Office of Inspector General

Audit Report

FAA OPERATIONAL AND PROGRAMMATIC DEFICIENCIES IMPEDE INTEGRATION OF RUNWAY SAFETY TECHNOLOGIES

Federal Aviation Administration

Report Number: AV-2014-060

Date Issued: June 26, 2014

Memorandum

U.S. Department of Transportation
Office of the Secretary
of Transportation
Office of Inspector General

Subject: **ACTION:** FAA Operational and Programmatic Deficiencies Impede Integration of Runway Safety Technologies
Federal Aviation Administration
Report Number AV-2014-060

Date: June 26, 2014

From: Matthew E. Hampton
Assistant Inspector General
for Aviation Audits

Reply to Attn. of: JA-10

To: Federal Aviation Administrator

While the Federal Aviation Administration (FAA) operates one of the world's safest aviation systems, runway safety remains a significant concern—especially given the recent rise in the number of runway incursions.[1] Runway incursions increased by 30 percent from fiscal year 2011 (954) to fiscal year 2013 (1,241) despite slight declines in air traffic operations during that time.[2]

FAA has made runway safety a key oversight priority and currently uses Airport Surface Detection Equipment-Model X (ASDE-X) to allow air traffic controllers to detect potential runway conflicts. As part of its efforts to improve safety, FAA plans to integrate two runway safety systems with ASDE-X: the Runway Status Lights (RWSL) system, which gives pilots a visible warning when runways are occupied by other aircraft, and the satellite-based Automatic Dependent Surveillance-Broadcast (ADS-B), which provides simultaneous alerts for controllers and pilots of potential runway incursions and ground collisions.

We initiated this audit to assess FAA's ongoing efforts to implement and integrate surface surveillance technologies. On April 12, 2013, the Ranking Member of the

[1] A runway incursion is any incident at an airport involving an aircraft, a vehicle, person, or an object on the ground that creates a collision hazard or results in a loss of separation with an aircraft taking off, intending to take off, landing, or intending to land. FAA's definition only applies to airports with operating air traffic control towers.

[2] *Review of FAA's Call to Action Plan for Runway Safety* (OIG Report No. AV-2010-071), July 21, 2010. We reported that the number of serious runway incursions decreased after FAA implemented its August 2007 Call to Action Plan for Runway Safety. However, between fiscal years 2010 and 2012, the number of reported serious runway incursions, as well as the total number of all incursions, increased significantly while air traffic operations declined slightly. OIG reports are available on our Web site: www.oig.dot.gov.

House Committee on Transportation and Infrastructure requested that we also examine FAA's actions to improve runway safety.[3] Accordingly, our overall audit objective was to assess FAA's progress in integrating ASDE-X with other technologies to improve runway safety. Specifically, we assessed (1) the status of ASDE-X implementation, (2) progress and challenges with RWSL integration, (3) progress and challenges with ADS-B integration, and (4) the adequacy of FAA's plans to implement runway safety technologies.

We focused on those surface surveillance programs that have established cost and schedule milestones. We conducted our work in accordance with generally accepted Government auditing standards. Exhibit A details our scope and methodology.

RESULTS IN BRIEF

FAA completed ASDE-X deployment at all 35 planned airports in 2011; however, the system now requires hardware and software upgrades to maintain current performance levels and meet anticipated increases in air traffic. Although FAA budgeted $45 million through fiscal year 2016 for upgrades, it will require additional funding to complete all testing of ASDE-X receivers and conduct two remaining projects associated with upgrading ASDE-X remote units. FAA does not anticipate problems with upgrading ASDE-X; however, until FAA can complete sufficient operational tests it is uncertain whether and to what extent the upgrades will impact ASDE-X's performance.

FAA has encountered software deficiencies with its efforts to integrate RWSL with ASDE-X, resulting in schedule delays and cost growth. Initial tests of the system revealed critical deficiencies with system reliability and faulty RWSL light fixtures that either provide false alerts or do not function at all. Further testing identified 50 operational and technical issues, several of which involve software and functional integration problems with RWSL. Thirty of these issues were still unresolved when FAA deployed the first operational RWSL system in August 2013—2 years later than planned. In addition, FAA needs to develop additional software to correct the faults found during testing before it can deploy the remaining systems. Due to these software issues and increases in construction and equipment costs, FAA rebaselined the RWSL program in July 2013. The new baseline increased costs from $327 million to $367 million, reduced the number of planned systems from 23 to 17, and delayed program completion by 2 years to 2017.

FAA has made progress deploying ADS-B technology at ASDE-X sites; however, it has not fully tested ADS-B tools to enhance pilots' surface awareness or

[3]We also initiated a companion audit addressing FAA's Runway Safety Program, CC-2013-018, on April 12, 2013.

determined if these tools are technologically feasible. For example, FAA has not completed testing to verify whether pilots can use moving map applications to display ADS-B information in cockpits. In addition, FAA has halted work on airport surface indicator alerts for pilots utilizing ADS-B due to technical challenges with signal accuracy and frequency interferences discovered during early demonstrations. Consequently, it is unclear when or how ADS-B will help enhance pilots' awareness of their and others' location on the runway.

FAA's planning documents used to communicate its goals for implementing runway safety technologies lack key details regarding priorities, timing, and accountability. For example, the plans do not specify how various surface surveillance efforts will be integrated, when they will be available, or who is responsible for deployment. FAA states that it intended these plans to be broad and fluid so that it can make adjustments to changes in technology and funding. However, without a clear roadmap, it is unlikely that any level of technology or standard for runway safety can be measured or achieved.

We are making recommendations to FAA to aid its efforts to integrate surface surveillance technologies and promote runway safety.

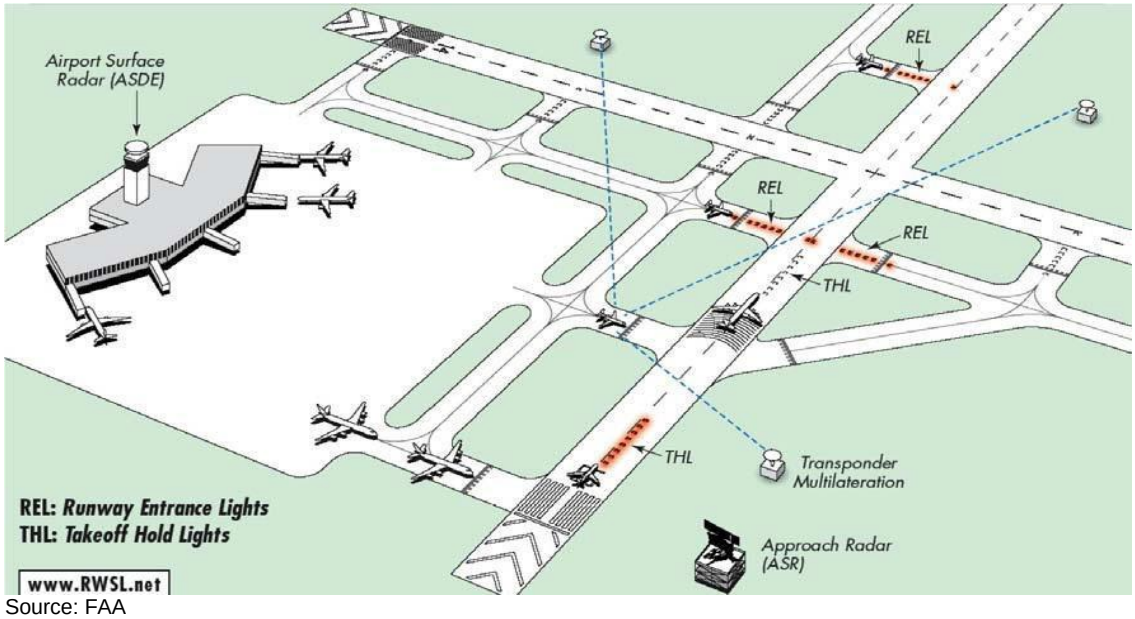
BACKGROUND

ASDE-X is a surface surveillance system designed to help maintain safe separation of aircraft and vehicles on the airport surface and aid controllers in avoiding ground collisions. ASDE-X processes data from airport surface and terminal radars, multilateration sensors,[4] and the ADS-B system to provide a seamless airport surface surveillance tool for air traffic controllers (see figure 1). By fusing the data from these three sources, ASDE-X is able to determine and display the position and identification of transponder-equipped aircraft and vehicles on the airport movement area, as well as aircraft flying within 5 miles of the airport. ASDE-X monitors traffic on runways and taxiways for conflict and, in various scenarios, is able to produce an alert (visual and audible) to warn controllers of pending ground collisions. FAA also intends for ASDE-X to be the core system supplying data to other surface surveillance systems.

FAA is also planning to deploy a similar surface surveillance system—referred to as the Airport Surface Surveillance Capability (ASSC)—at 9 additional airports through 2017, increasing the total number of airports to receive improved capabilities technology to 44. The newer ASSC system is basically the same as ASDE-X, except that it does not need the input from the radar that is used for airport surface movement. A complete listing of airports where FAA has deployed surface surveillance technologies can be found in exhibit C.

[4] Multilateration sensors are airfield antennas that transmit and receive both aircraft transponders and ADS-B data.

Figure 1. Airport with ASDE-X and Runway Status Lights



Source: FAA

The National Transportation Safety Board (NTSB) has long recommended that FAA not only provide alerts to controllers managing air traffic, but also provide alerts directly to pilots. The capability to alert pilots is especially important since pilots caused 63 percent of runway incursions in a 5-year period ending September 2012. Additionally, we have reported[5] that FAA must expedite technologies, that help pilots know their and others' location on the runway to avoid close calls that pose a safety risk to airline crews and passengers.

- **RWSL:** RWSL consists of series of lights that automatically give pilots a visible warning when runways are not clear to enter, cross, or depart. RWSL must be integrated with ASDE-X because its operation is primarily based on ASDE-X surveillance data. In 2010, FAA approved funding to install RWSL systems at 23 airports from fiscal year 2011 to fiscal year 2016[6] at a cost of $327 million. RWSL prototypes are currently under evaluation at Boston, Dallas-Ft. Worth, San Diego, and Los Angeles airports, with the Orlando International Airport designated as the key site for the first fully operational RWSL system.

- **ADS-B:** ADS-B is a satellite-based surveillance system that will provide inputs to ASDE-X from properly equipped aircraft and vehicles that automatically broadcast their position and identification information. ADS-B

[5] *FAA Needs To Improve ASDE-X Management Controls To Address Cost Growth, Schedule Delays, and Safety Risks* (OIG Report No. AV-2008-004) Oct. 31, 2007.
[6] As of 2011, FAA had deployed ASDE-X systems at all airports slated for RWSL except for the San Francisco International Airport in San Francisco, CA.

information will be transmitted by ASDE-X to alert controllers of potential conflicts so that they can direct pilots to take action to prevent surface incidents. ADS-B input would also directly supply pilots with information on an airport moving map display showing an aircraft's position relative to other runway vehicles and graphical depictions of ground and air traffic. FAA also plans to utilize ADS-B for providing direct alerts to pilots. FAA is in process of completing ADS-B deployment at all 35 ASDE-X sites, and the Agency plans to complete ADS-B deployment at the 9 additional airports with the ASSC systems by 2017.

FAA DEPLOYED ASDE-X AT ALL PLANNED SITES, BUT CRITICAL UPGRADES TO THE SYSTEM ARE NEEDED

FAA completed ASDE-X deployments at 35 airports, 30 of which handle 68 percent of operations in the National Airspace System (NAS).[7] The Agency is also deploying the newer ASSC system with similar capabilities at nine additional airports by 2017. However, FAA must now upgrade the deployed ASDE-X hardware and software to ensure the system is supportable through its designated 2030 lifecycle, is compatible with ASSC, and meets the increasing demands of ADS-B message traffic over the coming years.

FAA is upgrading ASDE-X systems at the 35 sites to address operational deficiencies with the current design by replacing obsolete parts. According to FAA, these upgrades involve several efforts: procuring spare parts to ensure that sufficient stock is available to replace failed units, replacing processors[8] and multilateration receivers,[9] and upgrading remote units.[10]

According to FAA, a number of key interdependencies associated with development of the newer ASSC system are critical for FAA to successfully upgrade ASDE-X systems. For example, some of the spare parts needed to support ASDE-X are being redesigned under ASSC so they will only be available for purchase at the completion of the development effort. Additionally, while FAA is planning to replace ASDE-X processors with the ASSC processors that are now in development, the associated software integration and testing must be completed

[7] FAA activated the first ASDE-X system for operational use at General Mitchell International Airport in Milwaukee, WI, in October 2003 and installed the last system at Memphis International Airport, TN, in July 2011.

[8] The replacement of these processors, including ones used to interface with RWSL and ADS-B, will allow for the merging of ASDE-X and ASSC software, and also provide a common performance standard across all sites to simplify software maintenance.

[9] Specifically, the receivers that need upgrading are the ones that receive inputs from general aviation aircraft, because the existing design fails to meet some performance requirements and causes the random loss of ADS-B messages.

[10] These upgrades include an increase in remote unit data transmission rate to ensure ADS-B provides complete and continuous coverage as ADS-B data rates increase in the future. Additionally, the remote units require time synchronization to the Global Positioning System—a space-based satellite navigation system—to increase multilateration positional accuracy and system availability.

before the processors can be used in ASDE-X. FAA is also planning to replace ASDE-X multilateration with another system currently under development and designed to support ASSC; however, FAA is uncertain about when it will complete these upgrades.[11] Therefore, where possible, FAA plans to take advantage of ASSC program development efforts to accomplish a common platform for ASDE-X and ASSC hardware and software. These efforts will also reduce duplicative activities for testing, documentation, and training needed to support ASDE-X upgrades.

Additionally, FAA has not fully funded all activities to complete ASDE-X upgrades. Although FAA budgeted $45 million through fiscal year 2016 for some upgrades, it will need more funding to address the remaining ASDE-X operational performance limitations and obsolescence issues. For example, FAA approved funds to procure spare parts and replace ASDE-X processors and multilateration receivers. However, FAA has not provided funding to test the receivers. Moreover, FAA has yet to fund the last two projects associated with upgrading ASDE-X remote units. In fiscal year 2013, the ASDE-X program office initiated a study to determine the best method of upgrading the communication circuits.[12] Once this study is complete, the program office will complete an accurate cost estimate.

FAA states that it does not anticipate any problems with upgrading the ASDE-X system. However, until the Agency completes operational and site testing, it is unclear as to whether or how these upgrades will affect ASDE-X's current functionality or its ability to integrate with other systems. Completing these upgrades in a timely manner is critical since ASDE-X is the core system for transmitting data to the other surface surveillance systems. Moreover, any issues affecting ASDE-X data integrity would affect the integrity of the other integrated systems and add further uncertainties.

PROBLEMS WITH RUNWAY STATUS LIGHTS HAVE INCREASED COSTS AND DELAYED THE PROGRAM'S SCHEDULE, BENEFITS, AND INTEGRATION WITH ASDE-X

The RWSL program has experienced operational and technical issues, resulting in cost growth and delays with ASDE-X integration. Operational tests have revealed system integrity issues, while other tests have uncovered software and interface problems for integrating RWSL with ASDE-X. As a result, FAA rebaselined the RWSL program in July 2013, which significantly increased costs, reduced the number of planned systems, and delayed program completion.

[11] FAA is currently projecting that effort to implement the required upgrades at all sites will begin in 2014 and end sometime in 2018.

[12] The study will examine each ASDE-X airport and each of the ASDE-X system's remote units.

RWSL Has Experienced Operational and Technical Deficiencies During Key Site Deployment

The RWSL program has experienced problems since it completed initial operating capability[13] at the Orlando key site in July 2011, resulting in additional software development and schedule delays. In RWSL tests completed in August 2011, FAA identified a number of operational suitability issues that required hardware changes, updated technical documents and training, and a new software build. These actions resulted in a schedule slip of over a year.

In June 2012, a test conducted by an FAA's Independent Operational Assessment team[14] indicated that RWSL was not operationally ready for national deployment due to seven safety and operational concerns, which include a lack of trained and certified personnel, as well as spare parts with which to perform required maintenance.

FAA installed the new software in Orlando in November 2012 and scheduled another operational test in January 2013. Results from this test indicated that the new software corrected problems revealed during the initial operational test but also uncovered new issues. For example, testing officials observed faulty runway light fixtures that had previously been classified as repaired, air conditioning units in processing equipment areas that could not be remotely monitored, and light fixtures that remained illuminated after being turned off by controllers. If unaddressed or allowed to recur, these problems will result in increased maintenance, reduced availability when needed, and potential safety concerns.

In January 2013, while testing the system to authorize RWSL system deployment—referred to as the in-service review—FAA identified 50 operational and technical issues. In spite of these issues, FAA declared an in-service decision (ISD)[15] to proceed in March 2013. As of August 2013, 30 issues remained unresolved, several of which involve complex software integration of potential site adaptation changes and system interfaces needed to transfer data to FAA navigation, communications, and weather systems.

According to FAA's Acquisition Management System, FAA is only required to develop an action plan to address in-service review issues but not to solve specific issues before ISD. The Independent Operational Assessment team allowed FAA to incorporate its unaddressed issues as part of the ISD action plan. However, if these

[13] Initial Operating Capability is the milestone where the system is used for its intended operations on a limited basis.
[14] The Independent Operational Assessment, conducted by FAA's Safety and Technical Training office, is used to provide decision makers with an independent determination of operational readiness in support of production and in-service decisions.
[15] The in-service decision (ISD) authorizes deployment of a solution into the operational environment. It occurs after demonstration of initial operational capability at the key test site(s) and before initial operational capability at any non-key site or waterfall facility.

issues remain unresolved, they will likely impact FAA's ability to certify the system and maintain software and interface integrity.

Despite issues uncovered during earlier tests, FAA commissioned[16] the first system at Orlando in August 2013, 2 years later than originally planned. As a requirement of commissioning the system, FAA developed a plan to address or mitigate all operational testing issues. However, several test items remain open and will not be corrected until a future software build is developed, which is now underway. FAA is currently updating the RWSL software in preparation for the next system deployment at Washington Dulles International Airport, scheduled for commissioning in August 2014.

The RWSL Program Has Experienced Cost Growth and Schedule Delays

The RWSL program has experienced cost growth, delaying the expected capabilities needed to improve runway safety. There are site-specific cost increases due to

- higher-than-planned costs for light fixture construction and shelter installations,
- airports' requests for more lighting than originally planned, and
- limited availability of active runway and taxiways for construction activities.

For example, construction costs resulted in overall RWSL deployment cost estimates at Atlanta and Denver airports of $80 million and $54 million, respectively. Thus, FAA decided that it could not maintain an affordable schedule deploying at these two sites and removed them from the schedule.

Software deficiencies and cost growth led to FAA's decision to rebaseline the RWSL program in July 2013. The new baseline increased the total program cost by approximately $40 million (from $327 million to $367 million), decreased the number of deployed systems from 23 to 17, and extended RWSL deployment completion from 2015 to 2017 (see table 1).

[16]A commissioned system is one that has been formally accepted and placed into operational service in the National Airspace System and the deployment site has assumed maintenance responsibility.

Table 1. RWSL Deployment Schedule as of July 2013

	RWSL Airport Locations	Month/Year for Initial Operating Capability (IOC)	Month/Year for Commission Date
1	Orlando International (FL)	July 2011	August 2013
2	Washington Dulles International (VA)	July 2013	August 2014
3	Phoenix Sky Harbor International	August 2013	September 2014
4	Minneapolis/St. Paul International	November 2013	October 2014
5	George Bush Intercontinental (Houston, TX)	September 2013	November 2014
6	Seattle-Tacoma International (WA)	June 2014	December 2014
7	Charlotte-Douglas International (NC)	July 2014	January 2015
8	McCarran International (Las Vegas, NV)	August 2014	February 2015
9	Ft. Lauderdale-Hollywood International (FL)	September 2014	March 2015
10	Detroit Metropolitan Wayne County (MI)	November 2014	May 2015
11	LaGuardia (New York, NY)	November 2014	June 2015
12	Chicago O'Hare International (IL)	February 2015	August 2015
13	Los Angeles International (CA)	July 2015	December 2015
14	Newark Liberty International (NJ)	September 2016	March 2017
15	John F. Kennedy International (New York, NY)	November 2016	May 2017
16	San Francisco International (CA)	November 2016	May 2017
17	Baltimore/Washington International (MD)	February 2017	August 2017
18	Logan International (Boston, MA)	Site Removed From Baseline July 2013	
19	Dallas/Ft. Worth International (TX)	Site Removed From Baseline July 2013	
20	San Diego International (CA)	Site Removed From Baseline July 2013	
21	Hartsfield-Jackson Atlanta International (GA)	Site Removed From Baseline July 2013	
22	Denver International (CO)	Site Removed From Baseline July 2013	
23	Philadelphia International (PA)	Site Removed From Baseline July 2013	

Source: FAA

In moving forward with RWSL deployment at the 17 remaining airports, FAA acknowledges that it must address a number of risks, in coordination with airport authorities, before it can successfully deploy the system within the revised cost and schedule baseline. These risks include stabilizing construction methods across deployment sites, minimizing customized site adaptation and design, and balancing the availability of runways for RWSL installation with airport operations.

FAA also recognizes that it must continue efforts to provide direct warning capability to pilots at the six airports that were removed from the original schedule. For example, three of the six sites (Boston, Dallas/Fort Worth, and San Diego) have prototype RWSL systems that FAA will continue to maintain through fiscal year 2016. These airports will be considered for alternative solutions for alerting pilots focused on ADS-B applications. However, the rebaseline decision has resulted in delays to ASDE-X integration efforts, reduced benefits of improved detection of runway incursions and ground collisions, and the loss of key airports with prior experience and expertise with the new technology.

WHILE FAA HAS MADE PROGRESS INTEGRATING ADS-B AND ASDE-X, IT IS UNCLEAR HOW AND WHEN ADS-B WILL BENEFIT PILOTS

FAA has made progress deploying ADS-B technology with ASDE-X but has not determined whether ADS-B applications will provide pilots with expected benefits. FAA has not completed testing or demonstrations to determine whether ADS-B traffic information can be displayed to pilots in the cockpit through moving map displays. FAA also suspended efforts to provide pilots with direct alerts of potential ground collisions and incursions using ADS-B data because the Agency determined it needs more funding to address problems with the system's signal.

FAA Has Not Completed Sufficient Testing for the Use of Moving Map Displays in Aircraft Cockpits That Utilize ADS-B Data

FAA has nearly finished installing the infrastructure needed to broadcast ADS-B data at all airports with ASDE-X. However, FAA has not completed testing of a highly anticipated airport moving map application to determine whether ADS-B information can be displayed in the aircraft cockpit. In 2008, FAA's Office of Runway Safety established an Electronic Flight Bag[17] program to evaluate the safety impact and usability of moving maps that can display an aircraft's position in relation to the airport's surface. Although this evaluation ended in September 2012, FAA has not completed an additional study of Electronic Flight Bags that includes the use of moving map displays supplied with traffic information from ADS-B. Further, FAA has only approved the initial phase of a demonstration project in Philadelphia that will use a certified Electronic Flight Bag device to define procedures and provide a cockpit display of traffic information.

Despite incomplete testing, FAA tried to expand the use of ADS-B technology by issuing guidance in 2011 for installing ADS-B equipment to enable moving map displays with Electronic Flight Bag operation and installing and maintaining ADS-B transponder units on airport service vehicles. FAA maintains that ADS-B deployment at ASDE-X airports, including the capability of broadcasting surface traffic information, will encourage air carriers to voluntarily equip with ADS-B while also enticing airport authorities to sponsor efforts to equip their service vehicles. According to FAA, this technology will give air carriers a positive return on investment with increased accuracy and other benefits.

FAA is also continuing to conduct ADS-B demonstrations on aircraft and airport vehicles with airport moving map displays and transponder equipment. However,

[17] An Electronic Flight Bag is an electronic display system intended primarily for cockpit or cabin use. The electronic flight bag replaces the paper reference material that pilots typically carry.

the Agency has yet to verify whether these ADS-B applications can provide pilots with the expected benefits. According to FAA, demonstrations with "commercial-off-the-shelf" devices that are programmed to receive a traffic information service supplied by ADS-B will help inform the aviation industry that moving map applications will increase situational awareness.

However, FAA cannot quantify these benefits until air carriers choose to equip with this technology and until accuracy levels improve with more use, feedback, and development. At present, only about 2.5 percent of commercial air carriers are using moving map technology in cockpit displays. FAA states that the moving map display application is currently not an ADS-B program requirement and that it can only mandate that aviation users adopt this function through rulemaking. FAA also states that it will only develop timelines in response to user demand; however, users are reluctant to equip due to cost, the lack of an immediate return on investment, and the possibility that moving map technology may become obsolete before they can realize the benefits.

FAA Has Halted Plans To Provide Pilots With Direct Alerting Capability Based on ADS-B Data

FAA has suspended efforts to provide pilots with direct alerts of potential ground collisions using ADS-B data. These surface alerts would be similar to ASDE-X alerts for controllers and would enhance pilots' situational awareness of other traffic operating on runways and taxiways. Surface alerts would also be responsive to an NTSB recommendation[18] for FAA to develop an automatic system to alert pilots of attempted takeoffs from taxiways or wrong runways.

However, preliminary demonstrations on surface alert technology for pilots have identified deficiencies with signal accuracy, integrity, and frequency interference. Our review of the demonstration data showed that some targets did not have a clear line of sight, resulting in poor detection performance. Although re-broadcasting data from targets without line of sight to targets enabled with ADS-B may mitigate this weakness, it would require that airports be equipped with ADS-B surveillance and broadcast technology. The demonstrations also revealed that airport structures, such as the security gates installed around aircraft hangars, interfered with ADS-B signals and created blind spots on the airport surface. If not addressed, this weakness would leave surface alert technology unable to reliably detect aircraft operating on the surface, rendering the technology unsuitable for airports that could gain the most benefit from a surface alert system for pilots.

[18] NTSB Safety Recommendation A-07-045, issued August 28, 2007 to FAA: Require that all 14 Code of Federal Regulations Part 91K, 121, and 135 operators install on their aircraft cockpit moving map displays or an automatic system that alerts pilots when a takeoff is attempted on a taxiway or a runway other than the one intended. Status is currently Open-Unacceptable Response.

FAA concluded from these demonstrations that surface alerting technology requires a more complex design and upgrades to address these issues and stated it needs funding for further research and development. However, FAA indicated that research for how to provide ADS-B surface alerts will not be a funding priority until it first develops a surveillance system for pilots that meets FAA's requirements. Consequently, it is unclear as to when ADS-B will enhance surface awareness or how this technology will achieve benefits for pilots.

FAA'S PLANS TO IMPLEMENT SURFACE SURVEILLANCE TECHNOLOGIES LACK KEY DETAILS ON PRIORITIES, TIMING, AND ACCOUNTABILITY

FAA issued a biannual National Runway Safety Plan (NRSP) in September 2011 that identifies general roles, performance metrics, and current and emerging technologies designed to impact runway safety. The plan also outlines initiatives for runway safety, focusing on areas such as guidance, training, and infrastructure. According to the NSRP, the purpose of the plan is to provide a coordinated vision to achieve goals and objectives. Additionally, FAA's 2013 NextGen Implementation Plan (NGIP) outlines the Agency's goals of providing surface awareness for controllers and pilots to increase safety by expanding the use of ASSC at designated airports and developing taxi benefits for aircraft equipped with certified enhanced vision systems.[19]

However, neither the NRSP nor the NGIP contain specific details regarding

- which technologies are Agency priorities,
- when technologies will be deployed,
- how FAA will address integration challenges between the technologies,
- what goals and performance measures FAA must achieve to enhance runway safety with these technologies, and
- who will be accountable for ensuring technologies meet Agency goals.

According to FAA, the NRSP is intended to be a broad outline providing an overall national strategy to ensure organizations with runway safety responsibilities are working together. The NGIP is a document that covers a wide range of NextGen initiatives and only discusses runway safety technology in context with NextGen programs such as ADS-B. However, neither plan has a clear

[19] Certified Enhanced Vision Systems use imaging-sensor technologies to provide a real-time image of external scene topography to the pilot but are currently approved for only situational awareness and safety while on the ground.

roadmap on how to achieve a particular level of technology or standard to actually enhance runway safety.

In addition, FAA has a number of offices that cross several lines of business that play a role in runway safety activities as shown in table 2.

Table 2. FAA Offices Involved in Runway Safety

FAA Office	Roles/Responsibilities
Surveillance Services Program Management Office	**Deploys surveillance systems in airport movement areas only.** *(Air Traffic Organization - Program Management Operations)*
Runway Safety Group	**Maintains incursion data repository, sponsors integration studies, and performs independent assessments.** *(Air Traffic Organization – Safety and Technical Training)*
William J. Hughes FAA Technical Center	**Performs operational tests and ensures data integrity for surveillance systems.** *(Office of Deputy Administrator (NextGen) – Test & Evaluation Service Division)*
FAA Technical Operations	**Performs engineering and optimization activities for surface surveillance.** *(Air Traffic Organization – NAS Engineering Group)*
Office of Airports	**Negotiates and provides contacts with airport authorities.** *(Office of Airports – Airport Planning and Programming)*
NextGen Demonstrations	**Funds surveillance developmental activities and distributes data from surface surveillance prototypes.** *(Office of the Deputy Administrator (NextGen) –Technology Development and Prototyping Division)*
Flight Standards	**Provides standards, criteria, and policy on the design and use of future ground-based, airborne, navigation, and surveillance systems.** *(Aviation Safety – Flight Technologies and Procedures Division)*

Source: OIG

While FAA has identified its offices that must work together to improve runway safety, the Agency's plans do not detail an overall coordination strategy needed for these groups to integrate technologies in the NAS. FAA's Runway Safety Group, responsible for developing the NSRP, has experienced staffing reductions in recent years due to budget constraints and lacks the visibility needed to influence decision makers within FAA. As FAA moves toward portfolio management of all of its surveillance systems, adequate coordination between offices with roles in runway safety will be necessary to ensure successful implementation of surface surveillance systems and prevent duplicative efforts.

CONCLUSION

While FAA operates one of the world's safest aviation systems, runway safety remains a significant concern. To ensure its safety technologies are fully functional, effectively mitigate safety risks, and help prevent future accidents on runways, FAA will need to address key operational and management issues with its individual programs and develop a coherent strategy for an integrated runway safety system with clear priorities and lines of accountability.

RECOMMENDATIONS

To improve FAA's effectiveness in deploying and integrating surface surveillance systems that improve runway safety, we recommend the Agency:

1. Develop and implement a plan, in coordination with airport authorities, to address issues, such as construction schedules and site adaptation/design that may impede RWSL's deployment within cost and schedule estimates.

2. Develop and finalize timetables as to when ADS-B can be expected to impact surface surveillance systems through the use of moving map information in cockpit displays and surface alerts for pilots.

3. Develop specific milestones for integrating ASDE-X, ASSC, RWSL, and ADS-B based on coordination between offices involved in runway safety; identify the offices accountable for achieving these milestones; and publish this information in the FAA National Runway Safety Plan.

AGENCY COMMENTS AND OFFICE OF INSPECTOR GENERAL RESPONSE

We provided FAA with our draft report on April 22, 2014, and received its formal response on June 11, 2014. FAA's complete response is included in the appendix to this report. FAA concurred with recommendations 1 and 2 and partially concurred with recommendation 3. FAA provided appropriate planned actions and completion timeframes for recommendation 1, but we are requesting that FAA reconsider its response for recommendations 2 and 3.

Specifically, for recommendation 2, FAA concurred and stated that it has published regulations that form a framework for manufacturers to build and install avionics that overlay surveillance data for surface traffic on moving map cockpit displays. We acknowledged in our report that FAA published regulations; however, FAA's response did not address our concerns regarding when the

Agency will complete testing or demonstrations to determine whether (1) ADS-B traffic information can be displayed to pilots through moving map displays or (2) ADS-B applications can provide pilots with expected safety improvements. FAA's response also does not address when or if the Agency intends to move forward with testing surface alerts for pilots using ADS-B data to avoid ground collisions. This work is important because it addresses a longstanding NTSB safety recommendation to FAA to provide surface awareness tools to pilots. Therefore, we are requesting that FAA provide us with timeframes for when the Agency expects to complete testing of ADS-B in relation to moving map displays and surface alerts. Until we receive this information, we consider recommendation 2 open and unresolved.

For recommendation 3, FAA partially concurred, noting that programmatic milestones are not appropriate for publication in its NRSP. However, our recommendation did not reference programmatic milestones but rather integration milestones—timeframes for completing tests and verification activities for linking surface surveillance technologies that allow the introduction of new runway safety capabilities. We maintain that integration milestones are necessary because progress hinges on how well systems work together to achieve a level of runway safety. These milestones should also be coordinated and managed. Therefore, we request that FAA reconsider its response and specifically address integration issues and related milestones in the NRSP. Until we receive FAA's revised response, we consider recommendation 3 open and unresolved.

ACTIONS REQUIRED

FAA provided appropriate planned actions and completion timeframes for recommendation 1, and we consider it resolved but open pending completion of the planned actions. We consider recommendations 2 and 3 open and unresolved, and, in accordance with Department of Transportation Order 8000.1C, we request that FAA provide the additional information described above within 30 days of this report.

We appreciate the courtesies and cooperation of FAA representatives during this audit. If you have any questions concerning this report, please call me at (202) 366-1987 or Kevin Dorsey, Program Director, at (202) 366-1518.

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cc: FAA Deputy Administrator
FAA Chief of Staff
DOT Audit Liaison, M-1
FAA Audit Liaison, AAE-100

EXHIBIT A. SCOPE AND METHODOLOGY

We conducted this performance audit from November 2012 to April 2014 in accordance with generally accepted Government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient and appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

To assess FAA's progress in integrating ASDE-X with other technologies such as RWSL and ADS-B to improve runway safety, we focused our efforts on programs designed to improve surface situational awareness for pilots and controllers. Although there are other FAA initiatives designed to impact surface awareness, we focused on these programs because they have current baselines established through final investment decisions made by FAA's Joint Resources Council.

We analyzed key program planning, implementation, and status documentation for the ASDE-X, RWSL, and ADS-B programs. We reviewed various documents from the Surface Program Management Office at FAA Headquarters, FAA William J Hughes Technical Center in Atlantic City, NJ, and FAA's Aeronautical Center NAS Engineering Group in Oklahoma City, OK. We have also obtained and reviewed documents on: investment decisions, requirements, budget, in-service reviews, independent operational assessments, operational testing, optimization reports, event analysis reports, and runway safety plans.

We interviewed surface surveillance program officials at FAA Headquarters, FAA William J. Hughes Technical Center in Atlantic City, NJ, and FAA Aeronautical Center NAS Engineering Group in Oklahoma City, OK. We also interviewed various FAA officials from the Surveillance Services program office (which include ASDE-X, RWSL and ADS-B program office officials), NextGen Technology Development and Prototyping Division Office, Safety and Technical Training Office (Runway Safety), Aviation Safety (Flight Standards Service), Surface System Operations Services, Office of Airports (Safety and Standards Division), and Air Traffic Safety Oversight to obtain program status information, integration efforts, and identify risks.

We conducted a site visit at the Orlando, FL International Airport Air Traffic Control Tower and the Greater Orlando Airports Authority to determine the status of RWSL key site implementation and integration activities. We also visited the Boston, MA Logan Airport Air Traffic Control Tower and the Massachusetts Airports Authority to obtain information regarding RWSL prototype efforts at Boston's Logan Airport and integration activities.

EXHIBIT B. ACTIVITIES VISITED OR CONTACTED

Federal Aviation Administration (FAA)

Headquarters

Surveillance Services Program Management Office	Washington, DC
Office of Airports, Planning and Programming	Washington, DC
NextGen Demonstrations and Prototyping	Washington, DC
Runway Safety Group, Office of Safety and Technical Training	Washington, DC

Sites

FAA William J. Hughes Technical Center Test and Evaluation Service Division	Atlantic City, NJ
FAA Aeronautical Center, NAS Engineering Group	Oklahoma City, OK
Boston/Logan Airport Air Traffic Control Tower	Boston, MA
Massachusetts Airport Authority	Boston, MA
Orlando International Airport Air Traffic Control Tower	Orlando, FL
Greater Orlando Airport Authority	Orlando, FL

EXHIBIT C. AIRPORTS WITH INSTALLED SURFACE SURVEILLANCE TECHNOLOGIES

Airport	ASDE-X Installed	ADS-B Installed	RWSL Installed
1. General Mitchell International (Milwaukee, WI)	Y	Y	
2. Orlando International (FL)	Y	Y	Y
3. T. F. Green State (Providence, RI)	Y	Y	
4. W.F. Hobby (Houston, TX)	Y	Y	
5. Seattle-Tacoma International (WA)	Y	Y	N
6. Lambert-St. Louis International (MO)	Y	Y	
7. Hartsfield- Jackson Atlanta International (GA)	Y	Y	
8. Bradley International (Hartford, CT)	Y	Y	
9. Louisville International – Standiford Field (KY)	Y	Y	
10, Chicago O'Hare International (IL)	Y	N	N
11. Charlotte-Douglas International (NC)	Y	Y	N
12. Washington Dulles International (VA)	Y	N	N
13. Detroit Metropolitan Wayne County (MI)	Y	Y	N
14. Phoenix Sky Harbor International (AZ)	Y	Y	N
15. John F. Kennedy International (NY)	Y	N	N
16. Los Angeles International (CA)	Y	Y	N
17. Ft. Lauderdale/Hollywood International (FL)	Y	Y	N
18. Newark Liberty International (NJ)	Y	Y	N
19. Logan International (Boston, MA)	Y	Y	
20. George Bush Intercontinental (Houston, TX)	Y	Y	N
21. Miami International (FL)	Y	Y	
22. Denver International (CO)	Y	Y	
23. Philadelphia International (PA)	Y	Y	
24. Minneapolis-St. Paul International (MN)	Y	Y	N
25. Dallas/Ft. Worth International (TX)	Y	Y	
26. John Wayne-Orange County (CA)	Y	Y	
27. Salt Lake City International (UT)	Y	N	
28. Ronald Reagan Washington National (VA)	Y	Y	
29. Chicago Midway International (IL)	Y	N	
30. San Diego International (CA)	Y	Y	
31. Honolulu International (HA)	Y	N	
32. LaGuardia (New York, NY)	Y	Y	N
33. McCarran International (Las Vegas, NV)	Y	N	N
34. Baltimore/Washington International (MD)	Y	Y	N
35. Memphis International (TN)	Y	N	
	ASSC Installed	**ADS-B Installed**	**RWSL Installed**
36. San Francisco International (CA)	N	N	N
37. Cleveland Hopkins International (OH)	N	N	
38. Cincinnati/Northern Kentucky International (KY)	N	N	
39. Kansas City International (MO)	N	N	
40. Pittsburgh International (PA)	N	N	
41. Portland International (OR)	N	N	
42. Andrews Air Force Base (MD)	N	N	
43. Louis Armstrong New Orleans International (LA)	N	N	
44. Ted Stevens Anchorage International (AK)	N	N	

Source: FAA, Y=Yes N=No

EXHIBIT D. MAJOR CONTRIBUTORS TO THIS REPORT

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Kevin Dorsey	Program Director
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Calvin Moore	Analyst
Andrea Nossaman	Senior Writer-Editor

APPENDIX. AGENCY COMMENTS

Federal Aviation Administration

Memorandum

Date: June 11, 2014

To: Matthew E. Hampton, Deputy Assistant Inspector General for Aviation

From: H. Clayton Foushee, Director, Office of Audit and Evaluation, AAE-1

Subject: Federal Aviation Administration's (FAA) Response to Office of Inspector General (OIG) Draft Report: FAA's Runway Safety Technologies

The FAA is committed to enhancing airport safety through significant investments in the development and deployment of new technology surface surveillance systems. The Surveillance and Broadcast Services (SBS) program will deploy a new technology, Airport Surface Surveillance Capability (ASSC), at airports that did not receive an Airport Surface Detection Equipment, Model X (ASDE-X) system. ASSC will provide enhanced surface situational awareness and advanced warnings of potential runway incursions at nine U.S. airports,[1] and additional sites are under consideration. Each ASSC deployment will incorporate a number of sensors[2] and software for a single, combined view of the airport runways and taxiways. The flexible nature of the ASSC system architecture enables future airport surface safety enhancements, such as Runway Status Lights (RWSL), and airport surface movement data distribution to other approved systems and users.

In addition, the SBS program introduced an enhancement to the ASDE-X system to perform multilateration surveillance on the Universal Access Transceiver[3] data link. This upgraded capability provides a layered approach for surveillance of 978MHz equipped aircraft and vehicles and was completed in 2013.

ADS-B also provides the additional surveillance layer for surface operations with both aircraft and vehicles and enables advanced cockpit applications and improved data sharing for surface management. The deployment and integration of the ADS-B system

[1] Anchorage, Andrews AFB, Cincinnati/Northern Kentucky, Cleveland, Kansas City International, New Orleans, Pittsburgh, Portland and San Francisco

[2] Automatic dependent surveillance-broadcast (ADS-B) and multilateration, but not primary radar which is used primarily for non-cooperative vehicles/aircraft

[3] A Universal Access Transceiver (UAT) refers to a data link intended to serve the majority of the general aviation community.

in the surface domain will be completed by the end of 2014 at ASDE-X sites and in 2017 at ASSC sites.

RWSL systems integrate airport lighting equipment with approach and surface surveillance systems to provide a visual signal to pilots and vehicle operators indicating that it is unsafe to enter, cross, or begin takeoff on a runway. In July 2013, the Joint Resources Council made the decision to reduce the quantity of airports that would receive a RWSL system from 23 to 17. All Initial Operating Capability (IOC) and Operational Readiness Demonstration[4] at these 17 [5]sites are scheduled to be completed by the end of fiscal year 2017. The remaining six sites will be addressed in a second phase of the program in which the agency will analyze technology and non-technology alternatives to directly address runway incursions at future airport sites. Since the program was rebaselined, the RWSL program has made steady progress with the implementation of the system. Since the commissioning of the Orlando site in August 2013, IOC has been achieved at six additional sites (Dulles, Phoenix, Minneapolis, Houston Intercontinental, Seattle, and Las Vegas). Of these six sites, two sites, Phoenix and Houston Intercontinental, have also been commissioned.

RECOMMENDATIONS AND RESPONSES

Recommendation 1: Develop and implement a plan, in coordination with airport authorities, to address issues, such as construction schedules and site adaptation/design that may impede RWSL's deployment within cost and schedule estimates.

FAA Response: Concur. The FAA's RWSL program office has standardized a process for communicating with airport authorities in order to facilitate RWSL deployment within cost and schedule estimates. The process is described in detail in the RWSL Implementation Plan. A site coordination lead is assigned as the primary point of contact between the program office and the airport authority. The program office coordinates closely with the respective airport authorities in the development of a memorandum of agreement (MOA), which documents the work to be accomplished, the cost of the work, the timeframe, and each party's responsibilities.

During the development of the MOA, the program office explicitly communicates to the airport authority, the not-to-exceed funding budget and schedule for the project. Subsequently, during the site design process, the program office confers with the airport authority each step of the way. In addition to numerous design telecons, there are a minimum of two on-site design review meetings to resolve any noted discrepancies or

[4] IOC is a milestone met when the system is deemed acceptable to be introduced into the operational environment at a site. Operational Readiness Demonstration is when the system is certified and commissioned into NAS service after demonstration of readiness for full operational service at a site.

[5] Orlando, Dulles, Phoenix, Minneapolis, Houston, Seattle, Charlotte, Las Vegas, Ft. Lauderdale, Detroit, LaGuardia, Chicago, Los Angeles, Newark, John F. Kennedy, San Francisco and Baltimore-Washington.

deficiencies. This same high level coordination and communication is applied through pre-construction, construction, installation, and activation of service.

In accordance with FAA's acquisition practices, the program office is in the process of updating the RWSL Implementation Plan. The program office anticipates completing the update by June 30, 2014, and will provide a copy at that time.

Recommendation 2: Develop and finalize timetables as to when ADS-B can be expected to impact surface surveillance systems through the use of moving map information in cockpit displays and surface alerts for pilots.

FAA Response: Concur. ADS-B target data depicted on moving map cockpit displays are currently available. Minimum Operating Performance Specifications (DO-317A) containing the requirements of Basic Surface Situation Awareness were published in 2011 by Radio Technical Commission for Aeronautics. In 2012, FAA published Technical Standard Order (TSO-C195a) and Advisory Circular (AC 20-172A). These documents form the regulatory framework for manufacturers to build and install avionics that overlays surveillance data for surface traffic on a moving map on cockpit displays. The FAA requests that this recommendation be closed.

Recommendation 3: Develop specific milestones for integrating ASDE-X, ASSC, RWSL, and ADS-B based upon coordination between offices involved in runway safety; identify the offices accountable for achieving these milestones; and publish this information in the FAA National Runway Safety Plan.

FAA Response: Partially Concur. The National Runway Safety Plan (NRSP) is a high-level strategic document, and as such, specific programmatic milestones are not appropriate for inclusion in the NRSP. The Program Management Organization (PMO) produces more appropriate and timely reports of related milestones on a regular basis. The Office of Safety and Technical Training will coordinate with the PMO to identify the respective accountable offices for FAA's surface surveillance priorities, and will publish this information (not milestones) in the next NRSP, which will be completed by September 30, 2014.