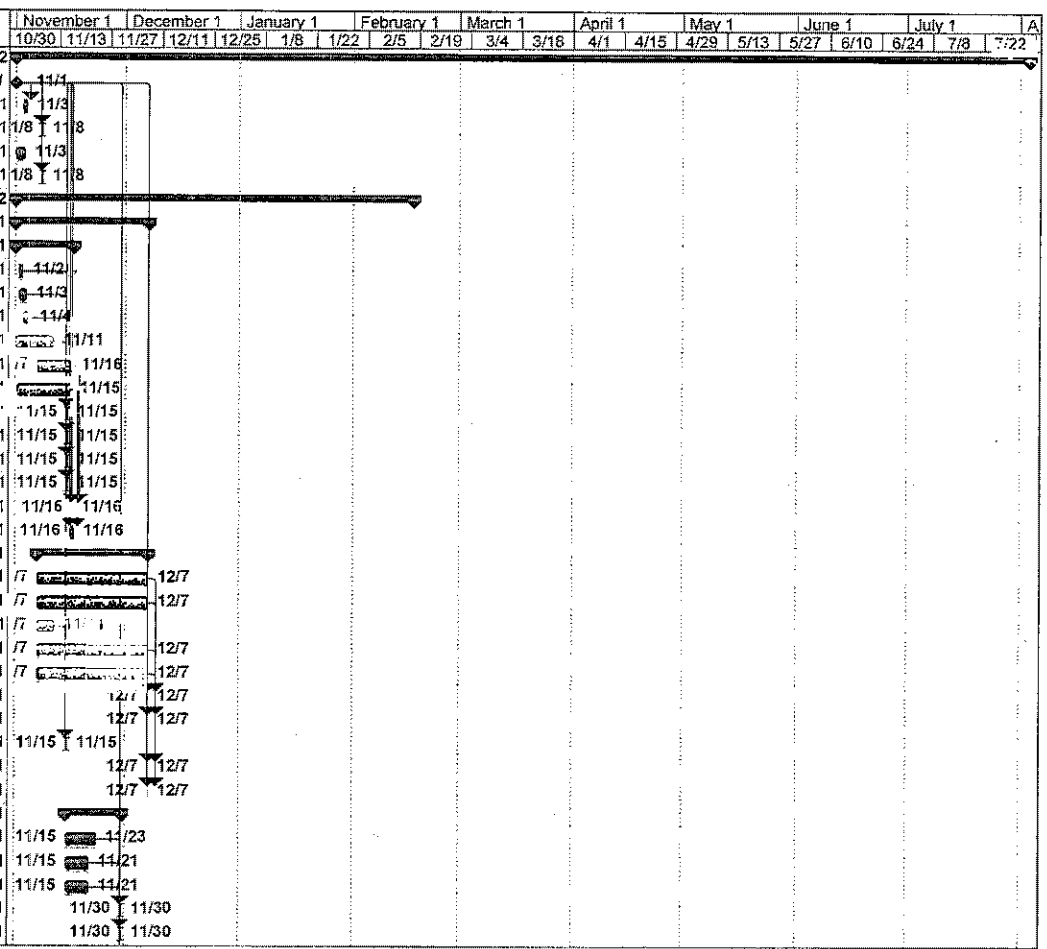
XIV. **Certified Environmentally Preferable Products/Practices**

See Exhibit B attached hereto.

Exhibit A

Project Schedule Phases A & B

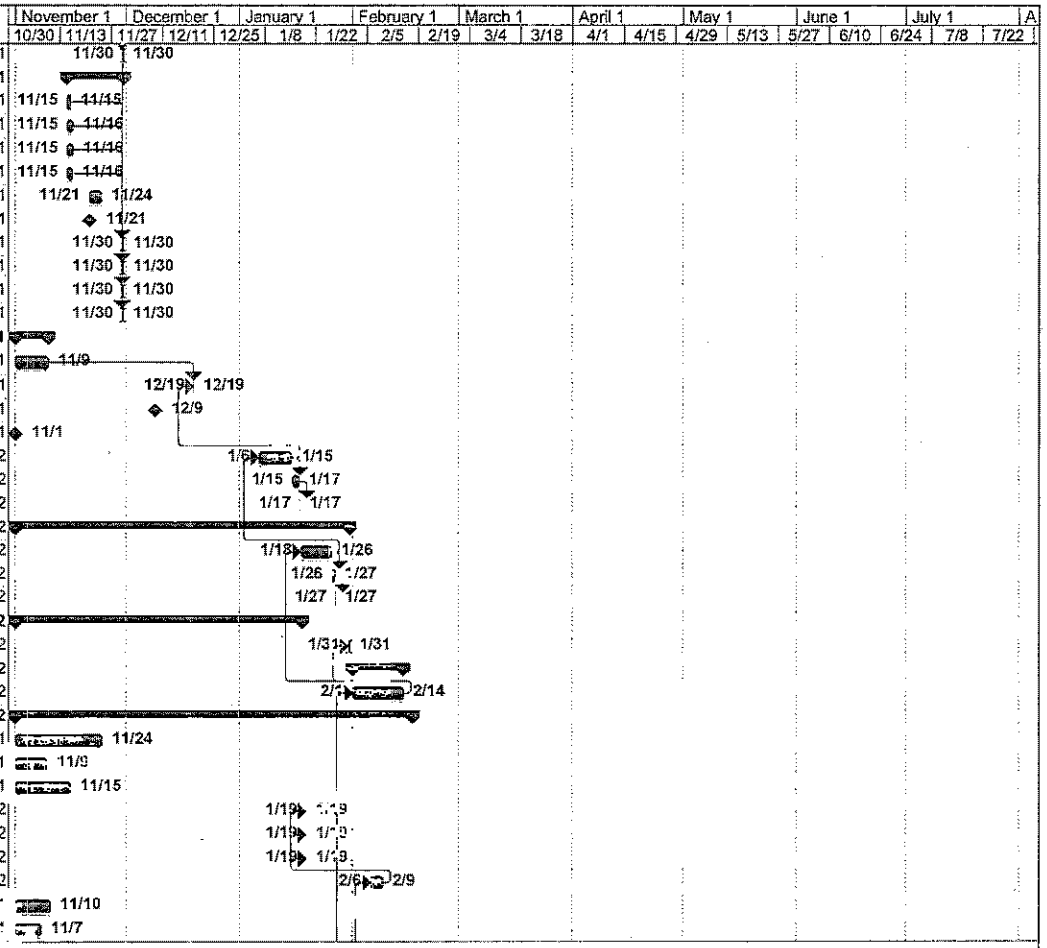
ID	Task Name	Start	Finish
1	**JFK SMS Program**	**Tue 11/1/11**	**Fri 8/3/12**
2	Contract Award	*Tue 11/1/11*	*Tue 11/1/11*
3	*Conduct Kick-Off meeting*	Thu 11/3/11	Thu 11/3/11
4	Deliver Proof of Insurance Certificate	Tue 11/8/11	Tue 11/8/11
5	Develop Project Plan and Schedule	Tue 11/1/11	Thu 11/3/11
6	*Deliver Project Plan and Schedule*	Tue 11/8/11	Tue 11/8/11
7	**PHASE A**	**Tue 11/1/11**	**Fri 2/17/12**
8	**System Documentation**	**Tue 11/1/11**	**Wed 12/7/11**
9	**Security Practices and Policies**	**Tue 11/1/11**	**Wed 11/16/11**
10	Write Executive Summary	Wed 11/2/11	Wed 11/2/11
11	Write Design Overview	Wed 11/2/11	Thu 11/3/11
12	Write Functional Description	Thu 11/3/11	Fri 11/4/11
13	Write System Architecture	Tue 11/1/11	Fri 11/11/11
14	Write Failure Handling and Recovery	Mon 11/7/11	Wed 11/16/11
15	Write Security Policy and Practices	Tue 11/1/11	Tue 11/15/11
16	*Deliver Executive Summary*	Tue 11/15/11	Tue 11/15/11
17	*Deliver Design Overview*	Tue 11/15/11	Tue 11/15/11
18	*Deliver Functional Description*	Tue 11/15/11	Tue 11/15/11
19	*Deliver System Architecture*	Tue 11/15/11	Tue 11/15/11
20	*Deliver Failure Handling and Recovery*	Wed 11/16/11	Wed 11/16/11
21	*Deliver Security Policy and Practices*	Wed 11/16/11	Wed 11/16/11
22	**Narratives**	**Mon 11/7/11**	**Wed 12/7/11**
23	Write Report Formats	Mon 11/7/11	Wed 12/7/11
24	Write Screen Layouts	Mon 11/7/11	Wed 12/7/11
25	Write Matrix of Access Restrictions	Mon 11/7/11	Fri 11/11/11
26	Write Data Loading Analysis	Mon 11/7/11	Wed 12/7/11
27	Write Requirements Matrix	Mon 11/7/11	Wed 12/7/11
28	*Deliver Report Formats*	Wed 12/7/11	Wed 12/7/11
29	*Deliver Screen Layouts*	Wed 12/7/11	Wed 12/7/11
30	*Deliver Matrix of Access Restrictions*	Tue 11/15/11	Tue 11/15/11
31	*Deliver Data Loading Analysis*	Wed 12/7/11	Wed 12/7/11
32	*Deliver Requirements Matrix*	Wed 12/7/11	Wed 12/7/11
33	**Engineering Documents**	**Tue 11/15/11**	**Wed 11/30/11**
34	Write System Block Diagram	Tue 11/15/11	Wed 11/23/11
35	Write Connectivity Diagram	Tue 11/15/11	Mon 11/21/11
36	Write Schematic Diagrams	Tue 11/15/11	Mon 11/21/11
37	*Deliver System Block Diagram*	Wed 11/30/11	Wed 11/30/11
38	*Deliver Connectivity Diagram*	Wed 11/30/11	Wed 11/30/11



Project: JFK SMS Project Plan 6-21-1
Date: Wed 7/27/11

Task		Summary		Rolled Up Progress		Project Summary	
Progress		Rolled Up Task		Split		Group By Summary	
Milestone	◆	Rolled Up Milestone	◇	External Tasks		Deadline	

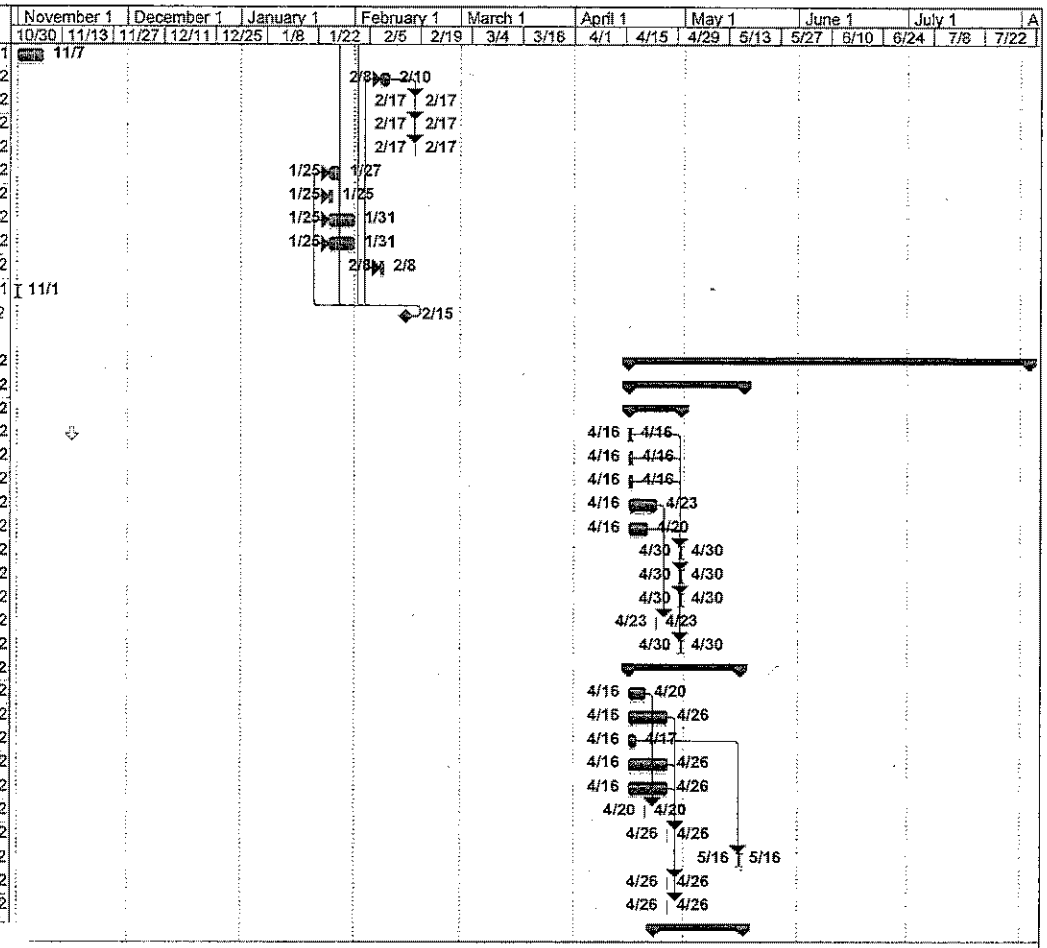
ID	Task Name	Start	Finish
39	*Deliver Schematic diagrams*	Wed 11/30/11	Wed 11/30/11
40	**Hardware Documentation**	**Tue 11/15/11**	**Wed 11/30/11**
41	Write Hardware Specifications	Tue 11/15/11	Tue 11/15/11
42	Write Component Drawings	Tue 11/15/11	Wed 11/16/11
43	Write Computer Hardware Requirements	Tue 11/15/11	Wed 11/16/11
44	Write Commercial off-the-shelf Products	Tue 11/15/11	Wed 11/16/11
45	Write Disaster Recovery Site Plan	Mon 11/21/11	Thu 11/24/11
46	*Write Audit Report*	Mon 11/21/11	Mon 11/21/11
47	*Deliver Hardware Specifications*	Wed 11/30/11	Wed 11/30/11
48	*Deliver Component Drawings*	Wed 11/30/11	Wed 11/30/11
49	*Deliver Computer Hardware Requirements*	Wed 11/30/11	Wed 11/30/11
50	*Deliver Commercial off-the-shelf Products*	Wed 11/30/11	Wed 11/30/11
51	**Pre-Acceptance Test**	**Tue 11/1/11**	**Wed 11/9/11**
52	Write Acceptance Test Plans	Tue 11/1/11	Wed 11/9/11
53	*Deliver Test Plans*	Mon 12/19/11	Mon 12/19/11
54	*Deliver Disaster Recovery Site Plan*	Fri 12/9/11	Fri 12/9/11
55	*Deliver Audit Report*	Tue 11/1/11	Tue 11/1/11
56	Conduct Pre-acceptance test	Fri 1/6/12	Sun 1/15/12
57	Document Test Results	Sun 1/15/12	Tue 1/17/12
58	*Deliver Test Results*	Tue 1/17/12	Tue 1/17/12
59	**Acceptance Test**	**Tue 11/1/11**	**Tue 1/31/12**
60	Conduct Acceptance test	Wed 1/18/12	Thu 1/26/12
61	Document Test Results	Thu 1/26/12	Fri 1/27/12
62	*Deliver Test Results*	Fri 1/27/12	Fri 1/27/12
63	**Database Documentation**	**Tue 11/1/11**	**Wed 1/18/12**
75	*Deliver Change Management procedures*	Tue 1/31/12	Tue 1/31/12
76	**Operational Test**	**Wed 2/1/12**	**Tue 2/14/12**
77	Conduct Operational Test	Wed 2/1/12	Tue 2/14/12
78	**Training**	**Tue 11/1/11**	**Fri 2/17/12**
79	Write Training Plan	Tue 11/1/11	Thu 11/24/11
80	Develop Training Schedule	Tue 11/1/11	Wed 11/9/11
81	Develop Post-training and/or on-the-job technical referenc	Tue 11/1/11	Tue 11/15/11
82	*Deliver Training Plan*	Thu 1/19/12	Thu 1/19/12
83	*Deliver Training Schedule*	Thu 1/19/12	Thu 1/19/12
84	*Deliver Technical Reference Guides*	Thu 1/19/12	Thu 1/19/12
85	Provide 2 Customer Training Sessions	Mon 2/6/12	Thu 2/9/12
86	Write Operations Manuals	Tue [illegible]	Fri 11/10/11
87	Write Applications Administration Manuals	Tue 11/1/11	Mon 11/7/11



Project: JFK SMS Project Plan 6-21-1
Date: Wed 7/27/11

Task		Summary		Rolled Up Progress		Project Summary	
Progress		Rolled Up Task		Split		Group By Summary	
Milestone		Rolled Up Milestone		External Tasks		Deadline	

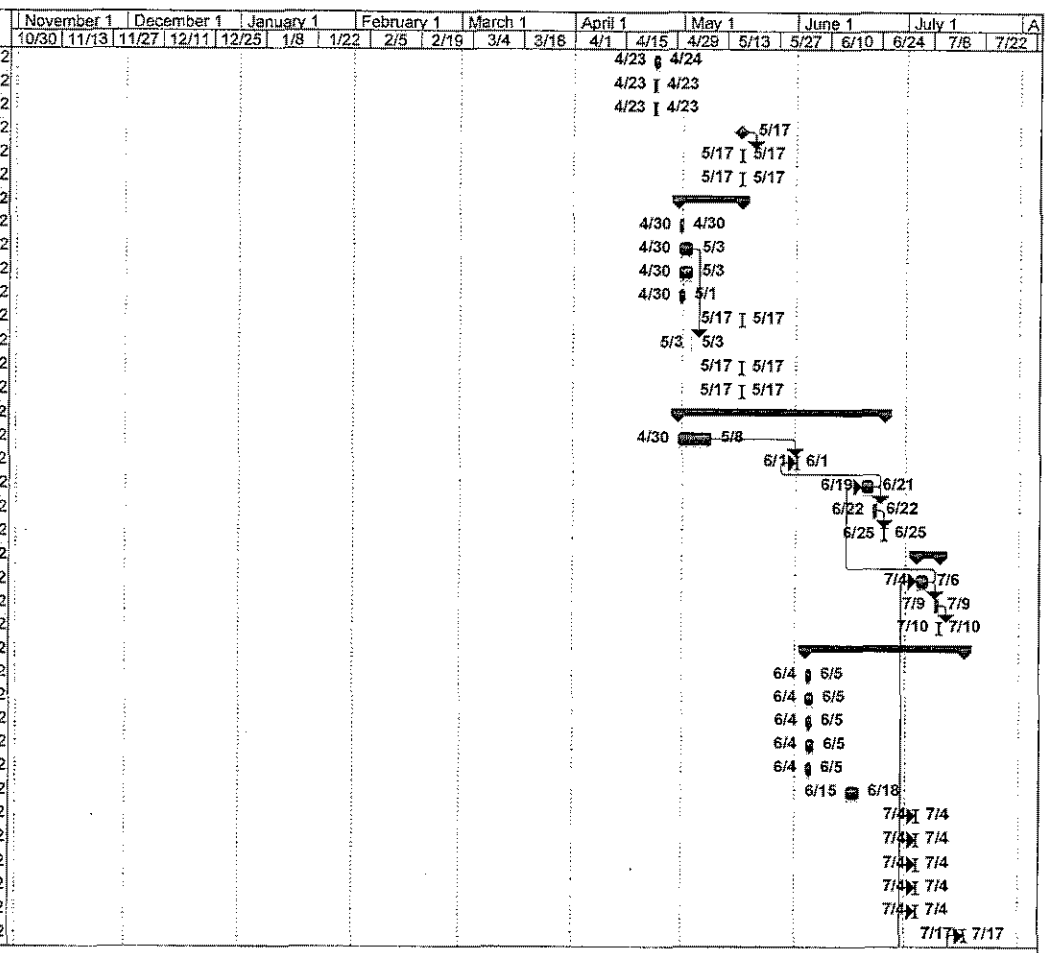
ID	Task Name	Start	Finish
88	Write System Administration Manuals	Tue 11/1/11	Mon 11/7/11
89	Conduct Terminal Training Coach Sessions	Wed 2/8/12	Fri 2/10/12
90	*Deliver Operations Manuals*	Fri 2/17/12	Fri 2/17/12
91	*Deliver Applications Administration Manuals*	Fri 2/17/12	Fri 2/17/12
92	*Deliver System Administration Manuals*	Fri 2/17/12	Fri 2/17/12
93	SMS Employee Training (Surface Mgmt System)	Wed 1/25/12	Fri 1/27/12
94	*Deliver Resumes of SMS Personnel*	Wed 1/25/12	Wed 1/25/12
95	Complete Security Training	Wed 1/25/12	Tue 1/31/12
96	SMS Employees Complete Physical/drug Test	Wed 1/25/12	Tue 1/31/12
97	Provide Cell Phone for SMS Manager	Wed 2/8/12	Wed 2/8/12
98	*Designate Alternate SMS Manager*	Tue 11/1/11	Tue 11/1/11
99	*Phase A Operational*	*Wed 2/15/12*	*Wed 2/15/12*
100			
101	**PHASE B**	**Mon 4/16/12**	**Fri 8/3/12**
102	**System Documentation**	**Mon 4/16/12**	**Thu 5/17/12**
103	**Security Practices and Policies**	**Mon 4/16/12**	**Mon 4/30/12**
104	Revise Executive Summary	Mon 4/16/12	Mon 4/16/12
105	Revise Design Overview	Mon 4/16/12	Mon 4/16/12
106	Revise Functional Description	Mon 4/16/12	Mon 4/16/12
107	Revise System Architecture	Mon 4/16/12	Mon 4/23/12
108	Revise Failure Handling and Recovery	Mon 4/16/12	Fri 4/20/12
109	*Deliver Executive Summary*	Mon 4/30/12	Mon 4/30/12
110	*Deliver Design Overview*	Mon 4/30/12	Mon 4/30/12
111	*Deliver Functional Description*	Mon 4/30/12	Mon 4/30/12
112	*Deliver System Architecture*	Mon 4/23/12	Mon 4/23/12
113	*Deliver Failure Handling and Recovery*	Mon 4/30/12	Mon 4/30/12
114	**Narratives**	**Mon 4/16/12**	**Wed 5/16/12**
115	Revise Report Formats	Mon 4/16/12	Fri 4/20/12
116	Revise Screen Layouts	Mon 4/16/12	Thu 4/26/12
117	Revise Matrix of Access Restrictions	Mon 4/16/12	Tue 4/17/12
118	Revise Data Loading Analysis	Mon 4/16/12	Thu 4/26/12
119	Revise Requirements Matrix	Mon 4/16/12	Thu 4/26/12
120	*Deliver Report Formats*	Fri 4/20/12	Fri 4/20/12
121	*Deliver Screen Layouts*	Thu 4/26/12	Thu 4/26/12
122	*Deliver Matrix of Access Restrictions*	Wed 5/16/12	Wed 5/16/12
123	*Deliver Data Loading Analysis*	Thu 4/26/12	Thu 4/26/12
124	*Deliver Requirements Matrix*	Thu 4/26/12	Thu 4/26/12
125	**Engineering Documents**	**Mon 4/23/12**	**Thu 5/17/1**



Project: JFK SMS Project Plan 6-21-1
Date: Wed 7/27/11

Task		Summary		Rolled Up Progress		Project Summary	
Progress		Rolled Up Task		Split		Group By Summary	
Milestone		Rolled Up Milestone		External Tasks		Deadline	

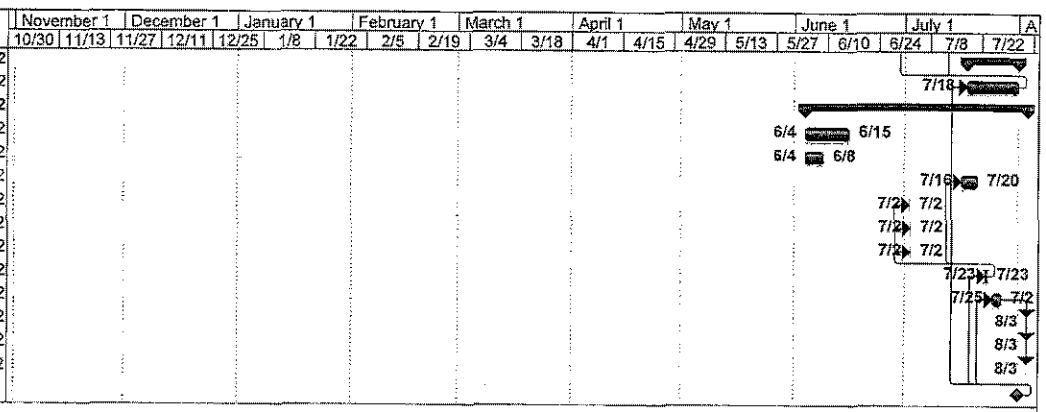
ID	Task Name	Start	Finish
126	Revise System Block Diagram	Mon 4/23/12	Tue 4/24/12
127	Revise Connectivity Diagram	Mon 4/23/12	Mon 4/23/12
128	Revise Schematic Diagrams	Mon 4/23/12	Mon 4/23/12
129	*Deliver System Block Diagram*	Thu 5/17/12	Thu 5/17/12
130	*Deliver Connectivity Diagram*	Thu 5/17/12	Thu 5/17/12
131	*Deliver Schematic Diagrams*	Thu 5/17/12	Thu 5/17/12
132	**Hardware Documentation**	**Mon 4/30/12**	**Thu 5/17/12**
133	Revise Hardware Specifications	Mon 4/30/12	Mon 4/30/12
134	Revise Component Drawings	Mon 4/30/12	Thu 5/3/12
135	Revise Computer Hardware Requirements	Mon 4/30/12	Thu 5/3/12
136	Revise Commercial Off-the-shelf Products	Mon 4/30/12	Tue 5/1/12
137	*Deliver Hardware Specifications*	Thu 5/17/12	Thu 5/17/12
138	*Deliver Component Drawings*	Thu 5/3/12	Thu 5/3/12
139	*Deliver Computer Hardware Requirements*	Thu 5/17/12	Thu 5/17/12
140	*Deliver Commercial Off-the-shelf Products*	Thu 5/17/12	Thu 5/17/12
141	**Pre-Acceptance Test**	**Mon 4/30/12**	**Mon 6/25/12**
142	Revise Acceptance Test Plans	Mon 4/30/12	Tue 5/8/12
143	*Deliver Test Plans*	Fri 6/1/12	Fri 6/1/12
144	*Conduct Pre-acceptance Test*	Tue 6/19/12	Thu 6/21/12
145	Document Test Results	Fri 6/22/12	Fri 6/22/12
146	*Deliver Test Results*	Mon 6/25/12	Mon 6/25/12
147	**Acceptance Test**	**Wed 7/4/12**	**Tue 7/10/12**
148	*Conduct Acceptance Test*	Wed 7/4/12	Fri 7/6/12
149	Document Test Results	Mon 7/9/12	Mon 7/9/12
150	*Deliver Test Results*	Tue 7/10/12	Tue 7/10/12
151	**Database Documentation**	**Mon 6/4/12**	**Tue 7/17/12**
152	Revise Database Schema	Mon 6/4/12	Tue 6/5/12
153	Revise Data Dictionary	Mon 6/4/12	Tue 6/5/12
154	Revise Data Storage Analysis	Mon 6/4/12	Tue 6/5/12
155	Revise Data Flow Diagram	Mon 6/4/12	Tue 6/5/12
156	Revise Entity-Relationship Diagram	Mon 6/4/12	Tue 6/5/12
157	Revise Change Management Procedures	Fri 6/15/12	Mon 6/18/12
158	*Deliver Database Schema*	Wed 7/4/12	Wed 7/4/12
159	*Deliver Data Dictionary*	Wed 7/4/12	Wed 7/4/12
160	*Deliver Data Storage Analysis*	Wed 7/4/12	Wed 7/4/12
161	*Deliver Data Flow Diagram*	Wed 7/4/12	Wed 7/4/12
162	*Deliver Entity-Relationship Diagram*	Wed 7/4/12	Wed 7/4/12
163	*Deliver Change Management procedures*	Tue 7/17/12	Tue 7/17/12



Project: JFK SMS Project Plan 6-21-1
Date: Wed 7/27/11

Task		Summary		Rolled Up Progress		Project Summary	
Progress		Rolled Up Task		Split		Group By Summary	
Milestone	◆	Rolled Up Milestone	◇	External Tasks		Deadline	

ID	Task Name	Start	Finish
164	**Operational Test**	**Wed 7/18/12**	**Tue 7/31/12**
165	*Conduct Operational Test*	Wed 7/18/12	Tue 7/31/12
166	**Training**	**Mon 6/4/12**	**Fri 8/3/12**
167	Revise Training Plan	Mon 6/4/12	Fri 6/15/12
168	Develop Training Schedule	Mon 6/4/12	Fri 6/8/12
169	Develop Post-training and/or on-the-job Technical Referer	Mon 7/16/12	Fri 7/20/12
170	*Deliver Training Plan*	Mon 7/2/12	Mon 7/2/12
171	*Deliver Training Schedule*	Mon 7/2/12	Mon 7/2/12
172	*Deliver Technical Reference Guides*	Mon 7/2/12	Mon 7/2/12
173	*Conduct 2 Customer Training Sessions*	Mon 7/23/12	Mon 7/23/12
174	*Conduct 9 Terminal Training Coach Sessions*	Wed 7/25/12	Fri 7/27/12
175	*Deliver Operations Manuals*	Fri 8/3/12	Fri 8/3/12
176	*Deliver Applications Administration Manuals*	Fri 8/3/12	Fri 8/3/12
177	*Deliver System Administration Manuals*	Fri 8/3/12	Fri 8/3/12
178	*Phase B Operational*	*Wed 8/1/12*	*Wed 8/1/12*



Project: JFK SMS Project Plan 6-21-1
Date: Wed 7/27/11

Task	Summary	Rolled Up Progress	Project Summary
Progress	Rolled Up Task	Split	Group By Summary
Milestone	Rolled Up Milestone	External Tasks	Deadline

Exhibit B

Certified Environmentally Preferable Products/Practices Form

ATTACHMENT G - Certified Environmentally Preferable Products/Practices

Proposer Name: PASSUR Aerospace Inc **Date:** July 11, 2011

In line with the Port Authority's efforts to promote products and practices which reduce our impact on the environment and human health, Proposers are encouraged to provide information regarding their environmentally preferable/sustainable business practices as they relate to this contract wherever possible. Proposers **must** complete this form and submit it with their response, if appropriate. Proposers **must** submit appropriate documentation to support the items for which the Proposer indicates a "Yes" and present this documentation in the proper sequence of this Attachment.

1. Packaging

Has the Proposer implemented any of the following environmental initiatives? **(A checkmark indicates "Yes")**

____ Use of corrugated materials that exceed the EPA recommended post-consumer recycled content

____ Use of other packaging materials that contain recycled content and are recyclable in most local programs

____ Promotes waste prevention and source reduction by reducing the extent of the packaging and/or offering
packaging take-back services, or shipping carton return

____ Reduces or eliminates materials which have been bleached with chlorine or chlorine derivatives

____ Eliminates any packaging that may contain polyvinyl chloride (PVC), or polystyrene or heavy metals

If yes, a description of the practices being followed must be included with the submission.

2. Business Practices / Operations / Manufacturing

Does the Proposer engage in practices that serve to reduce or minimize an impact to the environment, including, but not necessarily limited to, the following items? **(A checkmark indicates "Yes")**

____ Recycles materials in the warehouse or other operations

____ Use of alternative fuel vehicles or vehicles equipped with diesel emission control devices for delivery or transportation purposes

____ Use of energy efficient office equipment or signage or the incorporation of green building design elements

____ Use of recycled paper (that meets federal specifications) in their marketing and/or resource materials

____ Other sustainable initiative

If yes, a description of the practices being followed must be included with the submission.

3. Training and Education

Does the Proposer conduct/offer a program to train or inform customers and employees of the environmental benefits of the products to be offered under this contract, and/or does the Proposer conduct environmental training of its own staff?

☐ Yes ☐ No If yes, Proposer must attach a description of the training offered and the specific criteria targeted by the training.

4. Certifications

Has the Proposer or any of its manufacturers and/or subcontractors obtained any of the following product / industry certifications? **(A checkmark indicates "Yes")**

____ ISO 14000 or adopted some other equivalent environmental management system

____ Other industry environmental standards (where applicable), such as the CERES principles, LEED Certification, C2C Protocol, Responsible Care Codes of Practice or other similar standards

____ Third Party product certifications such as Green Seal, Scientific Certification Systems, Smartwood, etc.

If yes, Proposers must attach copies of the certificates obtained.

5. <u>Other Environmental Criteria</u>

Proposers are encouraged to respond to criteria specifically indicated in this RFP as "Management Approach" (and attach the appropriate documentation) to receive consideration in the evaluation.

I hereby certify, under penalty of the law that the above statements are true and correct.

Jeff Deming **Name** July 11, 2011 **Date**

ATTACHMENT G - Certified Environmentally Preferable Products/Practices

Proposer Name: Mosair ATM, Inc. **Date:** 8-1-11

In line with the Port Authority's efforts to promote products and practices which reduce our impact on the environment and human health, Proposers are encouraged to provide information regarding their environmentally preferable/sustainable business practices as they relate to this contract wherever possible. Proposers **must** complete this form and submit it with their response, if appropriate. Proposers **must** submit appropriate documentation to support the items for which the Proposer indicates a "Yes" and present this documentation in the proper sequence of this Attachment.

1. Packaging

Has the Proposer implemented any of the following environmental initiatives? **(A checkmark indicates "Yes")**

____ Use of corrugated materials that exceed the EPA recommended post-consumer recycled content

____ Use of other packaging materials that contain recycled content and are recyclable in most local programs

____ Promotes waste prevention and source reduction by reducing the extent of the packaging and/or offering
packaging take-back services, or shipping carton return

____ Reduces or eliminates materials which have been bleached with chlorine or chlorine derivatives

____ Eliminates any packaging that may contain polyvinyl chloride (PVC), or polystyrene or heavy metals

If yes, a description of the practices being followed must be included with the submission.

2. Business Practices / Operations / Manufacturing

Does the Proposer engage in practices that serve to reduce or minimize an impact to the environment, including, but not necessarily limited to, the following items? **(A checkmark indicates "Yes")**

____ Recycles materials in the warehouse or other operations

____ Use of alternative fuel vehicles or vehicles equipped with diesel emission control devices for delivery or transportation purposes

____ Use of energy efficient office equipment or signage or the incorporation of green building design elements

____ Use of recycled paper (that meets federal specifications) in their marketing and/or resource materials

____ Other sustainable initiative

If yes, a description of the practices being followed must be included with the submission.

3. Training and Education

Does the Proposer conduct/offer a program to train or inform customers and employees of the environmental benefits of the products to be offered under this contract, and/or does the Proposer conduct environmental training of its own staff?

☐ Yes ☒ No If yes, Proposer must attach a description of the training offered and the specific criteria targeted by the training.

4. Certifications

Has the Proposer or any of its manufacturers and/or subcontractors obtained any of the following product / industry certifications? **(A checkmark indicates "Yes")**

____ ISO 14000 or adopted some other equivalent environmental management system
____ Other industry environmental standards (where applicable), such as the CERES principles, LEED Certification, C2C Protocol, Responsible Care Codes of Practice or other similar standards
____ Third Party product certifications such as Green Seal, Scientific Certification Systems, Smartwood, etc.

If yes, Proposers must attach copies of the certificates obtained.

5. <u>Other Environmental Criteria</u>
Proposers are encouraged to respond to criteria specifically indicated in this RFP as "Management Approach" (and attach the appropriate documentation) to receive consideration in the evaluation.

I hereby certify, under penalty of the law that the above statements are true and correct.

_____ _____**Name** 8-1-11 _____**Date**

Christopher Q. Stevenson
Contracts Specialist
Mosaic ATM, Inc.

Response to Request for Proposal No. 24997

Surface Management System at John F. Kennedy International Airport

Section 4

Contractor Identity Check/Background Screening

Contractor Identity Check/Background Screening

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2. Periodic Audit 3
B. Drug Testing 4
1. Screening Procedure 4
2. Periodic Audit 4
C. Training 4

I. Overview

PASSUR Mosaic SMS Joint Venture (PMJV) recognizes that there are certain areas of the program where efficiencies can be realized and shared by the Authority and PMJV. One of these areas is in the front-end screening of PMJV staff members who will be supporting this project. The following procedure that PMJV and its subcontractors will follow for its background screening will ensure that only people who have been successfully pre-screened to the Authority's standards and by the Port Authority's approved organization will be able to provide services in accordance with the anticipated contract and/or will be recommended for SIDA identification cards.

II. PASSUR Mosaic SMS Joint Venture Procedures & Policies

PMJV strives for all of its employees, officers, and directors with the company to conduct business in accordance with applicable laws, rules, and regulations while maintaining the highest standards of ethical conduct, fair dealing, and honesty. PMJV's commitments and policies for providing an ethical and drug- and violence-free work environment are aligned with the Port Authority's requirements for such. Therefore, PMJV has adopted the following procedures:

A. Identification and Background Screening

Prior to becoming an employee, a job-related background check is conducted. In support of PMJV's zero-tolerance Violence in the Workplace and Security policies, PMJV will conduct a pre-employment criminal check. When appropriate, the criminal record is checked to protect PMJV's interest and that of its employees and customers.

1. Screening Procedure

A 10-year nationwide criminal background check, which consists of prior employment verification, professional reference checks, credit check, and education confirmation, is also performed. For PMJV and subcontractor employees dedicated to the SMS project, whether full- or part-time, PMJV will ensure that it utilizes the Secure Worker Access Consortium (S.W.A.C) to perform the background screenings. PMJV will ensure that only employees who have successfully completed this background screening will be permitted to perform work associated with the anticipated SMS contract.

2. Periodic Audit

Periodically the PMJV Contract Manager will perform floor checks of issued SIDA identification cards and audit of project records to ensure all employees and subcontractors have been properly screened.

B. Drug Testing

Prior to commencing services associated with the anticipated contract, PMJV will ensure that all associated staff members successfully complete a 10-panel drug screening.

1. Screening Procedure

PMJV contracts with third-party laboratories, which are convenient to PMJV candidates and employees, to complete an initial 10-panel drug screening prior to starting their position on the project.

2. Periodic Audit

The drug screenings may be re-performed on a random basis as decided by PMJV, or as periodically requested by the Port Authority's Project Manager. PMJV will ensure that only employees who successfully complete the drug screenings will be permitted to perform work associated with the anticipated SMS contract.

C. Training

Upon successful completion of the background and drug screenings, all employees, officers, and directors of PMJV are given orientation training to ensure their understanding of the various corporate policies, and are responsible for conducting themselves in compliance with this Code of Business Conduct and Ethics (the "Code"). The company adopted the code in order to assist the company and its employees, officers, and directors with the company's goals of conducting its business and affairs in accordance with applicable laws, rules, and regulations, and for maintaining the highest standards of ethical conduct, fair dealing, and honesty.

Response to Request for Proposal No. 24997

Surface Management System at John F. Kennedy International Airport

Section 5

Business Risk

Business Risk

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I. Overview

There are several factors that contribute to the significant reduction of business risk in selecting the PASSUR Mosaic Joint Venture (PMJV) for the SMS program. As the current provider of surface management system services at JFK, and other winter operations at JFK and at several other airports, PASSUR has extensive experience installing, operating, and maintaining surface management systems (including hands-on direct operating experience, especially associated with the JFK departure metering program, which is unlike any other surface program in the U.S.). PASSUR's experienced, proven team of aviation professionals have successfully managed the first phase of surface management at JFK, as well as eight years of winter operations at JFK, and bring a thorough understanding of the New York and national airspace, JFK surface operation, and organizational relationships at JFK. As a result, the PASSUR team can respond to any situation in this complex environment, using their extensive training and experience. Finally, all airlines at JFK have extensive exposure to PASSUR processes, staff, and systems.

Mosaic ATM (Mosaic) is the recognized leader in the study and development of the Surface Decision Support System (SDSS) and of its precursor technologies and systems, including Surface Management Systems (SMS). Three of the four recognized inventors of SMS are employees of Mosaic (the fourth is retired) and lead the continuing surface decision support tool analysis and research. Mosaic personnel led the SMS development and deployment efforts from Technology Readiness Level 1 (TRL1) through TRL 9. In addition to employing the inventors and developers of SMS, Mosaic has been responsible for maintaining the FAA's software baseline of the SDSS system since 2005.

Mosaic has been instrumental in the delivery of several of the most successful surface management system programs to date, including Memphis, TN, Louisville, KY, and Orlando, FL. Mosaic has also been involved in the development of several related traffic management programs for the FAA and NASA, such as Surface Trajectory Based Operation (STBO), Collaborative Departure Queue Management (CDQM), and the Flight Operator Surface Application (FOSA).

PMJV has the management structure and experience, technical and operational staffing resources, and financial capacity to deliver on the SMS program for JFK.

II. Avoiding Business Risk

By selecting the PMJV team, the Port Authority will avoid the risk of working with a new, unproven supplier and will instead continue to benefit from the talent of the PMJV team.

- PASSUR has been delivering the current Departure Metering program at JFK – a precursor to the SMS required in this proposal – for one and a half years. The underlying departure allocation technologies, situational awareness technologies, airspace

management technologies, and collaborative communication and coordination technologies, are all tested, vetted, and proven, not only at JFK, but also at many other airports and airlines.

- The professional services team which designed, implemented, managed, and operated the departure metering program is knowledgeable about the specific JFK surface operation, terminal airspace operation, and all the institutional relationships at JFK (carriers, the Port Authority, FAA, and others). These professionals, as well as those who will be added to the team for the new SMS, have extensive experience in airport operations, airline operations, and ATC operations – including hands-on direct operating experience, uniquely associated with the JFK departure metering program, which is unlike any other surface program in the U.S.
- The airline community at JFK is very familiar with PASSUR software, processes, and personnel. Therefore, continued use of PASSUR would avoid the risks associated with the introduction of a new vendor.
- Mosaic is recognized as the foremost provider of advanced surface management technologies, including the most advanced predictive, real-time, and post-operational analytics of surface operations. Mosaic has been the lead developer on several of the most advanced and successful deployments of surface management decision support systems in the U.S., helping to pioneer many of these core capabilities for the FAA and NASA – capabilities which will be fully implemented into the SMS for JFK.
- PASSUR has more than 30 years of experience in aircraft and airspace surveillance systems and decision support technologies.
- PASSUR has an extensive, experienced customer support team and program, which eliminates risk associated with the training, maintenance, and end-user support associated with a new vendor. The PASSUR customer support and maintenance program also includes extensive remote monitoring and management of all critical system components, allowing PASSUR to prevent problems.
- The PASSUR collaborative platform, which is a core element of the PASSUR SMS program delivery, was pioneered jointly with the Port Authority, and now is used by 16 airports nationwide and thousands of users around the world, with broad industry support from multiple airlines and airports.

A. Corporate Financial Viability

Both companies have the financial resources to meet or exceed all of the requirements of this contract. Additionally, both companies have years of experience dealing with large, complex, mission critical contracts with the U.S. Government, airlines, and airports (see for example references which are included in this RFP response).

B. Staff Resources for New Work

Both companies are fully equipped to address the requirements of this contract. PASSUR has years of experience meeting the requirements of the Port Authority.

C. Succession

PASSUR

Current President & CEO:

Mr. James T. Barry is the current President and CEO of PASSUR Aerospace, a position he has held since 2003. He is healthy and expected to be able continue his duties as President and CEO.

PASSUR has a highly capable senior management staff should a successor to Mr. Barry be needed, as determined by the Board of Directors, including:

Tina W. Jonas, Executive Vice President, Operations:

Ms. Jonas joined the Company as Executive Vice President of Operations on July 1, 2010. Prior to joining the Company, Ms. Jonas served as Director of Operations Planning and Analysis at Sikorsky Aircraft Corporation from 2008 to 2010. From 2004 to 2008, she served as Undersecretary of Defense, Comptroller, and Chief Financial Officer for the Department of Defense (DOD). Before joining the DOD, she served as Assistant Director and Chief Financial Officer for the Federal Bureau of Investigation from 2002 to 2004.

Tom White, Senior Vice President, Technology and Air Traffic Management:

Mr. White was named Senior Vice President of Technology and Air Traffic Management in March 2011. Prior to that he was Vice President Air Traffic Management. Before joining PASSUR, Mr. White spent 32 years in government service with the FAA and the US Military. Between 2002 and 2007 he was a Senior Manager for the FAA in New York. Before the FAA, he was a US Army Special Ops helicopter pilot serving with TF 160th.

Ron A. Dunsky, Senior Vice President, Marketing and Communications:

Mr. Dunsky was named Senior Vice President of Marketing and Communications in March of 2011. Mr. Dunsky joined the Company in 2001, and initially served as Director of Marketing and New Product Development, and then Vice President of Marketing. Prior to joining the Company, Mr. Dunsky was a Senior Aviation Producer with the New York bureau of ABCNews.com from 2000 to 2001. Prior to ABCNews.com, he was a Senior Aviation Producer with the New York bureau of CNN from 1995 to 2000. Prior to CNN, Mr. Dunsky was a business reporter for the PBS nightly newscast, The MacNeil-Lehrer NewsHour, after having served as the program's communications director. He began his career as a creative director at one of the pioneering social marketing firms, Manifest Communications of Toronto, Canada.

Christopher W. Maccarone, Vice President of Airline Performance:

Mr. Maccarone was named Vice President of Airline Performance in March 2011. Prior to joining PASSUR in July 2010 as lead business analyst on a special project, Mr. Maccarone was Managing Director, Performance Analysis at Northwest Airlines, where he was responsible for leading multiple groups in the Systems Operations Control Center (SOC). As a member of the senior operations team, Mr. Maccarone's focus was on improving global operational performance and reliability. In addition to his SOC responsibilities, Mr. Maccarone previously served in a variety of leadership roles at Northwest, including flight simulator operations, flight safety, pilot contract administration, operations analysis, aircraft performance engineering, fuel conservation, international alliances, and financial planning and analysis.

Mosaic

Mr. Chris Brinton is the current President of Mosaic. He is healthy and expected to be able continue his duties as president.

Positioned successor:

By agreement of the Board of Directors, Mr. Stephen Atkins, current Vice President, would be elected president should the current president be unable to perform his duties.

Pool of Senior Managers available for BOD consideration:

Within its current employee ranks, Mosaic has a pool of senior, experienced managers. These individuals are qualified and would be available for BOD nomination to corporate office position. Selection from this pool greatly enhances the continuity of corporate management functions as well as maintaining existing customer relationships. Individuals within this pool include:

William Hall, Director of Commercial Business:

Dr. Hall has managerial and leadership experience of more than 15 years in mid-size corporations providing services similar to those of Mosaic.

Mary Ellen Miller, Group Manager:

Mrs. Miller has corporate experience as senior manager at a large federal and defense contractor. Her experience spans more than 25 years and includes all activities in management and business leadership.

Stephen Simmons, CFO:

Mr. Simmons has corporation level leadership experience in a large defense contractor and has program managed large multi-million dollars projects.

Chris Wargo, Director of Business Development:

Mr. Wargo has more than 30 years of corporate and technical leadership experience. He has performed duties as a corporate board member, served as Vice President in a mid-size technology corporation, and as president in a technology firm similar in size to Mosaic, Inc.

Response to Request for Proposal No. 24997

Surface Management System at John F. Kennedy International Airport

Section 6

Demonstrations

Demonstrations

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I. Overview

The PASSUR Mosaic SMS Joint Venture (PMJV) is prepared and welcomes an opportunity to demonstrate the Surface Management System (SMS) and answer the Port Authority's questions regarding any aspect of its SMS goals and objectives, and any portion of PMJV's proposal.

II. Demonstration

At a minimum, PMJV will be prepared with standalone capability to demonstrate the following:

- User interface
- Proposed graphical representation of the base map, and
- Reporting capabilities including proposed reports, summary windows, report generation tools and printing, and playback capability

Following the demonstration, the PMJV will be able to loan the Port Authority the standalone unit for their continued trial. During this loan period, the Port Authority may address questions or issues relating to this demonstration to the following PMJV technical points of contact, who can be reached at PASSUR's corporate headquarters: **Telephone: 203-622-4086.**

Ron Dunsky, Senior Vice President of Marketing and Communications — e-mail: rondunsky@passur.com

Tom White, Vice President of Technology and Air Traffic Management — e-mail: twhite@passur.com

Response to Request for Proposal No. 24997

Surface Management System at John F. Kennedy International Airport

Section 7

Acknowledgement of Addenda

Acknowledgement of Addenda

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I. Overview

Addenda to Request for Proposal (RFP) No. 24997 are signed by PASSUR Mosaic SMS Joint Venture (PMJV) and attached hereto as the following exhibits:

II. Addendum 1

Attached hereto as Appendix A

III. Addendum 2

Attached hereto as Appendix B

IV. Addendum 3

Attached hereto as Appendix C

Appendix A

Addendum 1

THE PORT AUTHORITY OF NY & NJ

PURCHASING SERVICES DIVISION
ONE MADISON AVENUE 7TH FL.
NEW YORK, NY 10010

Date: July 7, 2011

ADDENDUM #1

To prospective Proposers on Request for Proposals (RFP) # 24997 for Surface Management System at John F. Kennedy International Airport (JFK)

☒ **Proposals due back on August 8, 2011, no later than 2:00 P.M.**

☒ Proposals originally due on July 11, 2011, no later than 2:00 P.M.

The following changes/modifications are hereby made to the solicitation documents:

1. Delete Attachment B, Contract Specific Terms and Conditions, Section 5. "Insurance Procured by the Contractor" in its entirety and replace with the attached revised "Insurance Procured by the Contractor".

All answers to Prospective Proposers' questions will be submitted at a later date.

This communication should be initialed by you and annexed to your proposal upon submission.

In case any Proposer fails to conform to these instructions, its proposal will nevertheless be construed as though this communication had been so physically annexed and initialed.

THE PORT AUTHORITY OF NY & NJ

KATHY LESLIE WHELAN, MANAGER
PURCHASING SERVICES DIVISON

PROPOSER'S FIRM NAME: Passur Aerospace, Inc. Mosaic ATM, Inc.

INITIALED: JPP

DATE: 07/29/11 07/28/2011

QUESTIONS CONCERNING THIS ADDENDUM MAY BE ADDRESSED TO LESLEY BROWN, WHO CAN BE REACHED AT (212) 435-3969.

ACTING JOINTLY AND SEVERALLY

Appendix B

Addendum 2

ANSWER 106:
There are no known OSHA requirements associated with this RFP.

QUESTION 107:
Did the PA intend to state duplicative liquidated damages, stated in Attachment B, Sec. 16, subsections B and F.? Both subsections impose $200/day for late distribution of reports pursuant to SOW Section IV, C.

ANSWER 107:
See Change/Modification # 8

QUESTION 108:
Can you please advise if not bidding Phase A, but only a Phase B solution will disqualify or disadvantage an offerer?

ANSWER 108:
As stated in Attachment C, 9, IV, D, Phase B includes all requirements in Phase A in addition to the requirements in Phase B. If a contractor is capable of implementing the requirements of both Phases at one time, it should be presented.

This communication should be initialed by you and annexed to your proposal upon submission.

In case any Proposer fails to conform to these instructions, its proposal will nevertheless be construed as though this communication had been so physically annexed and initialed.

THE PORT AUTHORITY OF NY & NJ

KATHY LESLIE WHELAN, MANAGER
PURCHASING SERVICES DIVISON

PROPOSER'S FIRM NAME: PASSUR Aerospace Inc. Mosaic ATM Inc.

INITIALED: RD

DATE: 08/04/2011 08/04/2011

QUESTIONS CONCERNING THIS ADDENDUM MAY BE ADDRESSED TO LESLEY BROWN, WHO CAN BE REACHED AT (212) 435-3969.

ACTING JOINTLY AND SEVERALLY

Appendix C

Addendum 3

(b) The Port Authority shall have the right to extend this Contract for three (3) additional one (1) year Option Periods to November 30, 2017 (hereinafter called the "Option Period") following the Expiration Date, upon the same terms and conditions If the Port Authority shall elect to exercise the Option(s) to extend this Contract, then, no later than thirty (30) days prior to the Expiration Date, the Port Authority shall send a notice that it is extending the Base Term of this Contract, and this Contract shall thereupon be extended for the applicable Option Period. If the Contract provides for more than one Option Period, the same procedure shall apply with regard to extending the term of this Contract for succeeding Option Periods.

(c) The Port Authority shall have the absolute right to extend the Base Term for an additional period of up to one hundred and twenty (120) days subsequent to the Expiration Date of the Base Term, or the Expiration Date of the final exercised Option Period (hereinafter called the "Extension Period"), subject to the same terms and conditions as the previous contract period. The prices quoted by the Contractor for the previous contract period shall remain in effect during this Extension Period without adjustment. If it so elects to extend this Contract, the Port Authority will advise the Contractor, in writing, that the term is so extended, and stipulate the length of the extended term, at least thirty (30) days prior to the expiration date of the previous contract period.

This communication should be initialed by you and annexed to your proposal upon submission.

In case any Proposer fails to conform to these instructions, its proposal will nevertheless be construed as though this communication had been so physically annexed and initialed.

THE PORT AUTHORITY OF NY & NJ

KATHY LESLIE WHELAN, MANAGER
PURCHASING SERVICES DIVISON

PROPOSER'S FIRM NAME: PASSUR Aerospace Inc. Mosaic ATM Inc.

INITIALED: RD

DATE: 08/04/2011 08/04/2011

QUESTIONS CONCERNING THIS ADDENDUM MAY BE ADDRESSED TO LESLEY BROWN, WHO CAN BE REACHED AT (212) 435-3969.

ACTING JOINTLY AND SEVERALLY

Response to Request for Proposal No. 24997

Surface Management System at John F. Kennedy International Airport

Section 8

Acceptance of General Contract Provisions

Acceptance of General Contract Provisions

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I. Statement of No Exception

The PASSUR Mosaic Joint Venture (PMJV) takes no exceptions to the General Contract Provisions (Attachment B, Part III).

Response to Request for Proposal No. 24997

Surface Management System at John F. Kennedy International Airport

Section 9

Minority/Women-Owned Business Enterprise Plan

Minority/Women Owned Business Enterprise Plan

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B. Subcontracting Plan 3
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I. Overview

The PASSUR Mosaic SMS Joint Venture (PMJV) sets out to be the Port Authority of New York & New Jersey's sole provider of all software products, software development, and associated services for their Surface Management System (SMS) at John F. Kennedy International Airport. Likewise, as the incumbent, PMJV is the sole provider to the Port Authority for SMS services.

A. Anticipated Subcontract Opportunities

In order to deliver the products and services described in this proposal, PMJV does not anticipate the need for additional division of work. The PMJV team intends to self perform the vast majority of the anticipated contract.

B. Subcontracting Plan

In the event that PMJV requires subcontractors subsequent to contract award, it will act in good faith by pursuing companies that qualify as minority-owned or women-owned business enterprises. Consistent with the requirements of the RFP, PMJV attaches Form PA3749B (Exhibit A), reflecting that there are not any current plans to subcontract with minority- or women-owned business enterprises.

II. Request for Exemption

In light of the above and pursuant to Request for Proposal No. 24997, Section 6, M/WBE Subcontracting Provisions, by submission of this Proposal, PMJV respectfully requests exemption from M/WBE Good Faith Participation and the subcontracting goals stated in Part 1, Section 6, page 12.

Appendix Form PA 3749B

PA 3749 B/ 08-07

THE PORT AUTHORITY OF NY & NJ

Office of Business and Job Opportunity

PROCUREMENT
M/WBE PARTICIPATION PLAN

NOTE: The Proposer/Bidder shall submit to the Manager, Line/Facility Dept. Form PA 3749 C MODIFIED PLAN for any changes to the original plan: i.e.; subcontractor, dollar amount or work performed.
If more than 1 page is used, complete totals on last page.

Purchase Order #: RFP # 24997

Proposer/Bidder Name: PASSUR Aerospace, Inc.

Mailing Address: One Landmark Square, Sute 1900
Stamford, CT 06901

Telephone Number: 203-622-4086

Contract Description: Surface Management System for JFK International Airport

Contract Amount:

Contract Goals: MBE 12% WBE 5%

Name, Address, Phone Number of PA Certified M/WBE subcontractor (including name of contact person)	Indicate MBE or WBE	Description of Work, Services to be provided. Where applicable, specify, "supply" or "install or both "supply" and "install."	Anticipated date work will start and finish	Approximate $ amount of M/WBE Subcontract	M/WBE % of Total Contract Amount
None					
			TOTAL:		

Signature of Contractor:

Print Name: James T. Barry for PASSUR Chris Brinton for Mosaic

Title: President of PASSUR President of Mosaic Date 8/5/2011

FOR OBJO USE ONLY
Contract Goals: ☐ Approved ☐ Waived ☐ Rejected
Reviewed by:
OBJO Business Development Representative
Print Name: Date

Distribution: Original – OBJO; Copy 2 –Manager, Line/Facility Department; Copy 3 –Proposer/Bidder, Copy 4 – Procurement Dept – Award File

Acting Jointly and Severally

INSTRUCTIONS

PROPOSER INSTRUCTIONS: In accordance with Section 6. M/WBE Subcontracting Provisions, the proposer shall submit this form as the M/WBE Participation Plan and/or good faith documentation as part of Section 7. Proposal Submission Requirements.

BIDDER INSTRUCTIONS: In accordance with Part VI of the contract book, the bidder shall submit a M/WBE Participation Plan and/or best efforts documentation to the Manager or designee identified in the contract book within 10 days of contract award.

MANAGER/DESIGNEE INSTRUCTIONS: After a review of the submitted M/WBE Participation plan, forward to the Office of Business and Job Opportunity via fax at (212) 435-7828 or PAD to 233PAS 4th Floor for review and approval. Approved/waived/rejected plan will be returned within 5 business days of receipt of this document. Manager/Designee will advise vendor of the results of the M/WBE Participation Plan review.

Response to Request for Proposal No. 24997

Surface Management System at John F. Kennedy International Airport

Section 10

Subcontractors

Subcontractors

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2. Scope Items to be Performed 3
3. Certification with Respect to Contractor's Integrity Provisions 4
II. Request for Consent of Subcontractor(s) 4

I. Overview

In pursuit of becoming the provider of the finest Surface Management System products and services solution to the Port Authority of New York & New Jersey, the PASSUR Mosaic SMS Joint Venture (PMJV) has teamed with the following Subcontractor.

A. ARINC Incorporated

ARINC Incorporated (ARINC), a portfolio company of The Carlyle Group, provides communications, engineering, and integration solutions for commercial, defense, and government customers worldwide. Headquartered in Annapolis, Maryland, with regional headquarters in London and Singapore, ARINC is ISO 9001-2008 certified.

1. Registered Vendor

ARINC Incorporated, with headquarters located at 2551 Riva Road, Annapolis, MD 21401, is currently not a registered contractor in the Port Authority's contractor database. If PMJV is awarded the contract anticipated by this Proposal, ARINC shall make complete the process to be a recognized vendor in the Port Authority's database.

2. Scope Items to be Performed

1. Delivery of "aircraft status" information to the PMJV central site computer, e.g. In and Out messages, and "Weight on Wheels" (messages from the aircraft — periodic updates on aircraft position on the airport surface). Additional information, when available, will be retrieved from the airlines, e.g., first passenger boarding card scanned, last passenger boarding card scanned, passenger door closed, cargo door closed, etc.

2. Delivery of "surface management" status/instructions (e.g. departure slot time) from PMJV central site computer to:

   a. Flight Deck

   b. Airline SOC centers

   c. Other parties as requested by the Port Authority and/or airlines

3. Design, engineering, consultation, and implementation services required to execute on items 1 and 2 above as requested by Prime Contractor.

4. Delivery of airline data and information contemplated herein shall be subject to obtaining consent from the owners, regulatory agencies or other parties having control of such data or information as applicable.

3. Certification with Respect to Contractor's Integrity Provisions

Upon award, ARINC has agreed to provide its written Certification with Respect to Contractor's Integrity Provisions as required in RFP Attachment B, Part III, Clause 32.

II. Request for Consent of Subcontractor(s)

If the Port Authority awards the contract anticipated by this Proposal, the PASSUR Mosaic SMS Joint Venture (PMJV) will assume that it has the Authority's consent for subcontracting with the above-named company, unless the Authority has expressly conveyed that it is withholding such consent.

Response to Request for Proposal No. 24997

Surface Management System at John F. Kennedy International Airport

Section 11

Conflict of Interest

Certification of No Conflicts of Interest

By submission of this proposal, the PASSUR Mosaic SMS Joint Venture (PMJV) certifies that:

Currently and during the term of this contract, the PMJV shall not be, or own, or operate directly or indirectly, or have any interest in, financial or otherwise, nor shall its executive management include individuals having or having had such interest in, any firm, or any other entity, including but not limited to, airlines, air cargo operators, airports, hotels, motels, restaurants or other related service industry operations which, in the opinion of the Port Authority, would create a conflict of interest or give the appearance of a conflict of interest.

The PMJV provides conflict of interest briefings to its employees, providing information on awareness, detection, reporting, mitigation, associated business risk of conflicts of interest, and PMJV's policies regarding the foregoing.

The PMJV companies' dedication and commitment to business ethics and corporate governance is at the heart of both of their corporate cultures, and provides that any such conflicts of interest, whether actual or potential, are discovered, mitigated, or addressed in a timely manner, and will be with complete disclosure to the Port Authority.

ATTACHMENT D- PROPOSER REFERENCE FORM

Name of Proposer: PASSUR-Mosaic Joint Venture (PMJV)

Customer Name: Aviation Development Council
Address: 141-07 20th Avenue, Suite 404, Whitestone, NY 11357
Contact Name and Title: William Huisman, Director
Phone and Fax Numbers of Contact: (718) 476-0212, (718) 494-6002
Contract date (s): 2/1/2010-present
Contract Cost: $90,000/month
Description of Work: JFK International Airport Deprture Metering Program (PASSUR)

Customer Name: Aviation Development Council
Address: 141-07 20th Avenue, Suite 404, Whitestone, NY 11357
Contact Name and Title: William Huisman, Director
Phone and Fax Numbers of Contact: (718) 476-0212, (718) 494-6002
Contract date (s): Software systems: 12/1/2002-present. Onsite staffing and management program: 12/1/2007-present
Contract Cost: $17,000/month
Description of Work: Snow Operations Management Program (software and staffing) and Field Condition Reporting for LGA and JFK (PASSUR)

Customer Name: Metropolitan Washington Airports Authority (MWAA)
Address: 1 Aviation Circle, Washington, DC 20001
Contact Name and Title: Dana Pitts, Operations Manager
Phone and Fax Numbers of Contact: (703) 572-2747, (703) 572-5718
Contract date (s): Software systems: 9/1/2004-present. Staffing and management program: 8/1/2008-present
Contract Cost: $22,000/month
Description of Work: Snow Operations Management Program (software and staffing) and Field Condition Reporting (PASSUR)

Customer Name: Federal Aviation Administration
Address: 800 Independence Avenue, S.W., Washington, D.C. 20591
Contact Name and Title: Katherine Williams, Contacting Officer
Phone and Fax Numbers of Contact: (202) 267-3669, (202) 285-6700
Contract date (s): 6/10/2010- present
Contract Cost: $240,187.50/month
Description of Work: Aviation Security Solutions (PASSUR)

Customer Name: FAA AWA
Address: 800 Independence Ave SW, Washington DC 20591
Contact Name and Title: Tom Prevost, COTR
Phone and Fax Numbers of Contact: (202) 267-3363, (202) 267-5111
Contract date (s): 8/1/2008-7/31/2013
Contract Cost: $9,275,446

Description of Work: NextGen Surface Trajectory-Basd Operations (Mosaic)

Customer Name: United Parcel Service Global Operations Center
Address: 825 Lotus Ave, Louisville, KY 40213
Contact Name and Title: Jim Hamilton, Manager, ATC
Phone and Fax Numbers of Contact: (502) 552-7640, (502) 583-3786
Contract date (s): 3/8/2007
Contract Cost: $5,000/month
Description of Work: UPS SDSS Support (Mosaic)

Customer Name: NASA Ames Research Center
Address: Mail Stop 210-10, Moffett Field, CA94035-1000
Contact Name and Title: Shawn Engelland, COTR
Phone and Fax Numbers of Contact: (817) 858-7634, (817) 858-7636
Contract date (s): 8/28/2009-10/31/2011
Contract Cost: $932,573
Description of Work: Surface Operations Data Analysis and Adaptation (Mosaic)

Customer Name: NASA Ames Research Center
Address: Mail Stop 210-10, Moffett Field, CA 94035-1000
Contact Name and Title: Shawn Engelland, COTR
Phone and Fax Numberts of Contact: (817) 858-7634, (817) 858-7636
Contract date (s): 12/15/2010 – 9/15/2013
Contract Cost: $1,443,048
Description of Work: Development of weather translation models for traffic flow management (Mosaic)

Customer Name: MIT Lincoln Laboratory
Address: 244 Wood Street, Lexington, MA 02420 (for FAA)
Contact Name and Title: Vineet Mehta, Project Manager & Technical Point of Contact
Phone and Fax Numberts of Contact: (781) 981-7438, (781) 861-0821
Contract date (s): 12/1/2009-5/13/2011
Contract Cost: $1,381,345
Description of Work: Tower Flight Data Manager (Mosaic)

Customer Name: Delta Air Lines
Address: P.O. Box 2070, Atlanta, Georgia 30320-6001
Contact Name and Title: Lorne Cass, Director ATC
Phone and Fax Numbers of Contact: (404) 715-1945, (404) 773-1850
Contract date (s): 2001-present
Contract Cost: $50,000/month
Description of Work: Delta Air Lines (which includes pre-merger Northwest Airlines locations) – Hub Management, Diversion Management, Airspace Optimization (PASSUR)

Customer Name: United Airlines
Address: 77 West Wacker Drive, Chicago, Ill 60601
Contact Name and Title: Donald Dillman, VP System Operations Control
Phone and Fax Numbers of Contact: (847) 700-4000, (847) 700-2241
Contract date (s): 2002-present
Contract Cost: $100,000/month
Description of Work: United Airlines (which includes pre-merger Continental Airlines locations) – Hub Management, Diversion Management, Airspace Optimization (PASSUR)

Customer Name: American Airlines
Address: 4333 Amon Carter Blvd., Ft. Worth, TX 76155
Contact Name and Title: Jon Snook, VP Operations
Phone and Fax Numbers of Contact: (817) 967-4147, (817) 931-7737
Contract date (s): February 2009-present
Contract Cost: $85,000/month
Description of Work: American Airlines – Hub Management, Diversion Management (PASSUR)

Customer Name: US Airways
Address: 150 Hookstown Grade Road, Coraopolis, PA 15108
Contact Name and Title: Ilhan Ince, Managing Director, Operations Planning & Performance
Phone and Fax Numbers of Contact: (412) 474-4100, (412) 262-2310
Contract date (s): June 2006-present
Contract Cost: $30,000/month
Description of Work: US Airways- Hub Management (PASSUR)

Customer Name: JetBlue Airways
Address: 118-29 Queens Blvd., Forrest Hills, NY 11375
Contact Name and Title: Bill Cranor, Director, System Operations
Phone and Fax Numbers of Contact: (718) 709-3745, (718) 709-3621
Contract date (s): January 2006-present
Contract Cost: $30,000/month
Description of Work: JetBlue Airways – Hub Management, Airspace Optimization (PASSUR)