Federal Aviation Administration

N A R P

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The *National Aviation Research Plan* (NARP) is a report of the Federal Aviation Administration to the United States Congress pursuant to Section 44501(c) of Title 49 of the United States Code. The NARP is available on the Internet at http://www.faa.gov/go/narp.

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Executive Summary

Aviation is a vital resource for the United States (U.S.) because of its strategic, economic, and social importance. It provides opportunities for business, job creation, economic development, law enforcement, emergency response, personal travel, and leisure. It attracts investment to local communities and opens up new domestic and international markets and supply chains. As a result, the U.S. needs a system that leads the global aviation community and responds quickly to changing and expanding transportation needs. The Federal Aviation Administration (FAA) supports this system through the introduction of new technologies and procedures, innovative policies, and advanced management practices.

The *National Aviation Research Plan* (NARP) is the FAA's performance-based plan to ensure that research and development (R&D) investments are well managed, deliver results, and sufficiently address national aviation priorities. The NARP integrates the FAA R&D programs into a portfolio that addresses the near-, mid-, and far-term research needs of the aviation community. The NARP features R&D principles and goals that support the strategic visions laid out by the President, Secretary of Transportation, and FAA Administrator. This approach enables the FAA to address the current challenges of operating the safest, most efficient air transportation system in the world while building a foundation for the future system in an environmentally sound manner. However, in accordance with the Presidential Sequestration Order dated March 1, 2013, sequestration impacts accounts funding FAA R&D in FY 2013, and funding impacts this year will likely have a continuing effect in FY 2014 and beyond for program plans (e.g. implementation schedule delays and out year cost estimate adjustments).

Section 44501(c) of Title 49 of the United States Code (49 U.S.C. § 44501(c)) requires the Administrator of the FAA to submit the NARP to Congress annually with the President's Budget. The NARP includes applied R&D as defined by the Office of Management and Budget (OMB) Circular A-11[1] and involves activities funded in four appropriation accounts: Research, Engineering and Development (RE&D), Facilities and Equipment (F&E), Grants-In-Aid for Airports (AIP), and Operations (Ops).

In fiscal year (FY) 2014, the FAA plans to invest a total of $309,050,000 in R&D. The R&D investment spans multiple appropriations for the FAA, including $166,000,000 in RE&D; $97,550,000 in F&E; $44,500,000 in AIP; and $1,000,000 in Ops. The funding will be used to achieve three central FAA R&D Principles - Improve Aviation Safety, Improve Efficiency, and Reduce Environmental Impacts. The NARP aligns with the White House National Science and Technology Council (NSTC)[2] *National Aeronautics Research and Development Plan,* the *U.S. Department of Transportation's Strategic Plan for Fiscal Years 2012–2016*, and FAA strategic planning.

[1] OMB Circular A-11, *Preparation, Submission and Execution of the Budget*, August 3, 2012, section 84, page 11 (http://www.whitehouse.gov/OMB/circulars).

[2] The National Science and Technology Council (NSTC) was established by Executive Order 12881 on November 23, 1993. This Cabinet-level Council is the principal means within the executive branch to coordinate science and technology policy across the diverse entities that make up the federal research and development enterprise. For more information, see: http://www.whitehouse.gov/ostp/nstc.

Preface

In previous years, the FAA's R&D portfolio and the NARP were aligned with the goals in the FAA *Flight Plan*. Since the *Flight Plan* has been superseded by other FAA strategic planning, the FAA's R&D goals and the format of the NARP required significant changes. Also, there was a desire to strengthen the alignment between the NARP and the NSTC *National Aeronautics Research and Development Plan*, as well as integrate the Next Generation Air Transportation System (NextGen) more uniformly throughout the NARP.

In 2012, the R&D Executive Board (REB) thoroughly analyzed the existing 10 R&D goals, R&D Targets, and Methods of Validation and replaced them with 3 new R&D principles and 22 R&D goals. The three R&D principles align with the NSTC *National Aeronautics Research and Development Plan*, the *U.S. Department of Transportation's Strategic Plan for Fiscal Years 2012–2016,* and FAA strategic planning. The new R&D goals cover the FAA's main research areas of Aircraft Safety, Weather, National Airspace System (NAS) Operations, Commercial Space, Airports, and Environment and Energy. Perhaps the most significant change in the 2013 NARP is that the new R&D principles and R&D goals are mapped to the principles and goals of the NSTC *National Aeronautics Research and Development Plan*.

Existing research milestones in the NARP did not change but were re-distributed to the appropriate new R&D principle and R&D goal. In previous NARP publications, all of the program information supporting the R&D goals appeared in Chapter 2. In the 2013 NARP, each of the three new R&D principles has its own chapter: Chapter 1 – Improve Aviation Safety, Chapter 2 – Improve Efficiency, and Chapter 3 – Reduce Environmental Impacts. Within each R&D Principle chapter are the R&D goals and supporting program information (program description, milestones, and progress items).

Over the last several years, the FAA's research community has been integrating the NextGen foundations of Safety, Flexibility, and Sustainability into current and future R&D programs. Hence, the previous standalone NextGen chapter (Chapter 3 - Alignment with NextGen), which was initially included in the 2008 NARP, was removed from the 2013 NARP. The majority of the information in the previous NextGen chapter was already being captured in other sections of the NARP and/or NextGen documents, such as the *NextGen Implementation Plan.*.

To streamline the NARP, the FAA has deleted the volume of appendices. Previously, Appendix A - Program Descriptions provided re-printed copies of all the budget narratives for that requested FY. Instead, the Program Funding tables at the beginning of each R&D Principle chapter list the section and page number reference for each budget narrative within the FAA's Congressional Justification for the President's Budget Request. The previous Appendix B - Partnership Activities now has a separate chapter within the NARP (Chapter 5), but the tables with specific contractual details of agreements are no longer presented. The previous Appendix C - Research, Engineering, and Development Advisory Committee (REDAC) has been deleted. A link to all of the information for REDAC is provided in Chapter 4. In addition, milestone information, which was previously provided in Appendix D - NARP Milestones Status, is now presented in tabular form in the corresponding R&D Principle Chapter 1 through 3 under the appropriate program.


Additional Security Checkpoint for all Southwest & AirTran departures is located on the Lower Level, near Bag Belt #1
Passengers Enter Here
Business Class, A+ Elite, and A2B Corporate customers check-in enter here

Introduction

To maximize the opportunities that the aviation industry provides, the U.S. must not only maintain, but also continue to improve upon, the National Airspace System (NAS) so that it remains responsive to rapidly changing and expanding transportation needs while ensuring the highest level of safety. Increased mobility, higher productivity, reduced environmental impact, and greater efficiency are possible through the introduction of new technologies and procedures, innovative policies, and advanced management practices. Collaborative, needs-driven research and development (R&D) is central to this process, because it enables the U.S. to be a world leader in its ability to move people and goods by air safely, securely, quickly, affordably, efficiently, and in an environmentally sound manner.

Mission

The FAA's mission is to provide the safest and most efficient aerospace system in the world. To support this mission, the FAA's corresponding R&D mission is to conduct, coordinate, and support domestic and international R&D of aviation-related products and services that will ensure a safe, efficient, and environmentally sound global air transportation system. It supports a range of research activities from materials and aeromedical research to the development of new products, services, and procedures.

Vision

The overall vision of the FAA is to strive to reach the next level of safety, efficiency, environmental responsibility, and global leadership. The FAA is accountable to the American public and stakeholders. Furthermore, in 2003 the Secretary of Transportation set forth a specific vision to transform the nation's air transportation system into one that is substantially more capable of ensuring America maintains its leadership in global aviation[3]. That proclamation led to the Vision 100 – Century of Aviation Reauthorization Act[4], which became the foundation of the Next Generation Air Transportation System (NextGen). To support these visions, the FAA strives to conduct world-class, cutting edge R&D.

[3] Letter to the President from Secretary of Transportation Norman Y. Mineta, "America at the Forefront of Aviation: Enhancing Economic Growth," November 25, 2003.

[4] Vision 100 – Century of Aviation Reauthorization Act, Public Law 108-176, December 12, 2003 (http://www.gpo.gov/fdsys/pkg/PLAW-108publ176/pdf/PLAW-108publ176.pdf)

The FAA has defined five R&D organizational values to enable it to better manage its programs and achieve its R&D vision. These are:

- Goal driven - Achieve the mission. The FAA uses R&D as a primary enabler to accomplish its goals and objectives.
- World class - Be the best. The FAA delivers R&D results that are high quality, relevant, and improve the performance of the aviation system.
- Collaborative - Work together. The FAA partners with other government agencies, industry, and academia to capitalize on national R&D capabilities to transform the air transportation system.
- Innovative - Turn ideas into reality. The FAA empowers, inspires, and encourages our people to invent new aviation capabilities and create new ways of doing business to accelerate the introduction of R&D results into new and better aviation products and services.
- Customer focused - Deliver results. The FAA R&D program delivers quality products and services to the customer quickly and affordably.

By aggressively promoting these values, the FAA will generate the maximum benefit from its R&D resources to help achieve its vision and the national vision of a transformed aviation system.

National Goals and Strategic Plans

The establishment of national goals provides a framework for the FAA to identify and confront the most significant research challenges facing our nation's aviation system. This section explains how the White House Office of Science and Technology Policy, Office of the Secretary of Transportation (OST), and FAA framework of goals and strategic plans are connected and how the FAA R&D portfolio supports the larger effort by providing research to pursue the near-, mid-, and far-term needs of the aviation community.

National Aeronautics Research and Development Plan

The National Aeronautics Research and Development Policy (December 2006) established a series of guiding principles to conduct Federal aeronautics research and development:

- Mobility through the air is vital to economic stability, growth, and security as a Nation.
- Aviation is vital to national security and homeland defense.
- Aviation safety is paramount.
- Security of and within the aeronautics enterprise must be maintained.
- The United States should continue to possess, rely on, and develop its world-class aeronautics workforce.
- Assuring energy availability and efficiency is central to the growth of the aeronautics enterprise.
- The environment must be protected while sustaining growth in air transportation.

To advance these principles, on February 2, 2010, the NSTC published the most recent *National Aeronautics Research and Development Plan*. The plan lays out high-priority national aeronautics R&D challenges, goals, and supporting objectives to guide the conduct of U.S. aeronautics R&D activities through 2020. As the first in a process of biennial updates, the plan provides focused updates to a number of specific R&D goals and objectives in the *National Plan for Aeronautics Research and Development and Related Infrastructure* published in 2007. This R&D plan:

- Supports the coordinated efforts of the Federal departments and agencies in the pursuit of stable and long-term foundational research
- Ensures U.S. technological leadership in aeronautics for national security and homeland defense capabilities
- Advances aeronautics research to improve aviation safety, air transportation, and reduce the environmental impacts of aviation
- Promotes the advancement of fuel efficiency and energy independence in the aviation sector
- Spurs the development of innovative technologies that enable new products and services

For more information, see: http://www.whitehouse.gov/sites/default/files/microsites/ostp/aero-rdplan-2010.pdf.

U.S. Department of Transportation Strategic Plan

The *U.S. Department of Transportation's Strategic Plan for Fiscal Years 2012–2016: Transportation for a New Generation* was created with the input from the U.S. Department of Transportation's (DOT) leadership, employees, and stakeholders. The plan re-imagines America's transportation system as the means by which we connect with one another, grow our economy, and protect the environment. The national objectives of general welfare, economic growth and stability, and the security of the U.S., require the development of transportation policies and programs that contribute to providing fast, safe, efficient, and convenient transportation at the lowest cost, consistent with those and other national objectives, including the efficient use and conservation of the resources of the U.S.[5]. The Plan fulfills the DOT's mission and sets the direction for the DOT to provide safe, efficient, convenient, and sustainable transportation choices through five strategic goals that are supported by a wide□ranging management goal (Organizational Excellence):

- Safety
- State of Good Repair
- Economic Competitiveness
- Livable Communities
- Environmental Sustainability

For more information, see: http://www.dot.gov/dot-strategic-plan.

[5] DOT's mission as stated in Section 101 of Title 49, U.S.C.

Next Generation Air Transportation System (NextGen)

Enacted in 2003 under the Vision 100 – Century of Aviation Reauthorization Act, NextGen is the ongoing transformation of the NAS to advance growth and increase safety while reducing aviation's environmental impact. It represents an evolution from a ground-based system of air traffic control (ATC) to a satellite-based system of air traffic management (ATM). This transformation is being realized through the development of aviation-specific applications for existing, widely-used technologies, such as the Global Positioning System (GPS), and technological innovation in areas such as weather forecasting, data networking, and digital communications. In conjunction with innovative technologies are new airport infrastructure and new procedures, including the shift of certain decision-making responsibilities from the ground to the cockpit. The *NextGen Implementation Plan* provides a roadmap of the FAA's ongoing transition to NextGen[6].

For more information, see: http://www.faa.gov/nextgen/.

FAA's Research and Development Principles and Goals

The FAA uses R&D to support policy and planning, regulation, certification, standards development, and modernization of the NAS. The FAA R&D portfolio supports both the day-to-day operations of the NAS and the development of NextGen. To achieve balance between the near-, mid-, and far-term, the FAA has defined three new R&D principles. The R&D principles help the FAA align, plan, and evaluate its R&D portfolio. The R&D principles are:

- **Improve Aviation Safety -** systematically expand and apply knowledge to produce useful materials, devices, systems, or methods that will improve aviation and space safety and achieve the lowest possible accident rate.

- **Improve Efficiency -** systematically expand and apply knowledge to produce useful materials, devices, systems, or methods that will improve access to and increase capacity and efficiency of the nation's aviation system.

- **Reduce Environmental Impacts -** systematically expand and apply knowledge to produce useful materials, devices, systems, or methods that will reduce aviation's environmental and energy impacts to a level that does not constrain growth.

The following table shows the primary relationship among the new FAA R&D principles, previous FAA R&D goals, and the goals from other pertinent strategic documents. The following chapters will provide greater detail about the 22 underlying goals that support FAA's accomplishment of these 3 principles.

[6] http://www.faa.gov/nextgen/implementation/

Strategic Alignment of FAA R&D Principles

Previous FAA R&D Goals 2006-2012 *NARP*			New FAA R&D Principles	*DOT Strategic Plan* Goals	*National Aeronautics Research and Development Plan* Principles
Situational Awareness System Knowledge	High Quality Teams and Individuals Human-Centered Design Human Protection Separation Assurance	Safe Aerospace Vehicles	Improve Aviation Safety	Safety	Aviation Safety
		Fast, Flexible, and Efficient	Improve Efficiency	Economic Competiveness	Mobility
		Clean and Quiet	Reduce Environmental Impacts	Environmental Sustainability	Energy and Environment
World Leadership					

Chapter 1
Improve Aviation Safety

Systematically expand and apply knowledge to produce useful materials, devices, systems, or methods that will improve aviation and space safety and achieve the lowest possible accident rate.

Ten goals support R&D Principle 1 - Improve Aviation Safety with work spread across all four budget appropriations (RE&D, F&E, AIP, and Ops):

- Goal 1 - Improved understanding of aerospace vehicle design, structure, and subsystems to reduce the potential for accidents and incidents and support the development of standards and policy and methodologies and tools for certification.

- Goal 2 - Improved knowledge of the human-system interface and a reduction in accidents and incidents through enhanced aerospace vehicle, air traffic, and technical operations that adapt to, compensate for, and augment the performance of the human.

- Goal 3 - Improved understanding of factors that influence human physiology and performance in aerospace environments and guidance and tools that enhance human safety, protection, and survival during civil aerospace operations.

- Goal 4 - Improved system-wide access and sharing of aviation safety data and analysis tools within the aviation community, providing safety resources that are integrated with operations of aviation industry stakeholders.

- Goal 5 - Established requirements and standards for enabling the availability and improving the quality and quantity of meteorological information to safely implement NextGen operational improvements.

- Goal 6 - Improved accuracy and accessibility of observed and forecast weather to reduce the number of accidents and incidents attributed to hazardous weather.

- Goal 7 - Optimized technical and regulatory provisions and processes used to oversee, coordinate, regulate, and promote safe and responsible activities reliable aerospace operations between space and Earth.

- Goal 8 - Improved vehicle safety and risk management, including knowledge of all safety-critical components and systems of the space vehicles and their operations, to better identify potential hazards and apply and verify hazard controls.

- Goal 9 - Guidance and tools that enhance human safety, protection, and survival during space operations.

- Goal 10 - No fatal accidents on certificated airports as a result of airport design, runway incursions or excursions, or wildlife strikes.

Table 1.0.1 shows how the FAA's Aviation Safety R&D goals and programs align with the NSTC Aviation Safety Goals. In many cases, FAA R&D programs support more than one NSTC goal. Throughout this chapter, progress in FY 2012 on 172 milestones across all of these programs is described. As of the end of FY 2012, 27 percent of milestones in support of R&D Principle 1 – Improve Aviation Safety were completed and 91 percent of active milestones were on schedule.

Table 1.0.1: FAA R&D Goals and Programs Alignment with NSTC Aviation Safety Goals

FAA R&D Principle	FAA R&D Goals	FAA R&D Programs	NSTC Goals		NSTC Principle
Improve Aviation Safety	1 - Improved understanding of aerospace vehicle design, structure, and subsystems to reduce the potential for accidents and incidents and support the development of standards and policy and methodologies and tools for certification.	Advanced Materials/Structural Safety	Goal 1 - Develop Technologies to Reduce Accidents and Incidents Through Enhanced Vehicle Design, Structure, and Subsystems		Aviation Safety is Paramount
		Aircraft Catastrophic Failure Prevention Research			
		Propulsion and Fuel Systems			
		Continued Airworthiness		Goal 2 - Develop Technologies, for Manned and Unmanned Systems, to Reduce Accidents and Incidents through Enhanced Aerospace Vehicle Operations on the Ground and in the Air	
		Aircraft Icing/Digital Systems Safety			
		NextGen – Advanced Systems and Software Validation			
		Unmanned Aircraft Systems Research Program			
	2 - Improved knowledge of the human-system interface and a reduction in accidents and incidents through enhanced aerospace vehicle, air traffic, and technical operations that adapt to, compensate for, and augment the performance of the human.	Air Traffic Control/Technical Operations Human Factors	Goal 2 - Develop Technologies, for Manned and Unmanned Systems, to Reduce Accidents and Incidents through Enhanced Aerospace Vehicle Operations on the Ground and in the Air		
		Flightdeck/Maintenance/System Integration Human Factors			
		NextGen - Air Ground Integration Human Factors			
	3 - Improved understanding of factors that influence human physiology and performance in aerospace environments and guidance and tools that enhance human safety, protection, and survival during civil aerospace operations.	Aeromedical Research	Goal 3 - Demonstrate Enhanced Passenger and Crew Survivability in the Event of an Accident		
		Fire Research and Safety			
	4 - Improved system-wide access and sharing of aviation safety data and analysis tools within the aviation community, providing safety resources that are integrated with operations of aviation industry stakeholders.	System Safety Management	Goal 2 - Develop Technologies, for Manned and Unmanned Systems, to Reduce Accidents and Incidents through Enhanced Aerospace Vehicle Operations on the Ground and in the Air		
		Safety, Security, Environment – Systems Safety Management Transformation			
	5 - Established requirements and standards for enabling the availability and improving the quality and quantity of meteorological information to safely implement NextGen operational improvements.	NextGen - Weather Technology in the Cockpit	Goal 2 - Develop Technologies, for Manned and Unmanned Systems, to Reduce Accidents and Incidents through Enhanced Aerospace Vehicle Operations on the Ground and in the Air		
	6 - Improved accuracy and accessibility of observed and forecast weather to reduce the number of accidents and incidents attributed to hazardous weather.	Weather Program			
	7 - Optimized technical and regulatory provisions and processes used to oversee, coordinate, regulate, and promote safe and responsible activities reliable aerospace operations between space and Earth. 8 - Improved vehicle safety and risk management, including knowledge of all safety-critical components and systems of the space vehicles and their operations, to better identify potential hazards and apply and verify hazard controls. 9 - Guidance and tools that enhance human safety, protection, and survival during space operations.	Commercial Space Transportation Safety	Goal 2 - Develop Technologies, for Manned and Unmanned Systems, to Reduce Accidents and Incidents through Enhanced Aerospace Vehicle Operations on the Ground and in the Air		
	10 - No fatal accidents on certificated airports as a result of airport design, runway incursions or excursions, or wildlife strikes.	Runway Incursion Reduction Program	Goal 2 - Develop Technologies, for Manned and Unmanned Systems, to Reduce Accidents and Incidents through Enhanced Aerospace Vehicle Operations on the Ground and in the Air		
		Airport Cooperative Research Program - Safety			
		Airport Technology Research Program - Safety			

In FY 2014, 42 percent of total FAA R&D funding is allocated to R&D Principle 1 - Improve Aviation Safety. Program funding levels for the 2013 Continuing Resolution (CR) Annualized and 2014 President's Request are shown in Table 1.0.2. Percent of Program reflects the part of each program's contribution towards R&D Principle 1 in the 2014 President's Request. Table 1.0.2 also lists the section and page number reference for each budget narrative within the FY 2014 Congressional Justification (CJ) for the President's Budget Request. The link to the FY 2014 CJ is: http://www.dot.gov/sites/dot.dev/files/docs/FAA_FY2014_Budget_Estimates.pdf.

Table 1.0.2: Program Funding for R&D Principle 1 - Improve Aviation Safety

2014 BLI	Program	CJ Reference (Section/Page)	Appropriation Account	2013 CR Annualized ($000)	2014 Request ($000)	2014 Percent of Program
A11.a	Fire Research and Safety	3C/9	RE&D	7,202	8,313	100%
A11.b	Propulsion and Fuel Systems	3C/13	RE&D	2,314	1,974	100%
A11.c	Advanced Materials/Structural Safety	3C/15	RE&D	2,550	2,607	100%
A11.d	Aircraft Icing/Digital System Safety	3C/19	RE&D	5,437	7,582	100%
A11.e	Continued Airworthiness	3C/24	RE&D	11,671	8,167	100%
A11.f	Aircraft Catastrophic Failure Prevention Research	3C/29	RE&D	1,154	1,652	100%
A11.g	Flightdeck/Maintenance/System Integration Human Factors	3C/32	RE&D	6,200	5,000	100%
A11.h	System Safety Management	3C/35	RE&D	10,088	11,583	100%
A11.i	Air Traffic Control/Technical Operations Human Factors	3C/40	RE&D	10,427	6,000	100%
A11.j	Aeromedical Research	3C/45	RE&D	11,067	8,672	100%
A11.k	Weather Program	3C/48	RE&D	8,071	7,640	50%
A11.l	Unmanned Aircraft Systems Research	3C/54	RE&D	3,525	7,500	100%
A11.n	NextGen - Advanced Systems and Software Validation	3C/63	RE&D	0	1,021	100%
A12.c	NextGen - Air Ground Integration Human Factors	3C/74	RE&D	7,395	7,230	70%
A12.d	NextGen - Weather Technology in the Cockpit	3C/78	RE&D	3,622	1,876	45%
A14.a	System Planning and Resource Management	3C/92	RE&D	980	1,299	57%
A14.b	William J. Hughes Technical Center Laboratory Facility	3C/95	RE&D	2,726	2,473	72%
1A01A	Runway Incursion Reduction Program	3B/12	F&E	2,810	5,000	100%
1A07G	Safety, Security, Environment – Systems Safety Management Transformation	3B/42	F&E	6,250	8,000	100%
4A08A	Center for Advanced Aviation System Development (CAASD)	3B/323	F&E	3,311	2,972	18%
--	Commercial Space Transportation Safety	3A4/3	Ops	1,000	1,000	100%
--	Airport Cooperative Research Program - Safety	3D/36	AIP	5,030	5,000	100%
--	Airport Technology Research Program - Safety	3D/28	AIP	15,358	15,393	100%
	Total ($000)			**128,188**	**127,953**	

1.1 Aviation Safety R&D Goal 1

Improved understanding of aerospace vehicle design, structure, and subsystems to reduce the potential for accidents and incidents and support the development of standards and policy and methodologies and tools for certification.

1.1.1 Advanced Materials/Structural Safety (RE&D - A11.c)

The Advanced Materials/Structural Safety Program supports this R&D goal by assessing the safety implications of composites, alloys, and other advanced materials, and associated structures and fabrication techniques that can help to reduce aviation fatalities. The program also supports this R&D goal by increasing the ability of passengers to survive aviation accidents by developing advanced methodologies for assessing aircraft crashworthiness. The FAA establishes rules for the certification of aircraft designed and constructed using a variety of materials and design methods. The program conducts research to support FAA regulatory activities, such as rulemaking, guidance, and advisory circulars, particularly in the area of composite materials.

The research milestones and their statuses are shown in Table 1.1.1 below, followed by a summary of the significant progress made in FY 2012 towards achieving this R&D goal.

Table 1.1.1: Advanced Materials/Structural Safety Program Milestones

Year	Milestone	Status	Notes
2010	Develop certification methods for damage tolerance and fatigue of composite airframes	Completed	
2013	Establish required skills and develop training materials for all second level composite structures knowledge areas (maintenance, inspection, structural engineering, and manufacturing) for operational safety	On schedule	
2014	Establish design criteria for restraint systems that protect occupants at the highest impact levels that the aircraft structure can sustain	On schedule	

Advanced Materials/Structural Safety Program Progress in FY 2012:

- ✓ Developed the Composite Structural Engineering Training course, a considerable achievement towards establishing the training and skill level requirements for civil aviation personnel dealing with composite aircraft structures. This course will be the second in a series of three that will form the second level training for aviation personnel (maintenance, inspection, structural engineering, and manufacturing) dealing with composite structures. The first course, Maintenance and Inspection, was completed in FY 2008. The final course that will establish the second level training, Composites Manufacturing Training, was initiated in FY 2012 and an outline of requirements was established.

- ✓ Completed aircraft side-facing research using postmortem human subjects to determine aircraft side-facing neck injury criteria and tolerances. These results support the FAA in the development of side-facing aircraft seat regulations and provide, through the use of an ES-2 anthropomorphic test dummy, certification criteria to demonstrate compliance.

- ✓ Developed a narrow-body model of a transport category aircraft, and an aircraft section was used to evaluate occupant loading in various impact scenarios. Data from the model will be used to help determine critical issues concerning aircraft structure, aircraft seats, and seat restraints. The research will provide seat and restraint loads at impact levels that the fuselage can sustain and impact conditions that result in maximum occupant loads.

1.1.2 Aircraft Catastrophic Failure Prevention Research (RE&D - A11.f)

The Aircraft Catastrophic Failure Prevention Research Program supports this R&D goal by developing technologies and methods to assess risk and prevent occurrence of potentially catastrophic defects, failures, and malfunctions in aircraft, aircraft components, and aircraft systems. The program also uses historical accident data and National Transportation Safety Board (NTSB) recommendations to examine and investigate turbine-engine uncontainment events and other engine-related impact events. Together with industry, the program develops material models associated with engine debris impact. These material models may be used for aircraft impact or shielding evaluations, engine containment evaluations, and to assist both aircraft and engine certification.

The research milestones and their statuses are shown in Table 1.1.2 below, followed by a summary of the significant progress made in FY 2012 towards achieving this R&D goal.

Table 1.1.2: Aircraft Catastrophic Failure Prevention Research Program Milestones

Year	Milestone	Status	Notes
2014	Develop and verify an improved predictive capability for aircraft damage associated with engine failure and debris impact	On schedule	This milestone has been revised to clarify the research need. Old wording: "Develop and verify a generalized damage and failure model with regularization for aluminum and titanium materials impacted during engine failure events" 2012 NARP Status: Delayed from 2013 to 2014

Aircraft Catastrophic Failure Prevention Research Program Progress in FY 2012:

- ✓ Conducted material testing and evaluation of aluminum and titanium to update the current tabulated Johnson-Cook method of predicting material failure. Development of an enhanced methodology known as the Generalized Yield Failure and Damage Model was initiated to improve the accuracy over a wider range of metallic materials and is expected to improve the results for titanium. Modeling results will be available to assist both aircraft and engine certifications.

1.1.3 Aircraft Icing/Digital System Safety (RE&D - A11.d)

The Aircraft Icing/Digital System Safety Program supports this R&D goal by developing and testing technologies that detect frozen contamination, predict anti-icing fluid failure, and ensure safe operations in atmospheric icing conditions. The program also develops new guidelines for testing, evaluating, and approving digital flight controls, avionics, and other systems for use in aircraft and engines.

The research milestones and their statuses are shown in Table 1.1.3 below, followed by a summary of the significant progress made in FY 2012 towards achieving this R&D goal.

Table 1.1.3: Aircraft Icing/Digital System Safety Program Milestones

Year	Milestone	Status	Notes
2013	Identify safety issues and propose mitigation approaches when software development techniques and tools are used in airborne systems	On schedule	

Year	Milestone	Status	Notes
2016	Develop data and methods for guidance material for the airworthiness acceptance criteria and test methods for engines in simulated high ice water content environments	Delayed	This milestone has been delayed from 2014 to 2016 due to major delays in preparing the aircraft to be used to collect the atmospheric data needed for the guidance material. 2012 NARP Status: On schedule

Aircraft Icing/Digital System Safety Program Progress in FY 2012:

- ✓ Examined alternative approaches for software assurance used in other industry and engineering disciplines to determine if they can be used to demonstrate compliance with the airworthiness rules. A survey and a review of other industries' practices in software assurance were conducted, and based on the results, select categories of software assurance approaches were identified for follow-on research. The research will help alleviate industry concerns over lengthy and expensive software assurance processes.

- ✓ Applied a System Architecture Virtual Integration's (SAVI) process on two shadow projects to demonstrate the use of annotated architecture models in virtual integration of aircraft systems. The SAVI process can eliminate a considerable number of errors very early in the development process, achieve safety goals, and generate artifacts for effective and efficient certification. The research will address the system consideration for complex digitally intensive systems issues.

- ✓ Conducted ice ingestion testing in a simulated warm engine environment. This testing was done as part of an ongoing effort to understand and predict ice that forms in the core of a jet engine, which has resulted in numerous rollback, surge, stall, and flameout events. Results showed that the hardness and shedding of the accreted ice could be correlated with the wet bulb temperature on the surface where the ice accreted.

1.1.4 Continued Airworthiness (RE&D - A11.e)

The Continued Airworthiness Program supports this R&D goal by promoting the development of technologies, procedures, technical data, and performance models to prevent accidents and mitigate accident severity related to civil aircraft failures as a function of their continued operation and usage. The program focuses on longer term maintenance of the structural integrity of fixed-wing aircraft and rotorcraft, continued safety of aircraft engines, development of inspection technologies, and the safety of electrical wiring interconnect systems and mechanical systems.

The research milestones and their statuses are shown in Table 1.1.4 below, followed by a summary of the significant progress made in FY 2012 towards achieving this R&D goal.

Table 1.1.4: Continued Airworthiness Program Milestones

Year	Milestone	Status	Notes
2011	Apply damage-detection technologies for inspecting remote and inaccessible areas of in-service aircraft with metal structures	Completed	
2011	Complete the study in usage, design, and training issues for rudder control systems in transport aircraft	Completed	
2011	Complete study of risk-based fleet management for small-airplane continued operational safety	Completed	
2013	Develop technical data on rotorcraft that provide guidance for certification of Health and Usage Monitoring Systems for usage credits	On schedule	
2013	Develop technical data on the performance of advanced nondestructive inspection methods and procedures for improved damage detection in solid composite laminates	On schedule	New milestone
2014	Develop technical data to assess the application of advanced aluminum-lithium metallic alloys for primary fuselage structure in transport category airplanes	On schedule	
2016	Develop technical data to assess the fatigue and environmental durability of bonded repairs to metallic structure	On schedule	

Continued Airworthiness Program Progress in FY 2012:

- ✓ Designed and implemented a field experiment in which a set of composite test panels containing various programmed flaws were inspected by airline personnel to determine the probability of detection (PoD) of available ultrasonic test methods. The specimens were designed and built collaboratively with the aviation industry via the Society of Automotive Engineers Commercial Aircraft Composite Repair Committee. A total of 60 inspectors from 15 airlines and maintenance, repair, and overhaul organizations voluntarily participated in the study. The results quantified the PoD for various laminate thicknesses and geometries and identified best practice recommendations.

1.1.5 NextGen - Advanced Systems and Software Validation (RE&D - A11.n)

The NextGen - Advanced Systems and Software Validation Program is a new program for FY 2014 that supports development of policy, guidance, technology, and training needs for highly integrated and complex systems expected to operate in a NextGen environment that rely on digital systems and are tightly integrated across airborne and ground-based components. The program includes research to 1) identify possible issues and shortcomings with the current processes used by the commercial aviation industry regarding requirements definition, validation, and verification for complex airborne digital systems; 2) determine acceptable means to analyze, integrate, validate, and verify airborne systems; and 3) investigate electromagnetic compatibility and the system safety analysis process for complex systems.

The research milestones and their statuses are shown in Table 1.1.5 below.

Table 1.1.5: NextGen - Advanced Systems and Software Validation Program Milestones

Year	Milestone	Status	Notes
2014	Identify effects of system complexity on aircraft safety margins and investigate highly integrated, complex airborne systems being difficult to validate and verify and the potential for a reduction in aircraft safety margins with highly integrated, complex airborne systems	Not started	New milestone
2014	Define complexity, investigate quantification of complexity beyond the usual metrics, and determine if an aircraft can become too complex to certify	Not started	New milestone
2015	Identify possible issues with the current process used by the commercial aviation industry regarding requirements' definition, validation, and verification for aircraft digital system requirements to ensure their applicability to NextGen systems	Not started	New milestone
2015	Complete the examination of safety issues associated with, and potential approaches to, safely approving independently-verified components when part of a larger non-federated system	Not started	New milestone
2015	Identify specific proposals to address what specific tasks are necessary to ensure complex digital systems have been fully integrated	Not started	New milestone

1.1.6 Propulsion and Fuel Systems (RE&D - A11.b)

The Propulsion and Fuel Systems Program supports this R&D goal by developing technologies, procedures, test methods, and criteria to enhance the airworthiness, reliability, and performance of civil turbine and piston engines, propellers, fuels, and fuel management systems.

The research milestones and their statuses are shown in Table 1.1.6 below, followed by a summary of the significant progress made in FY 2012 towards achieving this R&D goal.

Table 1.1.6: Propulsion and Fuel Systems Program Milestones

Year	Milestone	Status	Notes
2015	Complete a certification tool that will predict the risk of failure of turbine engine rotor disks that may contain undetected material and manufacturing anomalies	On schedule	2012 NARP Status: Delayed from 2014 to 2015

Propulsion and Fuel Systems Program Progress in FY 2012:

- ✓ Managed the development of new enhancements in Design Assessment of Reliability With INspection (DARWIN®), a program that determines the risk of fracture of turbine engine rotor disks containing undetected material anomalies. The enhancements include a new capability to define fracture models in general non-hoop stress planes and a new bivariant stress-intensity factor solution for semi-elliptical surface cracks at off-center holes. In earlier versions of DARWIN®, fracture analysis was limited to hoop, axial, and radial planes for two-dimensional axisymmetric models and visualization was limited to hoop planes.

1.1.7 Unmanned Aircraft Systems Research (RE&D - A11.l)

The Unmanned Aircraft Systems Research Program supports this R&D goal by conducting research to ensure the safe, efficient, and timely integration of unmanned aircraft systems (UAS) in the NAS by providing information to support certification procedures, airworthiness standards, operational requirements, maintenance procedures, and safety oversight activities for UAS civil applications and operations. Research activities focus on new technology assessments, methodology development, data collection and generation, laboratory and field validation, and technology transfer. The Joint Planning and Development Office (JPDO) is facilitating interagency collaboration for the program by formulating the strategic national program plan for UAS integration.

The research milestones and their statuses are shown in Table 1.1.7 below, followed by a summary of the significant progress made in FY 2012 towards achieving this R&D goal.

Table 1.1.7: Unmanned Aircraft Systems Research Program Milestones

Year	Milestone	Status	Notes
2012	Determine a set of performance characteristics and operational requirements for sense and avoid technologies	Deleted	This milestone has been deleted and replaced with the one below. 2012 NARP Status: On schedule
2013	Develop the capability to evaluate potential Sense and Avoid logic and algorithms and review several available algorithms for methodology development	On schedule	New milestone
2013	Analyze data and identify potential safety implications of system performance impediments of communications latency	On schedule	
2013	Identify the current technologies for small unmanned aircraft systems to establish a central repository of historical data used to track continuous airworthiness of life limited components	On schedule	
2015	Identify recommended strategies for unmanned aircraft systems to compensate for missing sensory information at the control station and a method to assess performance requirements and methods of compliance for control stations	On schedule	
2016	Conduct field evaluations of unmanned aircraft system technologies and procedures (including sense and avoid, control and communications, and contingency management) to develop certification and airworthiness standards	On schedule	This milestone has been revised for clarity. Old wording: "Conduct field evaluations of unmanned aircraft system technologies in an operational environment, including sense and avoid, control and communications, and contingency management technologies. The documented results will be used to develop certification and airworthiness standards"

Unmanned Aircraft Systems Research Program Progress in FY 2012:

- ✓ Published the UAS Portfolio Research Management Plan (version 1.0), a tool used to document current research, identify potential research gaps, and recommend future research.

- ✓ Initiated development of a tool suite and conducted research to identify and describe metrics to support feasibility and interoperability evaluations of potential sense and avoid (SAA) logic and algorithms.

- ✓ Conducted research to determine the minimum SAA information a pilot needs to execute a collision avoidance maneuver.

- ✓ Studied UAS communication security and control link performance requirements.

- ✓ Developed a prototype database repository for maintenance and repair data, and began defining data elements and descriptions for UAS life-limited parts.

1.2 Aviation Safety R&D Goal 2

Improved knowledge of the human-system interface and a reduction in accidents and incidents through enhanced aerospace vehicle, air traffic, and technical operations that adapt to, compensate for, and augment the performance of the human.

1.2.1 Air Traffic Control/Technical Operations Human Factors (RE&D - A11.i)

The Air Traffic Control/Technical Operations Human Factors Program supports this R&D goal by emphasizing the concept of human-system integration (HSI) and safety aspects of the functions performed by air traffic controllers and technical operations personnel. The HSI concept addresses the interactions between workstation design, personnel selection and training, and human error and human safety.

The research milestones and their statuses are shown in Table 1.2.1 below, followed by a summary of the significant progress made in FY 2012 towards achieving this R&D goal.

Table 1.2.1: Air Traffic Control/Technical Operations Human Factors Program Milestones

Year	Milestone	Status	Notes
2012	Improve computer-human interface design to reduce information overload and resulting errors	Completed	2012 NARP Status: On schedule
2013	Assess the Front Line Manager Quick Reference Guide for effectiveness in aiding air traffic control safety	On schedule	
2015	Provide a draft of a revised Human Factors Design Standard for human factors application to air traffic control system acquisition	Delayed	This milestone has been delayed from 2014 to 2015 due to increased complexity of the task. 2012 NARP Status: On schedule

Air Traffic Control/Technical Operations Human Factors Program Progress in FY 2012:

- ✓ Developed a symbology standard for the creation, use, structure, and content of symbols, icons, markings, legends, text and any other construct conveying information on ATC displays. The standard will mitigate differences in design of symbols used across legacy, new, and upgraded ATC systems. The standard will be applied as a requirements document for future ATC system acquisitions.

1.2.2 Flightdeck/Maintenance/System Integration Human Factors (RE&D - A11.g)

The Flightdeck/Maintenance/System Integration Human Factors Program supports this R&D goal by providing the human factors research for guidelines, handbooks, advisory circulars, rules, and regulations that ensure safe and efficient aircraft operations. Research results enable the FAA and industry to: improve task performance and training for aircrew, inspectors, and maintenance technicians; improve training for UAS control station and crew; develop and apply error management strategies to flight and maintenance operations; and ensure certification of new aircraft and design or modification of equipment considers human factors.

The research milestones and their statuses are shown in Table 1.2.2 below, followed by a summary of the significant progress made in FY 2012 towards achieving this R&D goal.

Table 1.2.2: Flightdeck/Maintenance/System Integration Human Factors Program Milestones

Year	Milestone	Status	Notes
2012	Develop human factors guidance for Automatic Dependent Surveillance – Broadcast enabled Cockpit Display of Traffic Information certification and operational approval	Completed	2012 NARP Status: On schedule
2012	Provide human factors guidance for the design of instrument procedures	Completed	2012 NARP Status: On schedule
2014	Document the results of jet upset/ loss of control simulation model development and evaluation	On schedule	New milestone
2014	Analyze and provide recommendations on evolving methods of alternative fatigue risk assessment (e.g., voice analysis) that considers time on task fatigue and method validation	On schedule	New milestone

Flightdeck/Maintenance/System Integration Human Factors Program Progress in FY 2012:

- ✓ Administered research to develop techniques to measure the effective intensity of flashing lights, such as aircraft anti-collision lights, that incorporate new technologies such as light-emitting diodes (LED). Since it has been proposed that LED anti-collision lights replace xenon strobe light sources, it was imperative to update current testing methods. Experiments compared steady versus flashing LEDs, collected subject data, and employed several different analysis techniques, such as Signal Detection Theory, Method of Limits, and Contrast versus Threshold. The research will produce criteria for aircraft manufacturers and maintainers that ensure the conspicuity of LED lights.

- ✓ Developed three significant documents that contain human factors guidance for Automatic Dependent Surveillance – Broadcast (ADS-B) enabled Cockpit Display of Traffic Information (CDTI) certification and operational approval. The first report, *Human Factors Considerations for Flight Deck Alerts*, provides recommendations that can be applied in assessing new systems, including the operational need, salience, and location for alerts. The second report, *Airline Operational Evaluation of the Cockpit Display of Traffic Information*, provides recommendations for data collection for operational evaluations of CDTI (including oceanic and pair-wise delegated separation). The results are expected to assist the Office of Aircraft Certification in the evaluation of CDTIs and ADS-B technology as well as identify issues that need to be addressed for the successful implementation of ADS-B. The third report, *ADS-B Symbol Intuitiveness Study*, describes the research to understand which traffic symbols are perceived to be useful and intuitive for pilots when displayed on a surface moving map. The results are intended to support development of RTCA DO-317 Minimum Operational Performance Standards for Aircraft Surveillance Applications System.

- ✓ Developed recommendations to improve the employment and reliability of aeronautical charts for new performance-based navigation (PBN) instrument procedures based on Area Navigation (RNAV) and Required Navigation Performance (RNP). Since new procedures may result in increased visual complexity and pilot workload, the research aimed at producing recommendations that would ultimately reduce the susceptibility to errors by pilots. Results will enable the FAA to modify, update, and improve related guidance documents (e.g., FAA Orders in the 8260 series, FAA Order 8900.1, and Advisory Circular (AC) 120-76).

1.2.3 NextGen - Air Ground Integration Human Factors (RE&D - A12.c)

The NextGen - Air Ground Integration Human Factors Program supports this R&D goal by addressing flight deck and ATC integration for NextGen operational capabilities. It focuses on human factors issues that primarily affect the pilot side of the air-ground integration challenge. It conducts research to ensure pilots receive the right information at the right time for decision-making and collaboration with ATC to operate in the NAS safely. The program also includes research done in the former NextGen - Self-Separation Human Factors (A12d.) program, which addressed human performance and coordination requirements for pilots and Air Navigation Service Providers (ANSPs) through development of the initial standards and procedures that lead to operational capabilities for separation assurance. It assessed the human factors risks and requirements associated with self-separation policies, procedures, and maneuvers, including interim operational capabilities for reduced and delegated separation and high-density airport traffic operations in reduced visibility using advanced flight deck technologies.

The research milestones and their statuses are shown in Table 1.2.3 below, followed by a summary of the significant progress made in FY 2012 towards achieving this R&D goal.

Table 1.2.3: NextGen - Air Ground Integration Human Factors Program Milestones

Year	Milestone	Status	Notes
2012	Complete research to evaluate and recommend minimum display standards for use of enhanced and synthetic vision systems, as well as airport markings and signage, to conduct surface movements across a range of visibility conditions	Completed	This milestone has been revised to clarify the result of the research. Old wording: "Complete initial research to evaluate and recommend minimum display standards for use of enhanced and synthetic vision systems, as well as airport markings and signage, to conduct surface movements across a range of visibility conditions" 2012 NARP Status: On schedule
2012	Complete initial research to evaluate the impact and potential risks associated with use of the Traffic Alert and Collision Avoidance System in NextGen procedures	Completed	2012 NARP Status: Delayed from 2011 to 2012
2012	Complete initial research to evaluate and recommend procedures, equipage, and training to safely conduct oceanic and en route pair-wise delegated separation	Completed	2012 NARP Status: Delayed from 2011 to 2012
2014	Complete research to identify likely human error modes and recommend mitigation strategies in closely spaced arrival/departure routings	On schedule	
2014	Evaluate and recommend minimum display standards and operational procedures for use of Cockpit Display of Traffic Information to support pilot awareness of potential ground conflicts and to support transition between taxi, takeoff, departure and arrival phases of flight	On schedule	
2015	Complete research to enable enhanced aircraft spacing for surface movements in low-visibility conditions guided by enhanced and synthetic vision systems, as well as cockpit displays of aircraft and ground vehicles and associated procedures	On schedule	2012 NARP Status: Accelerated from 2016 to 2015

Year	Milestone	Status	Notes
2015	Complete research and provide human factors guidance to reduce arrival and departure spacing including variable separation in a mixed equipage environment	On schedule	
2015	Enable reduced and delegated separation in oceanic airspace and en route corridors	On schedule	

NextGen - Air Ground Integration Human Factors Program Progress in FY 2012:

- ✓ Conducted pilot-in-the-loop simulations and flight testing to collect empirical operational data in support of the use of Synthetic Vision Systems and Enhanced Flight Vision Systems (SEVS) advanced cockpit vision technologies in NextGen operations. SEVS could enable equivalent operational efficiencies in both the low visibility and visual terminal environments. Some results indicate that expanding the Enhanced Flight Vision Systems visual segment from decision height to the runway in visibilities as low as 1000 feet runway visual range appears to be viable. These data will be used by RTCA SC-213 *Enhanced Flight Vision Systems and Synthetic Vision Systems (EFVS/SVS)* in the development of minimum aviation system performance standards for SEVS technologies and by the FAA for possible rule-making and regulatory activities.

- ✓ Completed two studies on the factors driving effective pilot interaction with the Traffic Alert and Collision Avoidance System (TCAS) in the NextGen environment. While TCAS has been extremely successful in reducing the risk of midair collisions, these studies sought to address the human factors concerns associated with the transition to NextGen. TCAS first delivers a Traffic Advisory (recommendation but not a command or authorization for an avoidance maneuver) and then delivers a Resolution Advisory (RA) (vertical avoidance maneuver or limits on vertical speed to maintain separation). The first study evaluated NextGen applications that allow for reduced separation, which then may create a need for introduction of horizontal RAs to provide additional flexibility to safely resolve conflicts. Results showed that both pilots and controllers found horizontal RAs to be a potentially viable solution. The second study investigated five key variables believed to impact pilot interaction with TCAS: type of RA relative to the immediate trajectory, prior interaction with ATC, RA execution by the autopilot, pilot training, and near-and far-term variants of the TCAS Traffic Situation Display.

1.2.4 Center for Advanced Aviation System Development (F&E - 4A08A)

The Center for Advanced Aviation System Development (CAASD) Program supports this R&D goal by working collaboratively with the FAA and the aviation community to model and simulate operational improvements and identify issues of PBN, leading to improved safety.

CAASD made the following progress in FY 2012 towards Aviation Safety R&D Goal 2.

- ✓ Examined the possibility of reducing minimums for RNAV approaches to short or narrow runways. The research was part of a multi-year effort to evaluate the implications of adjustments to airport design standards for accommodating RNAV approaches. Initially, the study focused on aircraft in Aircraft Approach Category B (≥91 but <121 knots). A pilot-in-the-loop experiment was conducted in a King Air 200 Full Flight Simulator at the Flight Safety International Atlanta Learning Center with 50 private, commercial, or airline transport pilots. Follow-on pilot-in-the-loop experiments at another facility were initiated in Aircraft Approach Category A aircraft (<91 knots).

1.3 Aviation Safety R&D Goal 3

Improved understanding of factors that influence human physiology and performance in aerospace environments and guidance and tools that enhance human safety, protection, and survival during civil aerospace operations.

1.3.1 Aeromedical Research (RE&D - A11.j)

The Aeromedical Research Program supports this R&D goal by identifying pilot, flight attendant, and passenger medical conditions that indicate an inability to meet flight demands, both in the absence and in the presence of emergency flight conditions. It also defines cabin air quality and analyzes requirements for occupant protection and aircraft decontamination.

The research milestones and their statuses are shown in Table 1.3.1 below, followed by a summary of the significant progress made in FY 2012 towards achieving this R&D goal.

Table 1.3.1: Aeromedical Research Program Milestones

Year	Milestone	Status	Notes
2010	Validate computational models of chemical air contaminants, such as volatile organic compounds, to evaluate health and safety impacts on passengers and crew	Completed	
2014	Develop and validate chemical kinetic models for bleed air systems for health and safety effects on passengers and crew	Delayed	This milestone has been delayed from 2012 to 2014 due to changing Aeromedical Research program priorities. 2012 NARP Status: On schedule
2014	Accomplish experimental projects in support of regulations, certification, and operations for existing Aviation Rulemaking Committees by providing data and guidance for new or revised regulation of airliner cabin environment standards	On schedule	2012 NARP Status: Delayed from 2012 to 2014
2014	Develop and analyze methods to detect and analyze aircraft cabin contamination including chemical-biological hazards and other airborne irritants	On schedule	

Year	Milestone	Status	Notes
2014	Apply and validate advanced air sensing technology for volatile organic compounds in the aircraft cabin environment	On schedule	
2015	Establish validation parameters for mathematical models that can evaluate whether aircraft type designs meet requirements for evacuation and emergency response capability, in lieu of actual tests	On schedule	
2015	Develop bleed air contamination models of engine compressors and high temperature air system for effects on the health and safety of passengers and crew	On schedule	
2015	Incorporate aerospace medical issues in the development of safety strategies concerning pilot impairment, incapacitation, spatial disorientation, and other aeromedical-related factors that contribute to loss of aircraft control	On schedule	
2015	Develop advanced methods to extract aeromedical information for prognostic identification of human safety risks	On schedule	
2015	Deploy a system (Aerospace Accident Injury and Autopsy Data System) capable of compiling, classifying, assessing, and determining causal factors of aviation-related injuries. The system will link aviation-related injuries to autopsy findings, medical certification data, aircraft cabin configurations, and biodynamic test results	On schedule	This milestone was revised to clarify that the system would be deployed instead of developed in 2015. Old wording: "Develop a system (Aerospace Accident Injury and Autopsy Data System) capable of compiling, classifying, assessing, and determining causal factors of aviation-related injuries. The system will link aviation-related injuries to autopsy findings, medical certification data, aircraft cabin configurations, and biodynamic test results"
2016	Apply and develop advances in gene expression, toxicology, and bioinformatics technology and methods to define human response to aerospace stressors	On schedule	

Aeromedical Research Program Progress in FY 2012:

- ✓ Identified, assessed, and developed improved cabin evacuation equipment and cabin evacuation aids to enhance rapid evacuation. Research included assessments on visual, aural, and tactile evacuation aides, such as lighting, aural way-finding systems, and symbolic information media. The results of study will support the development of additional guidance material and potential new regulatory requirements, to include operational advice on the early adoption of enhanced systems in the form of Safety Alerts for Operators. Detailed analysis and findings are in the report *Advancements in Wayfinding Technology and its Application to Aircraft Emergency Evacuation*.

- ✓ Completed Aerospace Accident Injury and Autopsy Data System (AA-IADS) user acceptance testing and began collaboration with biodynamics research engineers. AA-IADS employs systematic and continuous monitoring of aviation accident data to proactively identify hazards and resulting injuries, injury mechanisms, and mitigation strategies to reduce future injuries and fatalities. AA-IADS uses sophisticated analysis tools to detect trends, identify precursors, assess risks, and identify previously undiscovered risks that are buried in aircraft accident injury information. AA-IADS is scheduled to be deployed and fully operational in 2015.

- ✓ Completed a study that examined the frequency of laser illumination events and their adverse effects involving helicopters compared with fixed-wing aircraft for a 32-year study period (1980-2010). Results of the study indicated that the majority of helicopter laser exposures (70 percent) were within the altitude limit established for the Laser Free Zone (≤ 2,000 feet) versus only 18 percent of fixed-wing aircraft. More than 86 percent of all adverse effects reported by helicopter pilots were in this altitude range, compared to 29 percent of all fixed-wing effects reported. Special protective measures may be needed for helicopters due to the higher percentage of adverse effects associated with these events and the increased risk inherent in low-altitude flight operations. Detailed analysis and findings are in the report *Laser Illumination of Helicopters: A Comparative Analysis with Fixed-wing Aircraft for the Period 1980 – 2010*.

- ✓ Conducted a study on fatal aviation accidents from 2010-2011 to identify potential aeromedical hazards and report that information to FAA accident investigators. This study identified possible medical factors that require further attention during accident investigations. Data was collected from FAA databases and autopsy reports and posted in the Civil Aerospace Medical Institute Medical Analysis TRAcking (MANTRA) system and analyzed for demographics and trends. During the period studied, there were 549 fatal accidents involving 623 pilots that were predominantly male (96 percent). The average age was approximately 53 and roughly half of the pilots in fatal accidents had been issued class 3 medical certificates. Detailed analysis and findings are in the report *Medical Review of U.S. Fatal Accidents: FY 2010-FY 2011*.

- ✓ Conducted a study to determine the status and disposition of pilots' applications for special issuance medical certificates after reporting the use of FAA-approved antidepressant medications. Aeromedical records of pilot applicants who reported the use of these Selective Serotonin Reuptake Inhibitors (SSRIs) were reviewed. The process included a review by the FAA Office of Aerospace Medicine of several neurocognitive tests and other reports from the treating psychiatrist, the airman, and other sources. The study found that the FAA SSRI medical certification program, though cumbersome, has been successful in returning airmen undergoing treatment with common SSRIs to flying status. Detailed analysis and findings are in the report *Aeromedical Certification: Serotonin Reuptake Inhibitors*.

- ✓ Conducted a study to assess postmortem concentrations of sertraline, an antidepressant medication of the SSRI class, in human specimens obtained from aviation accidents. The results of this study will enhance accident investigation strategies and aviation safety decision-making processes. Details of the research findings are available in *Analysis of Sertraline in Postmortem Fluids and Tissues in Aviation Accident Victims*.

- ✓ Conducted a study to evaluate the effects of exposure of pooled blood to an atmosphere containing carbon monoxide and hydrogen cyanide, two primary combustion gases, on their concentrations in blood. Findings of the evaluation will be useful in the investigation of aviation accidents involving fires by correctly interpreting the levels of carboxyhemoglobin and cyanide in blood collected from the victims exposed to these fire and smoke gases. Details of the research findings are available in *In Vitro Absorption of Atmospheric Carbon Monoxide and Hydrogen Cyanide in Undisturbed Pooled Blood*.

- ✓ Developed an upgraded Windows 64-bit version of the FAA's CARI software program that calculates the effective dose of galactic cosmic radiation received by an individual on an aircraft. This improvement will allow CARI to function in modern computers and assess thousands of flights. The software will also be available for download and data analysis.

- ✓ Conducted a study to establish times of useful consciousness for aviators exposed to high altitude rapid decompressions. The study investigated possible physiological determinants of hypoxia tolerance using a heterogeneous population of aviators who were given 5-minute hypobaric and normobaric exposures to 25,000 ft. The data from the study was used to update FAA AC 61-107B. Details of the research findings are available in *Physiological Basis for Individual Differences in Hypoxia Tolerance in Humans*.

- ✓ Performed a study on the environmental conditions and cabin air contaminants measured on 83 aircraft, across 3 different airlines, operating 8 airplane models, and compared these conditions and contaminants to existing standards as well as other indoor environments. This study revealed direct evidence of ozone chemical reactions forming irritating carbonyls and ultrafine particles in aircraft cabins. The study offers further evidence that cabin ozone levels can exceed Federal Aviation Regulations, and that ozone converters will substantially reduce the chance for high excursions. Details of the research findings are available in *In-Flight/Onboard Monitoring: ACER's Component for ASHRAE 1262, Part 2*.

1.3.2 Fire Research and Safety (RE&D - A11.a)

The Fire Research and Safety Program supports this R&D goal by developing technologies, procedures, test methods, and fire performance criteria that can prevent accidents caused by hidden cabin or cargo compartment in-flight fires and fuel tank explosions and improve survivability during a post-crash fire. Fire safety focuses on near-term improvements in fire test methods and materials performance criteria, fire detection and suppression systems, fuel tank explosion protection, and identification of hazardous materials. Fire research addresses fundamental issues of combustion toxicity, the impact of flame retardant chemicals, health hazards of cabin materials, the impact of materials flammability on the initiation of in-flight fires, and post-crash survivability. Far-term research focuses on the enabling technology for ultra-fire-resistant interior materials.

The research milestones and their statuses are shown in Table 1.3.2 below, followed by a summary of the significant progress made in FY 2012 towards achieving this R&D goal.

Table 1.3.2: Fire Research and Safety Program Milestones

Year	Milestone	Status	Notes
2011	Provide comprehensive guidance on lithium battery fire safety	Completed	
2012	Define composite fuselage fire safety design criteria	Completed	2012 NARP Status: On schedule
2013	Recommend a lab-scale flammability test method for magnesium seat structure	On schedule	New milestone
2014	Evaluate the effectiveness of a water spray system in a freighter main deck cargo compartment	On schedule	New milestone
2016	Develop hidden fire detection and extinguishment improvements	On schedule	New milestone

Fire Research and Safety Program Progress in FY 2012:

- ✓ Developed fire safety criteria and guidance for new large transport aircraft constructed of a structural composite fuselage and wings. The areas addressed were post-crash fire survivability, hidden in-flight fire protection, and fuel vapor flammability in composite wing tanks. Criteria were developed for toxic gas emissions to ensure passenger survivability during a post-crash fire. New fire test criteria for fuselage structure will prevent in-flight fires from propagating in vulnerable hidden areas. Data from fuel tank experiments showed that both composite and aluminum wing fuel tanks are most vulnerable to a fuel tank explosion on the ground on a hot sunny day and shortly after take-off, underscoring the importance of fuel tank inerting protection during this critical regime.

1.4 Aviation Safety R&D Goal 4

Improved system-wide access and sharing of aviation safety data and analysis tools within the aviation community, providing safety resources that are integrated with operations of aviation industry stakeholders.

1.4.1 Safety, Security, Environment – Systems Safety Management Transformation (F&E - 1A07G - NextGen – Systems Development)

The Safety, Security, Environment – Systems Safety Management Transformation Program supports this R&D goal by developing a comprehensive and proactive approach to aviation safety especially as it relates to the implementation of NextGen. The research enables safety assessments of proposed NextGen concepts, algorithms, and technologies and provides system knowledge to understand economic, implementation, operational and performance impacts (with respect to safety) of NextGen system alternatives. The program supports the development and implementation of integrated safety management systems across the air transportation system to ensure that the safety risk throughout the system is managed to an acceptable level.

The research milestones and their statuses are shown in Table 1.4.1 below, followed by a summary of the significant progress made in FY 2012 towards achieving this R&D goal.

Table 1.4.1: Safety, Security, Environment – Systems Safety Management Transformation Program Milestones

Year	Milestone	Status	Notes
2009	Evaluate current information protection and assurance models and evaluate potential conflicts with privacy and consumer advocacy groups	Completed	
2011	Develop proof of concept for NextGen including a prototype to implement on a trial basis with selected participants that involve a cross-section of air service providers	Completed	
2012	Using the existing Aviation Safety Information Analysis and Sharing system architecture, develop a proof-of-concept and prototype for the sharing of aviation safety information among Joint Planning and Development Office member agencies, participants, and stakeholders	Completed	

Year	Milestone	Status	Notes
2013	Complete the Aviation Safety Information Analysis and Sharing system pre-implementation activities, including concept definition, with other Joint Planning and Development Office member agencies, participants, and stakeholders	Completed	
2014	Demonstrate a National Level System Safety Assessment capability that will proactively identify emerging risk across NextGen	Deleted	This milestone has been deleted to ensure alignment with the Capital Investment Plan. 2012 NARP Status: On schedule
2014	Develop standard platform software incorporating previously deployed surface and terminal area risk analysis capabilities	On schedule	New milestone
2014	Produce an annual comparison of predicted versus actual events and precursor rates for severe accident scenarios	On schedule	New milestone
2014	Provide a safety report on surface movement for facilities with Airport Surface Detection Equipment, Model X and other surveillance data	On schedule	New milestone
2014	Deliver advisory group recommended analyses of operational safety assessments for NextGen concepts	On schedule	New milestone
2014	Conduct an annual FAA-wide safety risk management coordination workshop including all Systems Safety Management Transformation stakeholders to discuss and critique methodologies, topics and results of recent activities	On schedule	New milestone
2014	Conduct local surface and terminal area risk impact analyses for potential NextGen improvements with local risk forecast modeling assumptions adjusted to reflect the impact of NextGen improvements on throughput, delay and potential safety impacts	On schedule	New milestone

Year	Milestone	Status	Notes
2014	Deliver stakeholder-required analyses and reports for the advisory group using the integrated safety modeling capabilities. User requirements and feedback will be incorporated into changes in airport surface and terminal area risk baselines	On schedule	New milestone
2014	Develop baseline event sequence diagrams and probabilistic risk-based calculations for 30 accident scenarios relevant to aviation safety, calibrated to U.S. historical data, and accompanying fault tree analysis	On schedule	New milestone
2014	Establish an Aviation Safety Information Analysis and Sharing data interchange protocol and produce a report that provides a model-based risk assessment of an airport surface safety risk	On schedule	New milestone
2014	Deliver a preliminary peer-review report featuring FAA and European Organisation for the Safety of Air Navigation data exchange on Integrated Safety Assessment Model and Single European Sky Air Traffic Management Research Accident Incident Model for system risk baselines	On schedule	New milestone
2014	Deploy model-based risk calculation software in a secure web-based environment and produce a precursor data tracking requirements document	On schedule	New milestone
2014	Deliver an annual NAS-wide risk impact assessment for NextGen implementation segments	On schedule	New milestone
2014	Develop and conduct human-in-the-loop protocol for expert-judgment assessment of NextGen safety impacts and capture data into the Integrated Safety Assessment Model	On schedule	New milestone
2014	Establish software access to the NextGen program office and other FAA safety and operational organizations so that they can provide integrated data collected via FAA-wide hazard tracking systems into the system risk baseline analysis	On schedule	New milestone

Safety, Security, Environment – Systems Safety Management Transformation Program Progress in FY 2012:

- ✓ Demonstrated to the JPDO how non-commercial airlines can participate in Aviation Safety Information Analysis and Sharing (ASIAS) by taking Flight Operational Quality Assurance records from the Air Force and creating benchmarks identical to those received by ASIAS stakeholder airlines. Non-commercial airlines (in this case, the U.S. Department of Defense , or DoD) use variants of commercial aircraft (i.e., B737 and B757), fly in the same airspace, and use the same airports as commercial operators. Therefore, information gained from comparing potential safety issues for non-commercial flights to the millions of commercial flights allows operators to identify and mitigate undesired operational states which may be more prevalent in their particular types of operations.

- ✓ Expanded integration of the network-based ASIAS system to six new air carriers. The network-based architecture includes an infrastructure of hardware, networking, and software components both at a central location and at participants' locations, supporting secure and de-identified data entry, advanced data management processes, and a range of analytic tools for monitoring, trending, and visualizing data.

- ✓ Achieved the ability to detect exceedingly rare (defined as a 1-in-3,000,000 chance of occurrence) Part 121 Air Carrier Certification events, across the NAS with a confidence level of 95 percent, using ASIAS data sources.

- ✓ Coordinated reliable and consistent data sharing of safety information between the Air Traffic Safety Action Program, the Technical Operations Safety Action Program, and ASIAS.

- ✓ Completed full-scale assessments of the Airport Surface Anomaly Investigation Capability at all 35 commercial U.S. airports with significant activity (Operational Evolution Partnership airports). This capability identifies, diagnoses, and detects taxi and gate area operational anomalies for independent investigation. This approach provided the first operational taxiway safety baseline for aircraft and vehicle movements available to the FAA. Additionally, this methodology was incorporated into a tablet application that can be used by management to review events, replay radar images, and obtain diagnostic information such as braking profile, taxi distance, and taxi speed.

- ✓ Transitioned the Integrated Safety Assessment Model (ISAM) to a web-based environment and established an accident risk baseline by embedding into the model all accident scenarios resulting in fatalities since 1990. This version of ISAM also represented the NextGen operational improvements, their dependencies and enabling capabilities, and allowed analysts to evaluate how various accident scenarios might be affected by the implementation of NextGen.

- ✓ Conducted a software demonstration and analysis of an integrated baseline terminal model of operational improvements supporting RNAV/RNP and Collaborative Air Traffic Management to work towards proactively identifying emerging risks.

1.4.2 System Safety Management (RE&D - A11.h)

The System Safety Management Program supports this R&D goal by developing risk management methods, prototype tools, technical information, and Safety Management System procedures and practices. In addition, the program develops an infrastructure that enables the free sharing of de-identified, aggregate safety information derived from government and industry sources in a protected manner. It also conducts research to leverage new technologies and procedures that enhance pilot, aircraft and operational safety in terminal and en route domains.

The research milestones and their statuses are shown in Table 1.4.2 below, followed by a summary of the significant progress made in FY 2012 towards achieving this R&D goal.

Table 1.4.2: System Safety Management Program Milestones

Year	Milestone	Status	Notes
2010	Demonstrate a one-third reduction in the rate of fatalities and injuries	Completed	
2011	Develop automated tools to monitor databases for potential safety issues	Completed	
2012	Demonstrate a working prototype of network-based integration of information extracted from diverse, distributed sources	Completed	2012 NARP Status: On schedule
2012	Develop a quantitative and objective approach to prioritize new and evolving safety risks identified through analysis of multiple databases	Completed	2012 NARP Status: On schedule
2012	Develop a user interface and trend analysis capability that monitors NAS performance with respect to failures, risks, impact on air traffic control and other off-nominal occurrences	Completed	2012 NARP Status: On schedule
2012	Complete representative stall model for upset recovery training	Completed	2012 NARP Status: On schedule
2012	Complete a pilot-in-the-loop evaluation of radius-to-fix turns during departure procedures	Completed	2012 NARP Status: On schedule
2014	Complete the compilation of risk analysis data and/or statistical data into a format best suited for efficient use in transport airplane risk analysis	On schedule	2012 NARP Status: Delayed from 2012 to 2014
2015	Expand the Aviation Safety Information Analysis and Sharing system safety analysis to other domains (e.g., general aviation, rotorcraft, corporate, military)	On schedule	

Year	Milestone	Status	Notes
2016	Establish safety metrics to align with NextGen system changes	On schedule	
2016	Complete an evaluation of the reported runway slipperiness condition from all potential runway surface conditions and airplane configurations	On schedule	
2016	Develop test criteria by varying motion characteristics to span the domain of the criteria and compare variations against subjective opinions of motion quality	On schedule	

System Safety Management Program Progress in FY 2012:

- ✓ Developed a prototype solution for integrating network-based safety information. The prototype system, built on a Service Oriented Architecture using System Wide Information Management (SWIM) standards, provides a core infrastructure for sharing safety related information to individual safety analysts and safety applications throughout the FAA. The infrastructure facilitates (1) data sharing services that allow researchers, safety analysts, and safety systems secure and readily available access to safety related information, (2) infrastructure services that provide researchers access to external laboratories for conducting research, and (3) safety services that provide access to safety data analysis tools and risk assessment instruments. The research team completed integration of the network infrastructure with other FAA, National Aeronautics and Space Administration (NASA), DoD, federally funded research development centers, and university laboratory assets through the NextGen R&D domain.

- ✓ Completed the *Strategic Analysis of ATO Technical Operations and System-level Monitoring of Safety Performance* report that presents a framework for capturing system-level performance of the Air Traffic Organization's (ATO) technical operations using outage trends of unscheduled facilities NAS-wide. A complementary effort, the *Safety Indicators / Analysis Report* describes the daily tracking of technical operation activities on a specific NAS facility and the impact on NAS safety. A proof-of-concept prototype with a flexible user interface was developed to demonstrate the safety indicators and trend analysis capabilities that enable the FAA's Air Traffic Safety Oversight Service to monitor facility operations in the NAS.

- ✓ Developed an RNP departure prototype consisting of several tight Radius-to-Fix turns close to the departure end of a runway to evaluate the Flight Management System's capacity to maintain the performance of various aircraft types within the RNP boundaries. The evaluation was conducted using pilot-in-the-loop simulation tests in full flight simulators of three different aircraft types, including large, regional, and business jets. The analysis of the simulation tests, combined with other FAA Aircraft Flight Safety research efforts on avionics designs, bench tests, and operational experience, were used to support changes to the assumed bank angles for PBN procedure design criteria.

- ✓ Examined two approaches for updating stall models to improve upset prevention simulator training and reduce loss-of-control accidents. One approach was to create a type-specific stall model using data from actual flight test stalls of the aircraft from the aircraft manufacturer. The other approach was to create a representative model using engineering analyses, wind tunnel data, and subjective evaluation with pilots who had stalled the actual aircraft in certification testing. The two models will be implemented in an FAA simulator and evaluated, and the results will support the revision of 14 CFR Part 60 simulator standards. The revision will meet the Congressional mandate that the FAA require transport category pilots receive upset prevention and recovery training to reduce accidents arising from loss-of-control, the leading cause of fatalities in commercial jets.

- ✓ Developed a quantitative and objective approach to prioritize new and evolving safety risks identified through information gained from multiple proprietary databases. The process will be used for prioritizing safety events potentially identified for ASIAS analyses. The FAA internal report *ASIAS Safety Risk Assessment* provides the results of the process applied to case studies and describes how the risk assessment process fits into the overall study prioritization process.

1.5 Aviation Safety R&D Goals 5 and 6

Established requirements and standards for enabling the availability and improving the quality and quantity of meteorological information to safely implement NextGen operational improvements.

Improved accuracy and accessibility of observed and forecast weather to reduce the number of accidents and incidents attributed to hazardous weather.

1.5.1 NextGen - Weather Technology in the Cockpit (RE&D - A12.d)

The NextGen - Weather Technology in the Cockpit Program supports these R&D goals by developing, verifying, and validating requirements to support airworthiness standards for enabling availability and improving the quality and quantity of meteorological information to the aircraft to support safe current and NextGen operations. The program will result in the development of standards and requirements that define the weather information in the cockpit needed to support operations, the presentations and interfaces to enable proper information consumption and safe operations by pilots, and capabilities that enable efficient dissemination of the weather information to and from the cockpit at the right place and right time.

The research milestones and their statuses are shown in Table 1.5.1 below, followed by a summary of the significant progress made in FY 2012 towards achieving these R&D goals.

Table 1.5.1: NextGen - Weather Technology in the Cockpit Program Milestones

Year	Milestone	Status	Notes
2010	Assess bandwidth demand of graphical icing products (Current Icing Product and Forecast Icing Product) and graphical turbulence products (Graphical Turbulence Guidance) for potential delivery via existing and planned FAA data link services	Completed	
2011	Identify, validate, and document data link system attributes that may affect use of weather in the cockpit	Completed	
2012	Simulate and evaluate the benefits and impacts of presenting impact-oriented meteorological information in the cockpit in a collaborative decision environment	Completed	2012 NARP Status: On schedule

Year	Milestone	Status	Notes
2013	Identify specific and recurring weather-related causes in reported safety incidents/accidents that identify weather as a primary cause	Delayed	This milestone has been delayed from 2012 to 2013 due to an increase in scope to investigate additional weather-related incidents. 2012 NARP Status: On schedule
2013	Assess the impacts and benefits of mobile/portable devices for use in providing increased common meteorological situational awareness between the cockpit crew and ground based traffic managers	On schedule	
2014	Develop and implement resolutions to prevent recurrence of previously researched weather-related safety incidents/accidents	Delayed	This milestone has been delayed from 2013 to 2014 due to an increase in scope to investigate additional weather-related incidents. See also the delayed 2013 milestone: "Identify specific and recurring weather-related causes in reported safety incidents/accidents that identify weather as a primary cause" milestone. This milestone has been revised for clarity. Old wording: "Develop and implement resolutions to prevent recurrence of reported weather-related safety incidents/accidents that were researched in FY 2012" 2012 NARP Status: On schedule
2014	Assess and quantify the safety benefits to the NAS of providing Graphical Turbulence Guidance, Eddy Dissipation Rate, and icing to the cockpit	Delayed	This milestone has been delayed from 2013 to 2014 due to changing NextGen - Weather Technology in the Cockpit program priorities. 2012 NARP Status: On schedule
2014	Develop NextGen Part 121, 135, and Part 91 concepts of operation and user requirements for the provision, integration, and use of weather information in the cockpit	Delayed	This milestone has been delayed from 2013 to 2014 due to changing NextGen - Weather Technology in the Cockpit program priorities. 2012 NARP Status: Delayed from 2011 to 2013

Year	Milestone	Status	Notes
2014	Simulate, test, and evaluate fully-integrated cockpit use of NextGen operational concepts, including Weather Technology in the Cockpit	Deleted	This milestone has been deleted due to changing NextGen - Weather Technology in the Cockpit program priorities. 2012 NARP Status: On schedule
2014	Develop standards for time stamping of cockpit composite weather presentations	On schedule	New milestone
2015	Simulate, test, and evaluate cockpit use of weather decision support tools, including probabilistic forecasts	Delayed	This milestone has been delayed from 2014 to 2015 due to changing NextGen - Weather Technology in the Cockpit program priorities. 2012 NARP Status: On schedule
2016	Safety reporting systems indicate success of corrective actions and enhanced meteorological information (turbulence and icing) to reduce weather-related accidents/incidents	Delayed	This milestone has been delayed from 2015 to 2016 due to changing NextGen - Weather Technology in the Cockpit program priorities upon which this milestone depends. 2012 NARP Status: On schedule
2016	Demonstrate the integration of navigation information and flight information, including weather information, into cockpit decision-making and shared situational awareness among pilots, dispatchers, and air traffic controllers supported by NextGen air and ground capabilities	Delayed	This milestone has been delayed from 2015 to 2016 due to delays in projects upon which this milestone depends. 2012 NARP Status: On schedule
2016	Implement cockpit alerting to enhance pilot awareness of adverse weather (e.g., turbulence, icing)	On schedule	New milestone
2016	Provide recommendations on optimal presentation of general aviation weather information	On schedule	New milestone

NextGen - Weather Technology in the Cockpit Program Progress in FY 2012:

- ✓ Completed the first year of detailed callbacks and analysis of incident and accident reports linked to weather as a causal factor for data linked weather equipped aircraft. The research examined approximately 60 reported incidents in depth and determined that at least 100 reports are needed to perform a detailed trend analysis. The effort was extended into 2013 for an additional year of callbacks. The final report for the first year was completed and is being reviewed for trends and the potential for corrective actions.

- ✓ Completed a human-over-the-loop demonstration of providing cloud top information to pilots and controllers in a collaborative environment while aircraft were in oceanic and other data sparse regions. The demonstration results indicated that this impact information provided substantial utility in making adverse weather decisions.

1.5.2 Weather Program (RE&D - A11.k)

The Weather Program supports these R&D goals by conducting applied research focused on improving weather information required for integration into decision-support tools to reduce the impact of adverse weather on the NAS. The improved weather information increases safety by supporting better operational planning and decision-making by ATM, dispatchers, and pilots.

The research milestones and their statuses are shown in Table 1.5.2 below, followed by a summary of the significant progress made in FY 2012 towards achieving these R&D goals.

Table 1.5.2: Weather Program Milestones

Year	Milestone	Status	Notes
2010	Develop Continental U.S. ceiling, visibility, and flight category forecast capability	Completed	
2012	Develop Continental U.S. ceiling and visibility forecast to merge with National Weather Service capability	Completed	2012 NARP Status: On schedule
2014	Transition in-flight icing Alaska forecast and analysis capability for implementation	On schedule	
2014	Transition in-flight icing Alaska forecast for implementation	Deleted	This milestone has been deleted as it is a duplicate of the 2014 milestone "Transition in-flight icing Alaska forecast and analysis capability for implementation". 2012 NARP Status: On schedule

Year	Milestone	Status	Notes
2015	Demonstrate integrated FAA/National Weather Service ceiling and visibility forecast capability	On schedule	
2016	Demonstrate and validate prototype oceanic convection forecast capability	On schedule	New milestone

Weather Program Progress in FY 2012:

- ✓ Developed a ceiling and visibility forecast (CVF) capability that provides real-time 12 hour forecasts of low ceilings, restricted visibility, and flight category conditions, updated every 5 minutes with a 5 kilometer grid, across the U.S. A collaborative effort with the National Weather Service (NWS) is merging the CVF with the NWS Localized Aviation Model Output Statistics Product to form the basis of a gridded product. Initial verification and assessment of the additional capabilities that CVF provides is being quantified, and a modify-test-verify cycle will be used to implement overall algorithm improvements.

1.6 Aviation Safety R&D Goals 7 - 9

Optimized technical and regulatory provisions and processes used to oversee, coordinate, regulate, and promote safe and responsible activities reliable aerospace operations between space and Earth.

Improved vehicle safety and risk management, including knowledge of all safety-critical components and systems of the space vehicles and their operations, to better identify potential hazards and apply and verify hazard controls.

Guidance and tools that enhance human safety, protection, and survival during space operations.

1.6.1 Commercial Space Transportation Safety (Ops)

The Commercial Space Transportation Safety Program supports these R&D goals by examining safety considerations for commercial space transportation, including those that involve crew and spaceflight participants' health and safety, spacecraft vehicle safety, launch, and re-entry risks, public safety, and personal property risk. R&D for the Commercial Space Transportation Program is conducted through its Center of Excellence.

The research milestones and their statuses are shown in Table 1.6.1 below, followed by a summary of the significant progress made in FY 2012 towards achieving these R&D goals.

Table 1.6.1: Commercial Space Transportation Safety Program Milestones

Year	Milestone	Status	Notes
2009	Conduct a study to determine the need to develop a temporal wind database to support the launch of wind-weighted, unguided, suborbital rockets launched from nonfederal launch sites	Completed	
2009	Review integrated operations of reusable launch vehicles from joint use airports and spaceports and the surrounding airspace and provide recommendations to safely integrate and conduct routine operations from these facilities	Completed	

Year	Milestone	Status	Notes
2009	Conduct a study to survey the existing technologies available for determining wind conditions from the upper troposphere to the stratosphere. The study will address possible modifications of radar wind profiler to obtain winds to greater altitudes than currently available	Completed	
2010	Conduct a study with current information related to the state of the commercial suborbital transportation industry with a focus on market demand, safety, operability, and international coordination	Completed	
2010	Conduct a study to examine the operational environment, determine the number of sensors needed, define the data recovery process, and provide black box survivability criteria for use in developing requirements for a black box system to be used in commercial space transportation systems (expendable launch vehicles and reusable launch vehicles)	Completed	
2011	Release Commercial Space Transportation Research Road Map document, v1.0	Completed	
2011	Conduct a study to provide guidance to the FAA and industry on the use of operational limitations and inspection requirements for suborbital reusable launch vehicles comprised of composite materials. The results of this study will help to develop effective rules for operations and maintenance for use of composite materials, as they apply to commercial space transportation	Completed	
2012	Conduct a study to provide information on the capability, limitations, and considerations for global positioning system implementation in space launch and reentry environments, such as space and air traffic control, to help determine system usage and future technologies	Completed	2012 NARP Status: Delayed from 2011 to 2012

Year	Milestone	Status	Notes
2014	Conduct a study to identify means of preventing hazards (such as fires and explosions) involving nontraditional monopropellants and oxidizers (specifically hydrogen peroxide, H_2O_2, and nitrous oxide, N_2O) used in propulsion systems in commercial space applications	Delayed	This milestone has been delayed from 2012 to 2014 due to changing laboratory facility sites. 2012 NARP Status: Delayed from 2011 to 2012
2014	Develop FACET model to calculate probabilistic four-dimensional rocket trajectory envelopes to minimize impact on NAS	On schedule	New milestone
2014	Develop and deliver "anytime" version of Space Based Model Predictive Optimization to optimize power consumption and minimum energy trajectory calculations	On schedule	New milestone
2014	Report results of thermal ablation testing and analysis of ultra-high temperature composites for thermal protection systems in liquid rocket engine plume	On schedule	New milestone
2015	Complete Whole Atmosphere Model implementation coupling ionosphere and magnetospheric forcing and assimilate high-resolution data	On schedule	New milestone
2015	Report centrifuge test results evaluating biomedical monitoring equipment	On schedule	New milestone

Commercial Space Transportation Safety Program Progress in FY 2012:

- ✓ Launched an ADS-B payload into space on two missions that re-entered the Earth's atmosphere. In the first, ADS-B flew on a sounding rocket in April 2012 where the payload withstood a maximum acceleration of 16 g during a 12-second launch and successfully transmitted throughout the flight. During this flight, the payload provided information on the capability, limitations, and considerations for GPS-based systems in space launch and reentry environments. Tracking was conducted by FAA ground-based terminals in New Mexico and Texas, displaying the entry descent and landing of rocket in real time at the William J. Hughes Technical Center. On the second mission, the payload flew at the Team America Rocket Challenge in May 2012 on a large amateur rocket and was tracked in real time by mobile equipment and the FAA ground-based terminals in Northern Virginia.

1.7 Aviation Safety R&D Goal 10

No fatal accidents on certificated airports as a result of airport design, runway incursions or excursions, or wildlife strikes.

1.7.1 Airport Cooperative Research Program – Safety (AIP)

The Airport Cooperative Research Program – Safety supports this R&D goal by preventing or mitigating potential injuries and accidents within the airport operational environment. A fundamental element of the program is to produce results that provide protection of aircraft passengers and airport personnel through improved safety training, airport design, and advanced technology implementation.

The research milestones and their statuses are shown in Table 1.7.1 below, followed by a summary of the significant progress made in FY 2012 towards achieving this R&D goal.

Table 1.7.1: Airport Cooperative Research Program – Safety Milestones

Year	Milestone	Status	Notes
2011	Develop and validate a software tool to quantify risk and support engineering decision-making related to runway safety area requirements	Completed	
2012	Develop and test a simulation tool that helps decision making during airport emergency management situations	Completed	New milestone
2012	Publish guidance for airport mutual aid programs	Completed	New milestone
2013	Develop a tool to help define the roles of airports and airlines in the transmission and spread of insect-borne human diseases	On schedule	The completion year for this milestone has been corrected to 2013 and status changed to "On schedule" to align with the expected publication date of this report. This milestone has been revised for clarity. Old wording: "Assess the role of airports and airlines in the spread of vector borne-diseases"
2013	Determine high-risk areas and activities conducive to human disease at airports and on aircraft and identify mitigation measures to address those risks	On schedule	New milestone

Year	Milestone	Status	Notes
2013	Develop guidance for airport operators to help them understand the capabilities, benefits, and challenges of integrating geographical information systems into emergency management	On schedule	New milestone
2013	Develop guidance to evaluate and implement web-based collaboration tools that provide a common operating picture for both day-to-day operations and full emergency response management	On schedule	New milestone
2013	Develop a model Community Emergency Response Team program for the airport community	On schedule	New milestone
2013	Provide guidance to all size airports in integrating National Incident Management System in response to incidents/accidents and events regardless of the size, cause, or complexity of such events	On schedule	New milestone
2014	Develop a runway veer-off location distribution risk assessment model with guidelines for reporting and collecting runway veer-off incident/ accident data	On schedule	New milestone
2014	Develop a scalable tool to create and maintain integrated incident response plans for hazards in and around airport terminals	On schedule	New milestone

Airport Cooperative Research Program – Safety Progress in FY 2012:

- ✓ Developed and completed four field tests of Airport Emergency Response Operations Simulation (AEROS), a tool that provides a training-centered suite of exercise scenarios focused on decision making during airport emergency management situations. AEROS provides web-based exercises for command roles in the emergency operations center for the FAA-required hazards as listed in scenarios in 14 CFR Part 139.325, *Airport Emergency Plan*.

- ✓ Published a report titled *Airport-to-Airport Mutual Aid Programs*, which guides airports to develop and implement national and/or regional airport-to-airport mutual aid programs (MAPs) to plan, assess, respond, and recover from an event that adversely affects operations of the airport. The report describes the potential benefits of and different issues that should be considered when creating airport-to-airport MAPs.

1.7.2 Airport Technology Research Program – Safety (AIP)

The Airport Technology Research Program – Safety supports this R&D goal by increasing airport safety through research that improves airport lighting and marking, reduces wildlife hazards near airport runways, improves airport fire and rescue capability, and reduces surface accidents.

The research milestones and their statuses are shown in Table 1.7.2 below, followed by a summary of the significant progress made in FY 2012 towards achieving this R&D goal.

Table 1.7.2: Airport Technology Research Program – Safety Milestones

Year	Milestone	Status	Notes
2010	Develop advisory material to install new visual guidance systems	Completed	
2011	Develop performance standards for avian radar use on airports	Completed	
2011	Complete evaluation of new airport runway pavement groove shape to reduce risk of overrun due to hydroplaning	Completed	
2012	Develop aircraft rescue and fire-fighting procedures and equipment standards to address double-decked large aircraft	Completed	2012 NARP Status: On schedule
2012	Develop guidance material for airport planning to ensure consistency from the operator's perspective from airport to airport	Completed	2012 NARP Status: On schedule
2013	Complete assessment of the safety implications of using long range acoustic devices on civil airports to deter hazardous bird species	On schedule	New milestone
2013	Complete characterization of Foreign Object Debris at Chicago O'Hare International Airport	On schedule	New milestone
2013	Survey airport communities to update dose-response curves for aircraft noise annoyance and sleep disturbance	On schedule	New milestone
2013	Develop visual aid enhancements for Engineered Materials Arresting System beds	On schedule	New milestone
2013	Develop a safety database to identify the top five airport risk areas, mitigation strategies and implementation	On schedule	New milestone

Year	Milestone	Status	Notes
2013	Develop aircraft rescue and firefighting procedures and equipment for improved freighter aircraft fire fighting	On schedule	New milestone
2013	Develop improved tactics and strategies for freighter aircraft fire fighting	On schedule	New milestone
2013	Complete evaluation of operational and technical performance requirements of an alternative airfield lighting infrastructure (Electrical Infrastructure Research)	On schedule	New milestone
2014	Complete rehabilitation of the Airport Technology Research Taxiway	On schedule	New milestone
2014	Complete human factor laboratory/ simulation tests on use of linear light sources on airports	On schedule	New milestone
2014	Complete in-service testing of new light emitting diode lighting circuits at a large and small airport	On schedule	New milestone
2014	Update the Airport Safety Database and publish updated analysis report	On schedule	New milestone
2014	Complete evaluation to determine feasibility of implementing bird radar displays in air traffic control towers	On schedule	New milestone
2014	Complete the first phase of a study to establish a test protocol and collect baseline data for large aviation fuel fires at the New Large Aircraft Full-Scale Mockup	On schedule	New milestone
2014	Complete mu-slip testing with aircraft landing gear brakes on contaminated runway surfaces	On schedule	New milestone
2014	Complete construction of the High Temperature Pavement Test Facility	On schedule	New milestone
2014	Complete upgrade of all FAA Pavement Software to Windows Presentation Foundation	On schedule	New milestone
2014	Complete definition of airport pavement failure for 40 Year Pavement Life project	On schedule	New milestone

Airport Technology Research Program – Safety Progress in FY 2012:

- ✓ Developed guidance for using avian radar to supplement binoculars and point counts during airport wildlife hazard assessments. The guidance is based on research conducted with an avian radar system to demonstrate its usefulness as a supplement to a scheduled monthly observation that was part of a year-long wildlife hazard assessment at the Cedar City Regional Airport in Utah. The avian radar consistently observed more bird targets than were identified by visual observation and provided a useful data set for analyses that supported the development of the airport's Wildlife Hazard Management Plan.

- ✓ Completed research needed to develop aircraft rescue and fire-fighting procedures and equipment standards to address double-decked large aircraft. The effort identified new firefighting strategies for these types of aircraft, as well information on agent quantities, aircraft systems and components, and best practices in new large aircraft firefighting strategies.

- ✓ Completed taxiway deviation data collection activity at four Design Group III airports. The research is part of a large research effort to characterize different design group aircraft taxiing behavior on appropriately-wide taxiways. Using measurement data collected on the location of the aircraft in relation to the centerline of the taxiway, researchers performed statistical analysis of the data to determine the probability of an aircraft deviating from the centerline. In total, over 35,000 aircraft were measured at Palm Beach International Airport, Salisbury Ocean City Wicomico Airport, Key West International Airport, and Westchester County Airport.

1.7.3 Runway Incursion Reduction Program (F&E - 1A01A – Advanced Technology Development and Prototyping)

The Runway Incursion Reduction Program supports this R&D goal by conducting research, development, and operational evaluation of technologies to increase runway safety. Emphasis is on technologies that provide for direct safety indications and alerts to pilots at large airports as well as those that can be applied cost effectively at small to medium airports. The program tests alternative airport surface detection technologies and the application of these technologies for pilot, controller, and vehicle operator situational awareness tools. Program initiatives include Runway Status Lights technology enhancements such as Runway Intersection Lights (RIL) logic, LED technology, Low Cost Ground Surveillance (LCGS) pilot sites, Runway Safety Assessment studies, Final Approach Runway Occupancy Signal, and Enhanced Final Approach Runway Occupancy Signal (eFAROS) for high density airports.

The research milestones and their statuses are shown in Table 1.7.3 below, followed by a summary of the significant progress made in FY 2012 towards achieving this R&D goal.

Table 1.7.3: Runway Incursion Reduction Program Milestones

Year	Milestone	Status	Notes
2010	Develop system enhancements for Runway Status Lights	Completed	
2011	Continue development of Runway Status Lights system enhancements, install additional Low Cost Ground Surveillance pilot sites, and assess runway incursion mitigation programs via simulation	Completed	
2013	Complete the development of the interface required for the activation of direct to pilot indications using a low cost Surface Movement Radar as the surveillance sensor	On schedule	New milestone
2013	Complete human-in-the-loop simulation scenario coordination meeting with the William J. Hughes Technical Center Surface Lighting Team	On schedule	New milestone
2013	Complete final luminosity and operational evaluation report on San Diego International Airport's light emitting diode Runway Status Lights system	On schedule	New milestone
2013	Develop an annual technical and operational evaluation report of the existing Enhanced Final Approach Runway Occupancy Signal prototype system	On schedule	New milestone
2013	Publish an initial cost-benefit analysis for Enhanced Final Approach Runway Occupancy Signal	On schedule	New milestone
2013	Develop an annual technical and operational evaluation report of the existing prototype systems	On schedule	New milestone
2014	Develop annual technical and operational evaluation report of four Low Cost Ground Surveillance pilot systems	On schedule	New milestone
2014	Develop annual technical and operational evaluation report of existing Runway Status Lights prototype systems	On schedule	New milestone

Year	Milestone	Status	Notes
2014	Develop annual technical and operational evaluation report for Runway Intersection Lights at Boston Logan International Airport	On schedule	New milestone
2014	Complete the installation and produce operational evaluation report of a runway safety system for direct to pilot indications, using a low cost Surface Movement Radar as the surveillance sensor	On schedule	New milestone
2014	Complete installation and implementation of Enhanced Final Approach Runway Occupancy Signal units at second prototype location and commence operational evaluation	On schedule	New milestone
2014	Develop readiness report based on coordination of preliminary requirements document and cost benefit analysis documents required for Enhanced Final Approach Runway Occupancy Signal Investment Analysis Readiness Decision	On schedule	New milestone
2014	Develop annual technical and operational evaluation report of Enhanced Final Approach Runway Occupancy Signal units at all prototype locations	On schedule	New milestone
2014	Complete report on cockpit simulations at MITRE Center for Advanced Aviation System Development testing Human Factors, safety logic, aircraft performance, or any uncertainty or deficiency pertaining to surface based runway incursion indications	On schedule	New milestone
2014	Complete report on testing of safety logic enhancements to runway incursion detection and prevention products	On schedule	New milestone
2014	Publish initial report on field evaluation of alternative direct to pilot testing system at the FAA William J. Hughes Technical Center	On schedule	New milestone
2014	Complete initial requirements document for Enhanced Final Approach Runway Occupancy Signal	On schedule	New milestone

Year	Milestone	Status	Notes
2014	Publish the initial project plan and resource management plan for the utilization of fiber optics as a sensor to drive the activation of direct to pilot alerting safety logic	On schedule	New milestone

Runway Incursion Reduction Program Progress in FY 2012:

- ✓ Completed the coordination for installation and operational evaluation of low-power light emitting diode fixtures at San Diego International Airport. The prototype was evaluated to study the cost savings realized from lower energy consumption and reduced maintenance of the lamp fixtures.

- ✓ Published the final feasibility study report on whether LCGS can operate as a sensor to drive the activation of direct to pilot alerting safety logic. Data from the LCGS system at Spokane International Airport was analyzed and post-processed to assess the use of LCGS as a sensor to drive eFAROS safety logic.

- ✓ Installed and implemented the eFAROS at Dallas-Fort Worth International Airport (DFW). Flashing Precision Approach Path Indicator (PAPI) modification kits were installed at 8 PAPI facilities at DFW where a successful flight check of the eFAROS system was conducted. Boston Logan International Airport (BOS) was identified as the second location for the installation of a prototype eFAROS system. Development of the communications interface for use with the PAPI systems currently installed at BOS was completed which will enable remote monitoring and control of the PAPI modification kits.

- ✓ Published the initial requirements document and cost benefit analysis for RIL based on data gathered at BOS.

1.7.4 Center for Advanced Aviation System Development (F&E - 4A08A)

The CAASD Program supports this R&D goal by conducting analysis and field evaluations for early evaluation of capabilities to increase surface situational awareness and pilot warning to accelerate the implementation of Next Gen airport capacity and safety improvements.

CAASD made the following progress in FY 2012 towards Aviation Safety R&D Goal 10.

- ✓ Investigated the Closed Runway Operation Prevention Device, which uses speech recognition technology to prevent closed runway operations. The approach is to adapt commercial speech-recognition technology to monitor the delivery of clearances and to generate an alert when a controller issues a landing or departure clearance to a closed runway. This concept requires minimal controller attention, is designed to alert controllers before the operation has occurred, allows time for corrective action, and has a low false alarm rate. Results provide a baseline for speech recognition performance applied in the context of tower operations.

- ✓ Developed a controller display prototype and defined a concept of operations for Block Occupancy-Based Surface Surveillance that uses inexpensive magnetic sensors to create block boundaries to monitor entering and exiting aircraft and ground vehicles. The surveillance system identifies the occupancy status of each block, which is sent wirelessly to the tower, and presented to controllers. The prototype was integrated with CAASD's Aviation IDEA Laboratory for evaluation using experienced tower control personnel. Simulations examined the impact on controller workload, situational awareness, and response to off-nominal events (e.g., blunders) under high and low visibility conditions and with varying levels of traffic. Initial results suggest that controllers accept this capability, particularly under low visibility conditions, and it enhances controllers' ability to quickly detect off-nominal runway events.

Chapter 2
Improve Efficiency

Systematically expand and apply knowledge to produce useful materials, devices, systems, or methods that will improve access to and increase capacity and efficiency of the nation's aviation system.

Seven goals support R&D Principle 2 - Improve Efficiency with work spread across three budget appropriations (RE&D, F&E, and AIP):

- Goal 1 - Necessary NextGen related research priorities are identified, defined, and coordinated with partner agencies for improvements in efficiency and capacity.

- Goal 2 - Improved aircraft separation processes associated with current generalized and static air navigation service provider wake turbulence mitigation separation standards.

- Goal 3 - Improved human-system integration and an increase in ATC efficiency through enhanced controllers-pilots coordination in cooperatively managing traffic loads as cockpit technology and air traffic workstations are more closely connected.

- Goal 4 - Feasible procedures, operational methods, and technologically-advanced systems that can decrease workload and increase efficiency of the NAS.

- Goal 5 - Established requirements and standards for enabling availability and improving the quality and quantity of meteorological information to reduce impacts of adverse weather on rerouting, NAS capacity, and NextGen operational procedures.

- Goal 6 - Improved accuracy and accessibility of observed and forecast weather information to improve NAS efficiency (e.g., reduced delays and cancellations, increased capacity in high traffic areas).

- Goal 7 - Availability of existing airport facilities protected and used as efficiently as possible, while making strategic investments in new facilities consistent with evolving aviation needs.

Table 2.0.1 shows how the FAA's Efficiency R&D goals and programs align with the NSTC Mobility Goals. In many cases, FAA R&D programs support more than one NSTC goal. Throughout this chapter, progress in FY 2012 on 164 milestones across all of these programs is described. As of the end of FY 2012, 21 percent of milestones in support of R&D Principle 2 – Improve Efficiency were completed and 100 percent of active milestones were on schedule.

Table 2.0.1: FAA R&D Goals and Programs Alignment with NSTC Mobility Goals

FAA R&D Principle	FAA R&D Goals	FAA R&D Programs	NSTC Goals		NSTC Principle
Improve Efficiency	1 - Necessary NextGen related research priorities are identified, defined, and coordinated with partner agencies for improvements in efficiency and capacity.	Joint Planning and Development Office	Goal 5 - Develop Expanded Manned and Unmanned Aircraft System Capabilities to Take Advantage of Increased Air Transportation System Performance		Mobility Through the Air is Vital to Economic Stability, Growth, and Security as a Nation
	2 - Improved aircraft separation processes associated with current generalized and static air navigation service provider wake turbulence mitigation separation standards.	NextGen - Wake Turbulence	Goal 1 - Develop Reduced Aircraft Separation in Trajectory- and Performance-Based Operations		
		Wake Turbulence - Re-categorization	Goal 4 - Maximize Arrivals and Departures at Airports and in Metroplex Areas		
	3 - Improved human-system integration and an increase in ATC efficiency through enhanced controllers-pilots coordination in cooperatively managing traffic loads as cockpit technology and air traffic workstations are more closely connected.	NextGen - Air Ground Integration Human Factors	Goal 1 - Develop Reduced Aircraft Separation in Trajectory- and Performance-Based Operations		
		Air Traffic Control/Technical Operations Human Factors (Controller Efficiency and Air Ground Integration)	Goal 4 - Maximize Arrivals and Departures at Airports and in Metroplex Areas		
	4 - Feasible procedures, operational methods, and technologically-advanced systems that can decrease workload and increase efficiency of the NAS.	New Air Traffic Management Requirements	Goal 2 - Develop Increased NAS Capacity by Managing NAS Resources and Air Traffic Flow Contingencies	Goal 1 - Develop Reduced Aircraft Separation in Trajectory- and Performance-Based Operations Goal 4 - Maximize Arrivals and Departures at Airports and in Metroplex Areas	
		Major Airspace Redesign			
		System Capacity, Planning and Improvements			
		Operations Concept Validation Modeling			
		Networked Facilities - Staffed NextGen Towers			
		Operations Concept Validation and Infrastructure Evolution			
	5 - Established requirements and standards for enabling availability and improving the quality and quantity of meteorological information to reduce impacts of adverse weather on rerouting, NAS capacity, and NextGen operational procedures.	NextGen - Weather Technology in the Cockpit	Goal 3 - Reduce the Adverse Impacts of Weather on Air Traffic Management Decisions	Goal 2 - Develop Increased NAS Capacity by Managing NAS Resources and Air Traffic Flow Contingencies	
	6 - Improved accuracy and accessibility of observed and forecast weather information to improve NAS efficiency (e.g., reduced delays and cancellations, increased capacity in high traffic areas).	Weather Program			
	7 - Availability of existing airport facilities protected and used as efficiently as possible, while making strategic investments in new facilities consistent with evolving aviation needs.	Airport Cooperative Research Program - Capacity	Goal 2 - Develop Increased NAS Capacity by Managing NAS Resources and Air Traffic Flow Contingencies		
		Airport Technology Research Program - Capacity			

In FY 2014, 37 percent of total FAA R&D funding is allocated to R&D Principle 2 - Improve Efficiency. Program funding levels for the 2013 CR Annualized and 2014 President's Request are shown in Table 2.0.2. Percent of Program reflects the part of each program's contribution towards R&D Principle 2 in the 2014 President's Request. Table 2.0.2 also lists the section and page number reference for each budget narrative within the FY 2014 CJ for the President's Budget Request. The link to the FY 2014 CJ is: http://www.dot.gov/sites/dot.dev/files/docs/FAA_FY2014_Budget_Estimates.pdf.

Table 2.0.2: Program Funding for R&D Principle 2 - Improve Efficiency

2014 BLI	Program	CJ Reference (Section/Page)	Appropriation Account	2013 CR Annualized ($000)	2014 Request ($000)	2014 Percent of Program
A11.k	Weather Program	3C/48	RE&D	8,071	7,640	50%
A12.a	Joint Planning and Development Office (JPDO)	3C/65	RE&D	5,031	12,057	100%
A12.b	NextGen - Wake Turbulence	3C/70	RE&D	10,739	9,267	100%
A12.c	NextGen - Air Ground Integration Human Factors	3C/74	RE&D	3,169	3,099	30%
A12.d	NextGen - Weather Technology in the Cockpit	3C/78	RE&D	3,622	1,876	45%
A14.a	System Planning and Resource Management	3C/92	RE&D	386	512	22%
A14.b	William J. Hughes Technical Center Laboratory Facility	3C/95	RE&D	1,074	974	28%
1A01B	System Capacity, Planning and Improvements	3B/12	F&E	5,430	5,600	100%
1A01C	Operations Concept Validation and Infrastructure Evolution	3B/12	F&E	4,170	4,000	100%
1A01D	Major Airspace Redesign	3B/12	F&E	5,915	5,000	100%
1A07A	Air Traffic Control/Technical Operations Human Factors (Controller Efficiency and Air Ground Integration)	3B/42	F&E	4,165	5,000	100%
1A07B	New Air Traffic Management Requirements	3B/42	F&E	18,320	22,000	100%
1A07C	Operations Concept Validation Modeling	3B/42	F&E	4,165	5,000	100%
1A07E	Wake Turbulence - Re-categorization	3B/42	F&E	1,250	1,500	100%
1A07H	Networked Facilities - Staffed NextGen Towers	3B/42	F&E	2,915	2,000	100%
4A08A	Center for Advanced Aviation System Development (CAASD)	3B/323	F&E	13,555	12,165	74%
--	Airport Cooperative Research Program - Capacity	3D/36	AIP	5,031	5,000	100%
--	Airport Technology Research Program - Capacity	3D/28	AIP	12,571	12,607	100%
	Total ($000)			**109,579**	**115,296**	

2.1 Efficiency R&D Goal 1

Necessary NextGen related research priorities are identified, defined, and coordinated with partner agencies for improvements in efficiency and capacity.

2.1.1 Joint Planning and Development Office (RE&D - A12.a)

The JPDO supports this R&D goal by ensuring efficient coordination and collaboration among NextGen partner agencies and reinforcing agency accountability for NextGen through agency plans and reports that complement the long-term strategic plan. It addresses key interagency priorities identified by the Cabinet-level Senior Policy Committee for NextGen.

The research milestones and their statuses are shown in Table 2.1.1 below, followed by a summary of the significant progress made in FY 2012 towards achieving this R&D goal.

Table 2.1.1: Joint Planning and Development Office Milestones

Year	Milestone	Status	Notes
2013	Formulate the strategic national program plan for unmanned aircraft system integration	On schedule	New milestone
2013	Participate in a bi-agency capability evaluation between the FAA and the National Weather Service by June 30, 2013	On schedule	New milestone
2014	Execute the strategic national program plan for unmanned aircraft system integration	On schedule	New milestone
2014	Identify existing net-centric capabilities to support interagency requirements	On schedule	New milestone

Joint Planning and Development Office Program Progress in FY 2012:

- ✓ Developed initial safety case plan for the implementation of trajectory-based operations (TBO) built off a 2009 government/industry study team recommendation report for necessary operational improvements, research, policy, and procedures. This plan identifies areas where concept development is needed to address gaps, research is needed to enable a safety case to be made that demonstrates the acceptability of TBO, and policy decisions are needed to permit greater air-ground integration of the type TBO will introduce.

- ✓ Conducted a TBO Capability Safety Assessment to determine whether TBO capabilities, operational improvements, and enablers described in the JPDO Integrated Work Plan can be executed safely, given the state of maturity of the concepts being addressed.

2.2 Efficiency R&D Goal 2

Improved aircraft separation processes associated with current generalized and static air navigation service provider wake turbulence mitigation separation standards.

2.2.1 NextGen - Wake Turbulence (RE&D - A12.b)

The NextGen - Wake Turbulence Program supports this R&D goal by conducting research to increase airport runway capacity safely by reducing aircraft wake separation minima under certain conditions and addressing wake turbulence restrictions in today's terminal and en route airspace and in the future NextGen airspace designs.

The research milestones and their statuses are shown in Table 2.2.1 below, followed by a summary of the significant progress made in FY 2012 towards achieving this R&D goal.

Table 2.2.1: NextGen - Wake Turbulence Program Milestones

Year	Milestone	Status	Notes
2010	Determine Air Navigation Service Provider (and pilot as needed) situational aircraft separation display concepts required for implementation of the NextGen Trajectory-Based Operation and High Density concepts	Completed	
2011	Determine initial set of optimal aircraft flight characteristics and weather parameters for use in setting wake separation minimums	Completed	This milestone was completed under the NextGen - Wake Turbulence (A12.b) Program, not the Wake Turbulence - Re-Categorization (1A07E) Program, as previously reported.
2012	Determine the NAS infrastructure requirements (ground and aircraft) for implementing the NextGen Trajectory-Based Operation and High Density concepts within the constraints of aircraft-generated wake vortices and aircraft collision risk	Completed	2012 NARP Status: On schedule
2013	Modify procedures as requested to allow use of closely spaced parallel runways for arrival operations during non-visual conditions (two to three airports per year per Task Force 5 recommendations and for requests from airports)	On schedule	

Year	Milestone	Status	Notes
2014	Provide wake separation recommendations for Airbus 350 series aircraft	On schedule	New milestone
2016	Develop the algorithms that will be used in the Air Navigation Service Provider (and flight deck as needed) automation systems for setting dynamic wake separation minimum for each pair of aircraft	On schedule	Research for this milestone is being conducted under the NextGen - Wake Turbulence (A12.b) Program, not the Wake Turbulence - Re-Categorization (1A07E) Program, as previously reported.

NextGen - Wake Turbulence Program Progress in FY 2012:

- ✓ Completed detailed analyses of terminal area procedures at San Francisco International Airport (SFO) and Newark Liberty International Airport and determined they could use the air traffic control closely spaced runway diagonal wake separation procedure detailed in FAA Order 7110.308, contingent upon necessary changes to their runway glide slopes. Use of this procedure will significantly minimize the reduction in runway landing capacity associated with inclement weather or other conditions at these two airports.

- ✓ Published the Radio Technical Commission for Aeronautics (RTCA) document *Aircraft Derived Meteorological Data via Data Link for Wake Vortex, Air Traffic Management and Weather Applications - Operational Services and Environmental Definition (OSED)*. This document defines a concept of operations for transmitting aircraft-derived meteorological data to enable a wide range of NextGen and Single European Sky ATM Research (SESAR) applications in the areas of wake turbulence, air traffic management, and meteorology. The document represents a potential sea change in the thinking related to acquisition and use of aircraft-derived meteorological data.

- ✓ Established the Seal Point light detection and radar based data collection site at an adjacent park overlooking SFO. Data collected at SFO, a reliable measurement location for aircraft wakes, will be used in alternative analyses and safety assessments to support NextGen era changes in wake separation standards and applicable air traffic control procedures.

- ✓ Developed a data extraction tool to scan flight data recorders for potential low impact wake vortex encounters during an aircraft's flight. The tool was successfully tuned to the flight characteristics of the Boeing 737-800 by running it against 86,000 actual flight hours of recorded data. The tool aids in the understanding of how aircraft wakes affect other aircraft traveling on NextGen era trajectories.

2.2.2 Wake Turbulence - Re-Categorization (F&E - 1A07E – NextGen – Systems Development)

The Wake Turbulence - Re-Categorization Program supports this R&D goal by developing enhanced ATC procedures and separation standards that will safely allow reduced wake separations between aircraft, resulting in safe increased capacity for the nation's airports and airspace. As part of the program, wake encounter severity models are developed and used in combination with aircraft wake turbulence data collected by the NextGen – Wake Turbulence Program, NASA, and other global research partners. The models, in conjunction with measured data, are used in benefit and safety analyses of the project's developed proposed changes to ATC wake mitigation procedures and separation standards.

The research milestones and their statuses are shown in Table 2.2.2 below, followed by a summary of the significant progress made in FY 2012 towards achieving this R&D goal.

Table 2.2.2: Wake Turbulence - Re-Categorization Program Milestones

Year	Milestone	Status	Notes
2011	Refine the boundaries of the current six weight categories for the NAS fleet mix and define automation requirements to support those modifications	Completed	
2013	Develop the initial concept of operations document for leader/ follower pair-wise static operations	On schedule	This milestone has been revised to ensure alignment with the Capital Investment Plan. Old wording: "Determine how best to incorporate the leader/follower based wake separation standards into the en route and terminal automation platforms"
2013	Develop a benefits assessment based on the initial concept of operations document data collected for 6 Category wake standards	On schedule	New milestone
2014	Complete modifications to FAA Orders for Static 6 Category standards	On schedule	New milestone
2014	Complete leader/follower pair-wise static standards development	On schedule	New milestone
2014	Complete development of a set of enhanced process and procedure modeling tools to evaluate proposed pair-wise dynamic aircraft wake hazard mitigation procedures	On schedule	New milestone

Year	Milestone	Status	Notes
2014	Complete the implementation plan for the leader/follower pair-wise static tailored aircraft wake separation standards procedures and processes	On schedule	New milestone
2015	Together with the European Organisation for the Safety of Air Navigation, deliver a more capacity-efficient set of wake separation standards to the International Civil Aviation Organization (leader-follower pair-wise static)	Deleted	This milestone has been deleted to ensure alignment with the Capital Investment Plan. 2012 NARP Status: On schedule

Wake Turbulence - Re-Categorization Program Progress in FY 2012:

- ✓ Selected Memphis International Airport (MEM) as the first air traffic control facility to use the 6 Category Wake Separation Standards. To this end, a waiver to the FAA ATC Order 7110.65 was approved, software adaptation changes to the MEM terminal automation systems were developed and tested, and training system equipment was installed. In addition, MEM controller training and the use of associated new standards were initiated. Using the enhanced wake separation standards, MEM expects to achieve at least a seven percent increase in the airport's landing capacity when weather or other events dictates instrument flight rule operations during the FedEx evening rush.

- ✓ Completed an initial concept of operations document for more efficient leader/follower wake turbulence separation standards.

2.3 Efficiency R&D Goal 3

Improved human-system integration and an increase in ATC efficiency through enhanced controllers-pilots coordination in cooperatively managing traffic loads as cockpit technology and air traffic workstations are more closely connected.

2.3.1 NextGen - Air Ground Integration Human Factors (RE&D - A12.c)

The NextGen - Air Ground Integration Human Factors Program supports this R&D goal by addressing flight deck and ATC integration for NextGen operational capabilities. It focuses on human factors issues that primarily affect the pilot side of the air-ground integration challenge. It conducts research to ensure pilots receive the right information at the right time for decision-making and collaboration with ATC to operate in the NAS efficiently.

The research milestones and their statuses are shown in Table 2.3.1 below, followed by a summary of the significant progress made in FY 2012 towards achieving this R&D goal.

Table 2.3.1: NextGen - Air Ground Integration Human Factors Program Milestones

Year	Milestone	Status	Notes
2010	Initiate research to identify equipment categories for legacy flight deck avionics to support human factors evaluations of use of these systems in NextGen flight procedures	Completed	
2011	Develop initial mid-term analysis describing the relationship between human pilots and controllers with associated automated systems	Completed	
2012	Complete initial research to evaluate and recommend procedures for negotiations and shared decision-making between pilots and controllers	Completed	2012 NARP Status: On schedule
2012	Complete research to develop methods to mitigate mode errors in use of NextGen equipment	Completed	2012 NARP Status: On schedule
2012	Initiate research to assess pilot performance in normal and non-normal NextGen procedures, including single pilot operations	Completed	2012 NARP Status: On schedule
2013	Complete research to identify human factors issues and potential mitigation strategies for the use of legacy avionics in NextGen procedures	On schedule	

Year	Milestone	Status	Notes
2014	Develop initial guidance on training methods to support detection and correction of human errors in near- to mid-term NextGen procedures	On schedule	
2016	Complete research to assess procedures, training, display, and alerting requirements to support development and evaluation of planned and unplanned transitions between NextGen and legacy airspace procedures	On schedule	
2016	Complete initial research to enable safe and effective changes to controller roles and responsibilities for NextGen procedures	On schedule	
2016	Complete research to identify and manage the risks posed by new and altered human error modes in the use of NextGen procedures and equipment	On schedule	
2017	Complete a functional simulation – simulate integrated pilot and controller functional capabilities	On schedule	

NextGen - Air Ground Integration Human Factors Program Progress in FY 2012:

- ✓ Assessed pilot situational awareness, decision-making, and workload comparing data communications (Data Comm) to voice communications. Results indicated that with a well-designed Data Comm interface, sufficient training, and clear procedures, there may not be a loss of situational awareness, degradation of decision-making, or increase in workload when using Data Comm instead of voice communications.

- ✓ Evaluated procedures for receiving and reading Data Comm messages and generating the appropriate response while evaluating alternative flight crew procedures. Results suggested that the optimal procedure would be for both pilots to read the clearance silently, and then for the pilot monitoring to initiate discussion to obtain concurrence from the pilot flying by reading the clearance aloud.

- ✓ Investigated the cognitive load impact on single pilots operating integrated glass cockpit aircraft and developed recommendations for pilots executing NextGen procedures. Results indicated that integrated glass cockpit systems place a heavy cognitive load on pilots. Recommendations include: (1) pilots should try to complete short tasks associated with ATC clearances quickly, such as dialing in a new heading, while listening to the rest of the ATC clearance; (2) pilots should avail themselves of the full range of workload management strategies such as reducing airspeed (with notification to ATC as required); and (3) pilots should be intentional with the shedding or truncating of tasks, altering type of management automation selected, and asking for ATC assistance (e.g., vectors, a hold). The results provide input to the FAA for guidance to reduce the cognitive complexity of these systems, minimize the likelihood of human error, and better support pilots managing the workload and resources of single-pilot operations.

- ✓ Published a report on mode awareness in the cockpit, which reviewed the state-of-the-art in mode awareness research, identified current known mode and mode transition issues, investigated NextGen technologies with potential mode awareness impacts, and identified significant mode awareness issues for near- and mid- term NextGen applications.

- ✓ Created a database of NextGen human error hazards, which contains prioritized human performance hazards and associated mitigation strategies. The database contains information from many human factors safety analyses, including assessments of operational event scenarios, Data Comm, and NextGen operational improvements and increments. The database contains filters for hazard conditions, human error potentials, mode errors, worst credible outcomes, and human performance risk categories. Mitigation strategies of design, training, and research requirements were identified for each hazard. The database is available for use in system safety and risk analysis for new air traffic control capabilities.

2.3.2 Air Traffic Control/Technical Operations Human Factors (Controller Efficiency and Air Ground Integration) (F&E - 1A07A – NextGen – Systems Development)

The Air Traffic Control/Technical Operations Human Factors (Controller Efficiency and Air Ground Integration) Program supports this R&D goal by addressing human system integration and human performance issues related to improving controller efficiency to yield greater traffic throughput without a commensurate increase in the number of ANSP personnel. It examines how ANSP personnel can achieve higher efficiency levels through the integration of automation, decision support tools, workstation displays, and procedures. The program also works together with the NextGen - Air Ground Integration Human Factors Program to address the air-ground integration required to transition from the current system to NextGen. It addresses changes in responsibilities and examines new types of human error modes to manage safety risk.

The research milestones and their statuses are shown in Table 2.3.2 below, followed by a summary of the significant progress made in FY 2012 towards achieving this R&D goal.

Table 2.3.2: Air Traffic Control/Technical Operations Human Factors (Controller Efficiency and Air Ground Integration) Program Milestones

Year	Milestone	Status	Notes
2010	Define anticipated controller workload reductions due to implementation of data communications	Completed	
2010	Define initial requirements and anticipated efficiency benefits for merging and spacing decision support tools to support continuous descent approach in the terminal area	Completed	
2012	Apply program-generated human factors knowledge to improve aviation system personnel selection and training	Completed	2012 NARP Status: On schedule
2013	Conduct a conceptual high-level job analysis for NextGen midterm air traffic controllers' activities, tools, and equipment	On schedule	This milestone has been revised to ensure alignment with the Capital Investment Plan. Old wording: "Analyze controller roles in a strategic air traffic environment for the impact on personnel selection and training"
2013	Demonstrate collaborative air traffic management efficiencies enabled by common situation awareness between flight operators and Air Navigation Service Providers	Deleted	This milestone has been deleted due to changing program priorities. The simulation exercises which would have demonstrated this collaboration will not occur. 2012 NARP Status: On schedule
2013	Demonstrate increased Air Navigation Service Provider efficiencies through new procedures that allow the introduction of routing, airspace, and equipage mix changes in the dynamic air traffic environment	Deleted	This milestone has been deleted due to changing program priorities. The simulation exercises which would have demonstrated these efficiencies will not occur. 2012 NARP Status: On schedule
2014	Update NextGen controller strategic job analysis and training needs documents	On schedule	New milestone

Year	Milestone	Status	Notes
2014	Prepare a report identifying causes and potential fixes to reduce non-conformance to Performance Based Navigation Required Area Navigation/ Required Performance Navigation standards	On schedule	New milestone
2014	Develop a human error/safety database for NextGen capabilities	On schedule	New milestone
2014	Publish the Human System Integration Roadmap	On schedule	New milestone
2014	Develop traffic management coordinator dispatcher, controller, and pilot information requirements document	On schedule	New milestone
2014	Develop NextGen human-automation interaction functional requirements and resolution guidance documents	On schedule	New milestone
2015	Develop selection procedures to transform the workforce into a new generation of service providers that can manage traffic flows in a highly automated system	Deleted	This milestone has been deleted to ensure alignment with the Capital Investment Plan. 2012 NARP Status: On schedule
2016	Perform an analysis of controller roles in terms of the services they provide during a given phase of flight as the differences between en route and terminal begin to blur	Deleted	This milestone has been deleted to ensure alignment with the Capital Investment Plan. 2012 NARP Status: On schedule

Air Traffic Control/Technical Operations Human Factors (Controller Efficiency and Air Ground Integration) Program Progress in FY 2012:

- ✓ Conducted strategic analyses to determine the impact of NextGen operations on air traffic controllers in 2018 to support pre-employment and selection processes. The study included an analysis of the job tasks, required skills, and equipment used in current day operations as compared to 2018. Results suggest that NextGen will not substantively change what air traffic controllers do in 2018, but it will change how they do it. As a result, no substantive changes are recommended to the FAA's controller pre-employment selection test battery. However, due to the extensive impact of NextGen on the required knowledge and skill, the FAA's training program will likely be affected.

- ✓ Conducted a demonstration of the Human Error/Safety Database for off-nominal NextGen conditions and collected information on opportunities for human errors and associated severity and likelihood.

2.4 Efficiency R&D Goal 4

Feasible procedures, operational methods, and technologically-advanced systems that can decrease workload and increase efficiency of the NAS.

2.4.1 Major Airspace Redesign (F&E - 1A01D - Advanced Technology Development and Prototyping)

The Major Airspace Redesign Program (formerly known as the Airspace Management Program) supports this R&D goal by funding changes in facilities necessary to accommodate airspace redesign. Implementation of an airspace redesign frequently results in changes to the number and span of control of operational positions or sectors, including changes to sector, area, or facility boundaries. Transition to a new configuration resulting from airspace redesign requires changes in the supporting infrastructure. These infrastructure changes can include: radio frequencies, connecting a radio site to a control facility, position to position connectivity, surveillance infrastructure modifications to ensure proper radar coverage; automation modifications to facility data and flight data processing; interfacility communication modifications; additional consoles and communication backup needs; and modifications to facility power and cabling. The program also supports the use of risk management and collaborative evaluation capabilities to identify requirements, opportunities and threats in the early stages of the design process.

The research milestones and their statuses are shown in Table 2.4.1 below.

Table 2.4.1: Major Airspace Redesign Program Milestones

Year	Milestone	Status	Notes
2014	Implement Chicago Airspace Project final phase	On schedule	New milestone
2014	Support infrastructure changes resulting from Las Vegas optimization	On schedule	New milestone
2014	Conduct engineering for airspace redesign implementation	On schedule	New milestone

2.4.2 New Air Traffic Management Requirements (F&E - 1A07B – NextGen – Systems Development)

The New Air Traffic Management Requirements Program supports this R&D goal by identifying new opportunities to improve the efficiency and effectiveness of air traffic management and expanding capacity by developing decision support tools that improve the strategic management of operations in the NAS. The New Air Traffic Management Requirements Program explores opportunities in the following areas: TCAS, New Radar Requirements (Surveillance and Weather), Trajectory Modeling, Airborne SWIM, Weather Transition, Cloud Computing, Automation Convergence, Synchronization of Air/Ground Procedures, and Advanced Air Ground Communications.

The research milestones and their statuses are shown in Table 2.4.2 below, followed by a summary of the significant progress made in FY 2012 towards achieving this R&D goal.

Table 2.4.2: New Air Traffic Management Requirements Program Milestones

Year	Milestone	Status	Notes
2013	Complete the Airborne Access to System Wide Information Management concept of operations service level review for bi-directional	On schedule	New milestone
2013	Develop trajectory schema air-ground and ground-ground exchange	On schedule	New milestone
2013	Develop evaluation model to assess common trajectory	On schedule	New milestone
2013	Develop initial Airborne Access to System Wide Information Management bi-directional shortfall analysis	On schedule	New milestone
2013	Conduct validation activities for Airborne Access to System Wide Information Management	On schedule	New milestone
2014	Develop Traffic Alert and Collision Avoidance System and Automatic Dependent Surveillance-Broadcast compatibility and future requirements document	On schedule	New milestone
2014	Develop future Collision Avoidance System logic development and future surveillance requirements document	On schedule	New milestone
2014	Develop Collision Avoidance System logic assessment, avionics model future surveillance assessment, and Traffic Alert and Collision Avoidance System - Automatic Dependent Surveillance-Broadcast compatibility engineering study	On schedule	New milestone

Year	Milestone	Status	Notes
2014	Develop Acquisition Management System artifacts for the investment analysis readiness decision for the NextGen surveillance and weather radar capability	On schedule	New milestone
2014	Update the multi-function phased array radar concept of operations for New Radar Requirements (Surveillance and Weather)	On schedule	New milestone
2014	Develop multi-function phased array radar demonstration strategy for New Radar Requirements (Surveillance and Weather)	On schedule	New milestone
2014	Finalize documentation of data elements needed to support Trajectory Modeling	On schedule	New milestone
2014	Develop standard of use document for different classes of trajectories for Trajectory Modeling	On schedule	New milestone
2014	Conduct validation of the information requirements for Airborne Access to System Wide Information Management, which will study the feasibility and benefit of providing operational, weather, and regulatory data to pilots in flight, using Class I and II Electronic Flight Bags receiving data via a commercial data provider	On schedule	New milestone
2014	Develop operational requirements for Airborne Access to System Wide Information Management (2-way)	On schedule	New milestone
2014	Conduct functional analysis and allocation for Airborne Access to System Wide Information Management (2-way)	On schedule	New milestone
2014	Develop cost estimates for Airborne Access to System Wide Information Management (2-way)	On schedule	New milestone
2014	Develop a requirements allocation and validation document with the National Weather Service for Weather Transition	On schedule	New milestone
2014	Conduct a weather concept demonstration and prepare report of evaluation of demonstration for Weather Transition	On schedule	New milestone

Year	Milestone	Status	Notes
2014	Conduct an assessment of mature research for transition to the National Weather Service for Weather Transition	On schedule	New milestone
2014	Develop an engineering study Cloud Computing evaluating NAS systems for potential assignment to cloud environment and data center rather than the local environment	On schedule	New milestone
2014	Update technical assumptions documentation for Cloud Computing based on safety and mission criticality and the ability of current architecture to provide service in a point-to-point environment	On schedule	New milestone
2014	Develop an engineering study identifying potential systems/ displays for convergence including plug and play displays requirements, common Human Machine Interface implementation requirements	On schedule	New milestone
2014	Develop an engineering study which analyzes gaps in common display coordinates among current and future automation systems	On schedule	New milestone

New Air Traffic Management Requirements Program Progress in FY 2012:

- ✓ Completed the L-band Digital Aviation Communications System (LDACS) compatibility study, which provides an overview of LDACS technical assessment activities and RTCA L-band activities. The LDACS technical assessment focused on collaboration with the European Organisation for the Safety of Air Navigation (EUROCONTROL) to ensure that proposed solutions meet potential U.S. needs for the Future Communications Infrastructure (FCI) and to augment the capabilities of the FAA's Data Comm Program. RTCA L-band activities involved monitoring the progress of RTCA special committees to identify and assess other activities relating to development of potential L-band communications requirements that might impact the design and development of the en route L-band FCI.

- ✓ Completed the baseline requirements for future TCAS that define the operational and technical requirements underlying the present TCAS II equipment and standards.

- ✓ Conducted evaluations of a new approach to airborne collision avoidance system called Airborne Collision Avoidance System X (ACAS-X). The evaluations were performed using the same safety simulation methodology used in studies of the current TCAS. The evaluations indicated, relative to TCAS, that the ACAS-X approach significantly reduces the probability of a near midair collision while also significantly reducing the number of alerts and RA reversals. Consequently, the ACAS-X technology transitioned from NextGen R&D to the ATO Program Office for continued concept maturation and NAS implementation.

- ✓ Conducted the first hardware-in-the-loop simulation for the Airborne Access to SWIM (AAtS) concept evaluation. The simulation was conducted using an Airbus 320 cockpit simulator with integrated simulated ATC systems and realistic communications with ATC subject matter experts. The effects of additional weather and flight information via electronic flight bag on pilot workload and pilot-controller communications under arrival and departure scenarios were evaluated. Overall, there was pilot acceptance of the AAtS concept, and simulation results indicate the need for specific information sources and elements to maintain situational awareness.

- ✓ Finalized the integrated operational and technical requirements document for AAtS to support the exchange of air traffic management information.

- ✓ Published a report titled *Analysis of 4D Trajectory Activities in Single European Sky ATM Research (SESAR)*, which provides an overview of how four-dimensional (4D) trajectory management is addressed within the SESAR target concept of operations and how 4D trajectory management has progressed from operational requirements to system developments. The report is a significant achievement in the analysis of various ANSP 4D trajectory operations initiatives, as it describes features necessary to better understand the target concepts and activities currently under development and validation in Europe.

2.4.3 Operations Concept Validation Modeling (F&E - 1A07C – NextGen – Systems Development)

The Operations Concept Validation Modeling Program supports this R&D goal by developing and validating future gate-to-gate (flight planning through arrival) operational concepts that will increase capacity and improve efficiency and throughput. Special emphasis is placed on researching changes in roles and responsibilities between the FAA and airspace users (e.g., pilots and airlines), as well as the human interaction with automation systems. The program identifies procedures to decrease workload and increase reliance on automation for routine tasking to increase efficiency of the NAS. The program works toward developing operational methods to expand capacity by addressing future growth in demand and reducing transit times. Products developed by the program include concepts of operations; reports documenting findings of fast-time and real-time concept validation studies; operational requirements associated with validated concepts; shortfall and benefits analysis; and safety assessments.

The research milestones and their statuses are shown in Table 2.4.3 below, followed by a summary of the significant progress made in FY 2012 towards achieving this R&D goal.

Table 2.4.3: Operations Concept Validation Modeling Program Milestones

Year	Milestone	Status	Notes
2011	Demonstrate an increase in capacity and efficiency at 2018 forecasted traffic levels	Completed	The Operations Concept Validation and Infrastructure Evolution (1A01C) Program and System Capacity, Planning and Improvements (1A01B) Program were also responsible for this milestone.
2013	Demonstrate an increase in capacity and efficiency at 2021 forecasted traffic levels	Deleted	This milestone has been deleted in favor of program-specific milestones and to ensure alignment with the Capital Investment Plan. 2012 NARP Status: On schedule
2013	Complete a report on Three-Dimensional Path Arrival Management research for nominal and off-nominal events for Efficient Descent Advisor evolution analysis to support interval management	On schedule	New milestone
2013	Deliver the initial concept of operations for optimized route coordination for optimized route coordinator concept exploration	On schedule	New milestone
2014	Conduct concept validation studies and document findings in a concept validation report for end to end and lower level operational concepts for implementation in 2020 and beyond	On schedule	New milestone
2014	Develop operational requirements and other documents required for technical transfer for validated concepts for implementation in 2017-2019 and beyond	On schedule	New milestone
2014	Develop research papers on reducing risk and uncertainties of NextGen midterm operational concepts	On schedule	New milestone
2014	Document procedures to decrease workload and increase reliance on automation for routine tasking to increase efficiency of the NAS	On schedule	New milestone
2014	Develop an operational methods document to address future growth in demand and reduce transit time	On schedule	New milestone

Year	Milestone	Status	Notes
2016	Demonstrate an increase in capacity and efficiency at 2025 forecasted traffic levels	Deleted	This milestone has been deleted in favor of program-specific milestones and to ensure alignment with the Capital Investment Plan. 2012 NARP Status: On schedule

Operations Concept Validation Modeling Program Progress in FY 2012

- ✓ Evaluated the NextGen Midterm Concept of Operations update to determine if changes were needed based on research results and maturing concepts. As a result of the evaluation, minor changes were identified and documented that will help refine the future end-to-end operational concept.

2.4.4 Networked Facilities - Staffed NextGen Towers (F&E - 1A07H – NextGen – Systems Development)

The Networked Facilities - Staffed NextGen Towers Program supports this R&D goal by providing a conceptual shift from using the out-the-window view as the primary means for providing tower control services to using surface surveillance approved for operational use. With the expected increase in air traffic in the United States over the next several decades, there is a need for new, innovative ways to provide tower services. This Staffed NextGen Towers (SNT) concept is planned for high density airports as these airports are likely to have the surveillance infrastructure and most aircraft equipped with avionics that will support SNT operations. The program is developing the necessary requirements, operational procedures, and supporting documentation for the SNT concept. The application of SNT for small and medium airports is under concept exploration and development.

The research milestones and their statuses are shown in Table 2.4.4 below, followed by a summary of the significant progress made in FY 2012 towards achieving this R&D goal.

Table 2.4.4: Networked Facilities - Staffed NextGen Towers Program Milestones

Year	Milestone	Status	Notes
2014	Develop a preliminary operational procedures document in support of operationally-approved surface surveillance	On schedule	New milestone
2014	Complete an update of the requirements document for operationally approved surface surveillance	On schedule	New milestone

Networked Facilities - Staffed NextGen Towers Program Progress in FY 2012:

- ✓ Updated the Staffed NextGen Towers Program requirements document and completed the report from second field demonstration.

2.4.5 Operations Concept Validation and Infrastructure Evolution (F&E - 1A01C - Advanced Technology Development and Prototyping)

The Operations Concept Validation and Infrastructure Evolution Program supports this R&D goal by developing and validating NAS level operational concepts that are key to the FAA's modernization programs and NextGen. The program conducts the overall analysis and planning for NAS evolution by determining the required annual updates to the following NAS Enterprise Architecture products: Operational Improvements, Operational Sustainment, and Operational Requirements. It executes research, engineering analysis, and evaluation in support of mission analysis and investment analysis. The program conducts shortfall analyses as part of service analysis and ensures the linkage of proposed solutions back to validated operational needs to support budget planning and investment decisions. The program develops and maintains detailed second level concepts that support validation and requirements development. This work ensures that the NAS level operational concept and sustainment activities are integrated and consistent with the overall NAS Enterprise Architecture. In addition, the program supports the development and sustainment of analytical and computer models used to assess and validate operational changes to the NAS. The program contributes to the FAA's support for the RTCA, a non-profit association that develops standards based on manufacturers, government, and aviation operator inputs. RTCA also recommends operational improvements to increase the efficiency of air transportation.

The research milestones and their statuses are shown in Table 2.4.5 below, followed by a summary of the significant progress made in FY 2012 towards achieving this R&D goal.

Table 2.4.5: Operations Concept Validation and Infrastructure Evolution Program Milestones

Year	Milestone	Status	Notes
2011	Demonstrate an increase in capacity and efficiency at 2018 forecasted traffic levels	Completed	The Operations Concept Validation Modeling (1A07C) Program and System Capacity, Planning and Improvements (1A01B) Program were also responsible for this milestone.
2013	Demonstrate an increase in capacity and efficiency at 2021 forecasted traffic levels	Deleted	This milestone has been deleted in favor of program-specific milestones and to ensure alignment with the Capital Investment Plan. 2012 NARP Status: On schedule
2013	Provide an updated concept gap analysis that identifies concept shortfalls, including a revised concept hierarchy identifying relationships, dependencies, and duplicative efforts for traceability and greater alignment across NextGen mid-term concepts	On schedule	New milestone
2013	Evaluate aircraft fuel consumption modeling by comparing model results to actual data from recorded flight operations	On schedule	New milestone

Year	Milestone	Status	Notes
2014	Conduct analyses to support assessments of new air traffic control operational concepts	On schedule	New milestone
2014	Develop common concept development, validation, and measurement methodologies to support the Single European Sky Air Traffic Management Research joint undertaking	On schedule	New milestone
2014	Develop concepts of use to describe the operational use of new communication, navigation, automation, surveillance, and flight deck capabilities	On schedule	New milestone
2014	Produce reports on concept development and validation findings including second-level concepts, fast-time analyses, and human-in-the-loop real time studies	On schedule	New milestone
2014	Develop operational, information, and performance requirements	On schedule	New milestone
2014	Develop and provide annual updates to the NAS Enterprise Level Operational Requirements to reflect the results of research and development conducted in 2013	On schedule	New milestone
2014	Develop and provide annual updates to the NAS Enterprise Architecture for NAS level Operational Improvements and operational sustainment activities based on completed research and acquisition decisions made in 2013	On schedule	New milestone
2016	Demonstrate an increase in capacity and efficiency at 2025 forecasted traffic levels	Deleted	This milestone has been deleted in favor of program-specific milestones and to ensure alignment with the Capital Investment Plan. 2012 NARP Status: On schedule

Operations Concept Validation and Infrastructure Evolution Program Progress in FY 2012

- ✓ Developed agent based representations of an air traffic controller, radar tracking automation, inter-sector communication and coordination, and a tactical conflict probe (ground automation to alert near term aircraft-to-aircraft separation violations) through fast-time modeling and simulation. These simulations examined the cognitive issues faced by humans and changes in operating procedures or tools as a result of NextGen. The ability to represent air traffic controllers in a fast-time simulation environment allows researchers to identify potential issues related to human performance before conducting more costly human-in-the-loop simulations.

2.4.6 System Capacity, Planning and Improvements (F&E - 1A01B - Advanced Technology Development and Prototyping)

The System Capacity, Planning and Improvements Program supports this R&D goal by providing data and analyses on NAS operations to identify deficiencies and develop proposals to improve NAS performance. The program conducts airport modeling and analysis using actual data collected from ATC systems in the field to determine the value of potential improvements in airspace or airfield modifications. In addition, the program performs enhancements of the Performance Data Analysis and Reporting System, a fully integrated performance measurement tool designed to improve the NAS by tracking the daily operations of the ATC system and its environmental impacts. Furthermore, the program develops new Agency-level metrics to enhance management awareness of, and response to, system performance.

The research milestones and their statuses are shown in Table 2.4.6 below.

Table 2.4.6: System Capacity, Planning and Improvements Program Milestones

Year	Milestone	Status	Notes
2011	Demonstrate an increase in capacity and efficiency at 2018 forecasted traffic levels	Completed	The Operations Concept Validation and Infrastructure Evolution (1A01C) Program and Operations Concept Validation Modeling (1A07C) Program were also responsible for this milestone.
2013	Demonstrate an increase in capacity and efficiency at 2021 forecasted traffic levels	Deleted	This milestone has been deleted in favor of program-specific milestones and to ensure alignment with the Capital Investment Plan. 2012 NARP Status: On schedule
2013	Program the Performance Data and Analysis Reporting System to calculate surface metrics at one airport	On schedule	New milestone
2013	Complete the build-out of the gate-to-gate performance measurement system	On schedule	New milestone
2013	Complete Performance Data and Analysis Reporting System conversion to the FAA Telecommunications Infrastructure network	On schedule	New milestone
2013	Define a flight predictability metric and develop a conceptual approach	On schedule	New milestone
2013	Define a weather efficiency metric and develop a conceptual prototype	On schedule	New milestone
2014	Complete Performance Data and Analysis Reporting System connectivity with Airport Surface Detection Equipment, Model X at up to 30 core airports	On schedule	New milestone

Year	Milestone	Status	Notes
2014	Initiate Performance Data and Analysis Reporting System connectivity to En Route Automation Modernization (10 sites)	On schedule	New milestone
2014	Develop a plan to complete connectivity to Automatic Dependent Surveillance-Broadcast	On schedule	New milestone
2014	Complete an implementation plan to integrate Ocean 21 data into a full automated gate-to-gate analysis capability	On schedule	New milestone
2014	Complete a plan to expand Performance Data and Analysis Reporting System analysis capabilities to evaluate NextGen technology demonstrations	On schedule	New milestone
2014	Incorporate noise profiling technology via the Aviation Environmental Design Tool module	On schedule	New milestone
2014	Complete an operations research report to support the Science, Technology, Engineering and Math strategic initiative	On schedule	New milestone
2014	Prepare a bi-annual joint performance benchmark report with the European Organisation for the Safety of Air Navigation	On schedule	New milestone
2014	Complete Performance Data and Analysis Reporting System analysis to evaluate and improve the flight predictability metric	On schedule	New milestone
2014	Complete Performance Data and Analysis Reporting System analysis to evaluate and improve the weather metric	On schedule	New milestone
2014	Complete the Performance Data and Analysis Reporting System capability improvement evaluation	On schedule	New milestone
2016	Demonstrate an increase in capacity and efficiency at 2025 forecasted traffic levels	Deleted	This milestone has been deleted in favor of program-specific milestones and to ensure alignment with the Capital Investment Plan. 2012 NARP Status: On schedule

2.4.7 Demonstrations and Infrastructure Development (F&E – 1A06 – NextGen Demonstrations and Infrastructure Development)

The Demonstrations and Infrastructure Development Program previously supported this R&D goal by demonstrating and testing concepts related to NextGen, including trajectory-based operations and super density operations to mature technologies, support investment decisions, and deploy new capabilities. It identified early implementation opportunities, refined longer-term objectives, and, if results dictated, eliminated certain NextGen concepts from further consideration. The program is no longer considered R&D by the FAA, as it has progressed further along in the acquisition cycle.

The completed research milestones are shown in Table 2.4.7 below.

Table 2.4.7: Demonstrations and Infrastructure Development Program Milestones

Year	Milestone	Status	Notes
2009	Demonstrate the addition of convective weather (current and forecast) into Traffic Management Advisor routing to increase throughput and efficiency for large, super density airports	Completed	
2009	Demonstrate via simulation standard separation in a full-equipage, fully automated environment with no voice communication	Completed	
2009	Develop and simulate separation procedures that vary according to aircraft capability and pilot training	Completed	

2.4.8 Center for Advanced Aviation System Development (F&E - 4A08A)

The Center for Advanced Aviation System Development (CAASD) Program supports this R&D goal by promoting the integration of the modernized Traffic Flow Management (TFM) system with the evolution of the en route modernization plans, terminal systems, and NAS-wide operations while increasing common situational awareness and collaborative decision making with ATM stakeholders.

CAASD made the following progress in FY 2012 towards Efficiency R&D Goal 4.

- ✓ Developed a scientific approach that captures the traffic and weather uncertainties and impacts associated with TFM operations. The approach included the development of weather impact models that translate probabilistic weather forecasts into trajectories of TFM impact with associated statistics of likelihood. The research contributes to learning how sensitivity analysis methods and heuristic optimization approaches aid in the development of an integrated solution to strategic TFM problems.

- ✓ Created a working prototype and conducted a hardware-in-the-loop simulation of the Standard Terminal Automation Replacement System, which increases runway throughput at airports where there is a dependency between arrival and departure operations. The concept is to provide approach controllers with spacing guidance cues that are tailored in real time to the departure demand. Results indicated that controllers achieved a high level of conformance to guidance, workload levels were within a safe range, and both arrival and departure throughput could potentially be increased by using automated spacing guidance.

2.5 Efficiency R&D Goals 5 and 6

Established requirements and standards for enabling availability and improving the quality and quantity of meteorological information to reduce impacts of adverse weather on rerouting, NAS capacity, and NextGen operational procedures.

Improved accuracy and accessibility of observed and forecast weather information to improve NAS efficiency (e.g., reduced delays and cancellations, increased capacity in high traffic areas).

2.5.1 NextGen - Weather Technology in the Cockpit (RE&D - A12.d)

The NextGen - Weather Technology in the Cockpit Program supports these R&D goals by developing, verifying, and validating requirements to support airworthiness standards for enabling availability and improving the quality and quantity of meteorological information to the aircraft to support efficient current and NextGen operations. The program will result in the development of standards and requirements that define the weather information in the cockpit needed to support operations, the presentations and interfaces to enable proper information consumption and safe operations by pilots, and capabilities that enable efficient dissemination of the weather information to and from the cockpit at the right place and right time.

The research milestones and their statuses are shown in Table 2.5.1 below, followed by a summary of the significant progress made in FY 2012 towards achieving these R&D goals.

Table 2.5.1: NextGen - Weather Technology in the Cockpit Program Milestones

Year	Milestone	Status	Notes
2012	Establish "proof of concept" Wind Information Analysis Framework and produce sample and quantitative requirements for terminal-area wind diagnosis and forecast capabilities to improve benefits from four-dimensional Trajectory Based Operations	Completed	This milestone was revised to reduce 1) technical and program risks and 2) Phase 1 scope and lab fidelity due to changing program priorities. Old wording: "Establish and justify quantitative requirements for terminal-area wind diagnosis and forecast capabilities to improve benefits from four-dimensional Trajectory Based Operations" 2012 NARP Status: On schedule

Year	Milestone	Status	Notes
2013	Produce plots of wind forecast and diagnosis errors versus performance of selected NextGen operations using realistic scenarios and sufficient fidelity to enable standards development	On schedule	This milestone was revised for clarification. Old wording: "Expand wind studies to more comprehensive environments and procedures, and more comprehensive assessment of benefits versus wind modeling error and evaluate weather prediction technology relative to wind modeling accuracy"
2013	Evaluate and compare pilot performance using three prototype Weather Avoidance Fields cockpit presentations based on the Convective Weather Avoidance Model	On schedule	New milestone
2015	Provide accurate and timely wind information to the Flight Management System and Air Traffic Control systems, and demonstrate realization of predicted benefits of associated NextGen application programs	On schedule	This milestone was revised for clarification. Old wording: "Provide accurate and timely wind information to the Flight Management System and Air Traffic Control systems, and demonstrate Trajectory-Based Operation benefits"
2015	Complete demonstrations and provide data to support the development of human factors standards, guidance, and procedures for the presentation and use of meteorological information in the cockpit. Specific measurable performance objectives verified for human factors design elements	On schedule	This milestone was revised for clarity. Old wording: "Demonstrations completed and data available to support the development of human factors standards, guidance, and procedures for the presentation and use of meteorological information in the cockpit. Specific measurable performance objectives verified for human factors design elements"
2016	Complete demonstrations of alerting functions to improve pilot awareness of changing runway conditions resulting from adverse weather	On schedule	New milestone
2016	Complete an assessment on the benefits to NAS efficiency of providing Eddy Dissipation Rate and Graphical Turbulence Guidance to cockpits to reduce turbulence-induced airspace avoidance (reduced capacity)	On schedule	New milestone

NextGen - Weather Technology in the Cockpit Program Progress in FY 2012:

- ✓ Completed the first phase of a project to provide data for the development of wind quality standards to support multiple NextGen application programs and objectives. This was primarily a proof of concept phase that developed an initial framework for simulating the impacts of various wind quality forecasts and Flight Management System wind quality on multiple NextGen initiatives, including TBO, time metering, and reduced emissions. The framework was completed and applied to basic procedures, select aircraft, and a common wind scenario of vertical wind shear. Results indicated the concept is able to classify sources of wind errors, define metrics for wind quality, and provide preliminary data that show clear evidence of a point of diminishing returns for wind quality against multiple NextGen applications.

- ✓ Completed a laboratory demonstration using a general aviation (GA) flight simulator to explore the effects of cockpit weather presentations on GA pilot weather avoidance, weather presentation usage, and cognitive workload. Results indicated that variations in the presentation of weather information affect pilot behavior, workload, and decision-making.

2.5.2 Weather Program (RE&D - A11.k)

The Weather Program supports these R&D goals by conducting applied research focused on improving weather information required for integration into decision-support tools to reduce the impact of adverse weather on the NAS. The improved weather information enhances NAS efficiency and capacity by supporting better operational planning and decision-making by ATM, dispatchers, and pilots.

The research milestones and their statuses are shown in Table 2.5.2 below, followed by a summary of the significant progress made in FY 2012 towards achieving these R&D goals.

Table 2.5.2: Weather Program Milestones

Year	Milestone	Status	Notes
2010	Develop 0-8 hour advanced storm prediction algorithm	Completed	
2010	Transition Rapid Refresh Weather Forecast Model for implementation at National Oceanic and Atmospheric Administration National Centers for Environmental Prediction	Completed	
2011	Demonstrate 0-8 hour advanced storm prediction algorithm	Completed	
2013	Transition 0-8 hour advanced storm prediction algorithm for implementation	Completed	
2013	Transition mountain-wave turbulence forecast capability for implementation	On schedule	2012 NARP Status: Delayed from 2012 to 2013

Year	Milestone	Status	Notes
2015	Transition turbulence forecast capability for all flight levels for implementation	On schedule	
2016	Transition global turbulence forecast capability for implementation	On schedule	
2016	Transition High Resolution Rapid Refresh weather forecast model to the National Weather Service for operational implementation	On schedule	New milestone
2017	Transition convectively-induced turbulence forecast capability for implementation	On schedule	

Weather Program Progress in FY 2012:

- ✓ Transitioned the 0-8 hour advanced storm prediction algorithm to the FAA ATO for proof of concept and risk mitigation planning prior to implementation. The algorithm was designed and developed to minimize flight delays caused by convective weather (i.e., thunderstorms). The algorithm was evaluated by ATM users over two summers of convective weather and was found to provide information that enhanced strategic traffic flow management planning.

2.6 Efficiency R&D Goal 7

Availability of existing airport facilities protected and used as efficiently as possible, while making strategic investments in new facilities consistent with evolving aviation needs.

2.6.1 Airport Cooperative Research Program – Capacity (AIP)

The Airport Cooperative Research Program – Capacity supports this R&D goal by providing better airport planning and design. Future aviation demand will rely on the ability of airports to accommodate increased aircraft operations, larger aircraft, and more efficient passenger throughput. The program is preparing for those future needs while simultaneously solving current and near-term airport capacity issues.

The research milestones and their statuses are shown in Table 2.6.1 below, followed by a summary of the significant progress made in FY 2012 towards achieving this R&D goal.

Table 2.6.1: Airport Cooperative Research Program – Capacity Milestones

Year	Milestone	Status	Notes
2011	Develop a guidebook for airport operators and air cargo industry stakeholders that provides tools and techniques for measuring economic impacts of air cargo activities at the national, regional, and local level	Completed	
2011	Document ramp operational and safety techniques and how airport operators implement pavement maintenance programs	Completed	
2012	Develop a guidebook to assist airport planners with airfield and airspace capacity evaluation	Completed	The completion date of this milestone has been changed from 2011 to 2012 to reflect the accurate publication date of the report.
2012	Document performance measures for automated people mover systems	Completed	New milestone
2012	Develop guidebook to assist airport operators with forecasting peak period activity	Completed	New milestone
2012	Publish best practices for implementing and evaluating passenger conveyance systems	Completed	New milestone
2012	Detail how airport ground access information can be disseminated using various intelligent transportation systems	Completed	New milestone

Year	Milestone	Status	Notes
2012	Create a reference for integrating proven asset and infrastructure management practices and techniques at airports of all sizes	Completed	New milestone
2012	Develop methodology for augmenting standard airport master planning and strategic planning approaches	Completed	New milestone
2012	Identify procedures to eliminate or reduce baggage recheck for arriving international passengers	Completed	New milestone
2012	Publish guidance that assists aviation system partners in improving their response to customer care during a broad array of irregular operations	Completed	New milestone
2013	Prepare guidance for airports that provides strategies for developing and maintaining stakeholder support when undertaking new airport capacity initiatives	On schedule	New milestone
2013	Produce global best practices for improving terminal design to increase revenue generation and customer satisfaction	On schedule	New milestone
2013	Develop best practices for planning, designing, and marking apron areas for all sizes of airports in the U.S.	On schedule	New milestone
2013	Identify best practices and develop tools, techniques, and training aids for working in or near airport movement areas	On schedule	New milestone
2013	Develop guidance for airports to create a collaborative environment between operations and maintenance departments	On schedule	New milestone
2013	Develop guidance for operational and business continuity planning for prolonged airport disruptions	On schedule	New milestone
2013	Develop guidance for defining and measuring aircraft delay and airport capacity thresholds	On schedule	New milestone
2013	Assess the factors that drive airline service decisions and passenger choice in multi-airport regions	On schedule	New milestone
2013	Estimate the economic impact of air cargo at airports	On schedule	New milestone

Year	Milestone	Status	Notes
2013	Prepare guidance to assist airports in using benefit-cost analysis and other analytical techniques to make airport capital investment decisions	On schedule	New milestone
2013	Develop methods and tools necessary to improve integration of rail services with airports	On schedule	New milestone
2013	Develop guidelines for air cargo facility planning and development at airports	On schedule	New milestone
2013	Identify and quantify the cumulative effects of regulatory compliance requirements at small and non-hub airports	On schedule	New milestone
2014	Identify, test, and evaluate methods for obtaining aircraft operations counts at non-towered airports	On schedule	New milestone
2014	Quantify the national aggregate value of airports to communities and to aviation stakeholders	On schedule	New milestone
2014	Develop a guidebook to plan general aviation facilities	On schedule	New milestone
2014	Produce guidance to evaluate cost-saving and energy reduction technologies for escalators and moving walks at airports	On schedule	New milestone
2014	Develop guidance to determine the location, number, size, and configuration of airport terminal restroom facilities to best meet customer needs	On schedule	New milestone
2014	Provide guidance to help airports identify optimal lighting solutions for parking garage facilities	On schedule	New milestone
2014	Develop a primer on the benefits of a whole-building systems lifecycle approach to airport operations and maintenance optimization and recommissioning	On schedule	New milestone
2014	Create guidance on successful Computer Maintenance Management Systems selection and practices	On schedule	New milestone
2014	Help airports prepare for, operate during, and recover from disruptive winter events as well as manage airport user expectations	On schedule	New milestone

Airport Cooperative Research Program – Capacity Progress in FY 2012

- ✓ Published the *Guidebook for Measuring Performance of Automated People Mover Systems at Airports*, which identifies a set of performance measures and associated data requirements for automated people mover (APM) operators at airports to assess and improve performance, compare APM systems, and plan and design future APM systems. The project developed forms to help airports compile data for performance measurement process and an interactive model that tracks system-wide performance and service characteristics.

- ✓ Published a report titled *Preparing Peak Period and Operational Profiles—Guidebook*, which describes a process and includes software for converting annual airport activity forecasts into daily or hourly peak period activity forecasts. The software estimates current and future design day aircraft and passenger operation levels based on user-defined design day parameters. This report enhances the ability of airport operators to address demand and operational constraints and enabled users to create alternative growth and development scenarios by analyzing effects of potential change in aircraft, passenger, demographic, environmental and other relevant factors.

- ✓ Published a report titled *Airport Passenger Conveyance Systems Planning Guidebook*, which prescribes best practices and specific design considerations and presents decision-making frameworks for implementing and evaluating passenger conveyance systems at airports.

- ✓ Published the *Guidebook for Implementing Intelligent Transportation Systems Elements to Improve Airport Traveler Access Information*, which provides descriptions, component details, and examples of how airport ground access information can be disseminated using various intelligent transportation systems (ITS) technologies. The guidebook contains tables to help airport operators determine the applicability of certain ITS strategies based on airport operational needs and airport size.

- ✓ Published a report titled *Asset and Infrastructure Management for Airports—Primer and Guidebook*, which addresses asset and infrastructure management applicable to all areas of the operation of an airport and explores the benefits and costs of implementation. The report describes a systematic management approach for promoting the efficient use of airport resources in a proactive rather than reactive decision-making process. The report provides examples from various airports and is designed to be a reference for integrating proven asset and infrastructure management practices and techniques at airports of all sizes.

- ✓ Published a report titled *Evaluating Airfield Capacity*, which assists airport planners with airfield and airspace capacity evaluations at a wide range of airports. The report describes available methods to evaluate existing and future airfield capacity; provides guidance on selecting an appropriate capacity analysis method; offers best practices in assessing airfield capacity and applying modeling techniques; and outlines specifications for new models, tools, and enhancements.

- ✓ Published a report titled *Addressing Uncertainty about Future Airport Activity Levels in Airport Decision Making*, which provides a systems analysis methodology that augments standard airport master planning and strategic planning approaches and includes a set of tools for improving the understanding and application of risk and uncertainty in air traffic forecasts as well as for increasing the overall effectiveness of airport planning and decision making.

- ✓ Published a report titled *Elimination or Reduction of Baggage Recheck for Arriving International Passengers*, which identifies potential alternative procedures to help reduce or eliminate the need for the recheck of baggage for arriving international passengers at U.S. airports. The report describes the potential benefits and costs to airports, airlines, and federal agencies in adopting the procedures and also compares the alternative procedures with current practices.

- ✓ Published the *Guidebook for Airport Irregular Operations (IROPS) Contingency Planning*, which is designed for commercial passenger service airports of all sizes to develop, continually evaluate, and/or update their contingency plans for procedures pertaining to Irregular Operations (IROPS) that may cause significant disruptions to customers. The research assists aviation system partners in improving their response to customer care during a broad array of IROPS conditions and devises a step-by-step template for the preparation of contingency plans that include necessary communications, collaboration, and coordination to address customer needs.

2.6.2 Airport Technology Research Program – Capacity (AIP)

The Airport Technology Research Program – Capacity supports this R&D goal by providing better airport planning, designs, and improves runway pavement design, construction, and maintenance. It ensures that new pavement standards will be ready to support safe international operation of next-generation heavy aircraft and makes pavement design standards available to users worldwide.

The research milestones and their statuses are shown in Table 2.6.2 below, followed by a summary of the significant progress made in FY 2012 towards achieving this R&D goal.

Table 2.6.2: Airport Technology Research Program – Capacity Milestones

Year	Milestone	Status	Notes
2012	Develop new standards and guidelines for runway pavement design	Completed	2012 NARP Status: On schedule
2013	Complete the Accelerated Airport Pavement Test Vehicle	On schedule	New milestone
2013	Update the Airport and Airspace Simulation Model to Engine Version 3.5.10 and 3.11	On schedule	New milestone
2013	Complete the North Atlantic Fuel Burn Study	On schedule	New milestone
2014	Complete construction of High Temperature Pavement Test Facility	On schedule	New milestone

Year	Milestone	Status	Notes
2014	Complete upgrade of all pavement software to Windows Presentation Foundation	On schedule	New milestone
2014	Complete definition of airport pavement failure for the 40-Year Pavement Life project	On schedule	New milestone
2014	Complete scheduled software revisions for the Airport and Airspace Simulation Model	On schedule	New milestone
2014	Complete development of display playback animation software for the Airport and Airspace Simulation Model	On schedule	New milestone
2014	Complete the update of the Airfield Modeling Database with all new runway, taxiway, and gate data	On schedule	New milestone

Airport Technology Research Program – Capacity Progress in FY 2012:

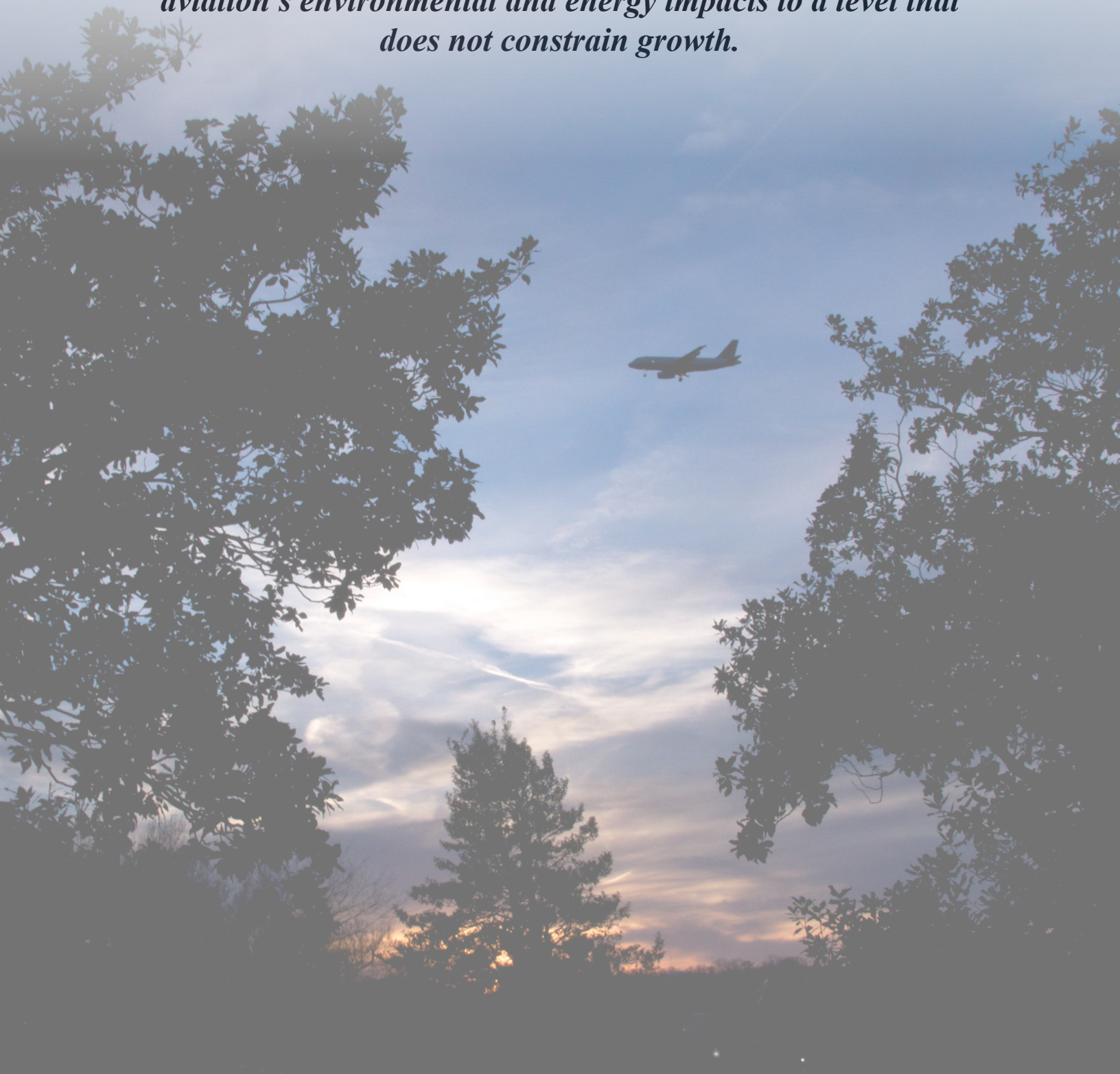
- ✓ Completed seven new enhancements to the FAA's Airport and Airspace Simulation Model, which is used to test and analyze the impact of various air traffic scenarios. The enhancements will improve the model's ability to simulate the movement of individual aircraft along airspace routes, runways, taxiways, and gates, as well as compute aircraft travel times and delay statistics.

- ✓ Investigated the integration of actual Airport Surface Detection Equipment, Model X data into FAA capacity models to provide more realistic forecasting. The Airport Database (and digitization of airports) has continued to be improved through: the integration of new fuel burn studies; updating of the database with new runways, taxiways, and gates; physical onsite data collection at several airports; and the electronic merging of several key capacity-related computer tools.

- ✓ Released an upgraded version of the FAA Rigid and Flexible Iterative Elastic Layered Design (FAARFIELD) software, which is used to design the thickness of new pavement and overlays of existing pavement for runways, taxiways, and aprons. The software accompanies AC 150/5320-6E Airport Pavement Design and Evaluation in the development of new computer-based standards for airport pavement structural design, a shift from design charts to desktop computing. The upgraded FAARFIELD 1.305 replaces all previous versions and incorporates full three-dimensional (3D) finite element responses to aircraft loads (for new rigid pavements and rigid overlays) and is fully compatible with 64-bit operating systems.

Chapter 3
Reduce Environmental Impacts

Systematically expand and apply knowledge to produce useful materials, devices, systems, or methods that will reduce aviation's environmental and energy impacts to a level that does not constrain growth.



Five goals support R&D Principle 3 - Reduce Environmental Effects with work spread across three budget appropriations (RE&D, F&E, and AIP):

- Goal 1 - Reduced significant community noise impacts in absolute terms.
- Goal 2 - Reduced impact of aviation emissions on air quality and global climate.
- Goal 3 - Improved energy efficiency and assured availability of sustainable alternative jet fuels.
- Goal 4 - Established requirements, policies, procedures, and resources to allow airports in the United States to become environmentally-friendly neighbors.
- Goal 5 - Established data and methodologies to support certification of alternative fuels for General Aviation aircraft.

Table 3.0.1 shows how the FAA's Environment and Energy R&D goals and programs align with the NSTC Energy and Environment Goals. In many cases, FAA R&D programs support more than one NSTC goal. Throughout this chapter, progress in FY 2012 on 103 milestones across all of these programs is described. As of the end of FY 2012, 30 percent of milestones in support of R&D Principle 3 – Reduce Environmental Impacts were completed and 99 percent of active milestones were on schedule.

Table 3.0.1: FAA R&D Goals and Programs Alignment with NSTC Energy and Environment Goals

FAA R&D Principle	FAA R&D Goals	FAA R&D Programs	NSTC Goals			NSTC Principle
Reduce Environmental Impact	1 - Reduced significant community noise impacts in absolute terms. 2 - Reduced impact of aviation emissions on air quality and global climate. 3 - Improved energy efficiency and assured availability of sustainable alternative jet fuels.	Environment and Energy	Goal 1 - Enable New Aviation Fuels Derived from Diverse and Domestic Resources to Improve Fuel Supply Security and Price Stability	Goal 2 - Advance Development of Technologies and Operations to Enable Significant Increases in the Energy Efficiency of the Aviation System	Goal 3 - Advance Development of Technologies and Operational Procedures to Decrease the Significant Environmental Impacts of the Aviation System	Assuring Energy Availability and Efficiency is Central to the Growth of the Aeronautics Enterprise, and the Environment Must be Protected while Sustaining Growth in Air Transportation
		NextGen - Environmental Research - Aircraft Technologies, Fuels, and Metrics				
		Environment and Energy – Environmental Management Systems and Advanced Noise and Emissions Reduction				
		Safety, Security, Environment – Operational Assessments				
		NextGen - Weather Technology in the Cockpit				
	4 - Established requirements, policies, procedures, and resources to allow airports in the United States to become environmentally-friendly neighbors.	Airport Cooperative Research Program - Environment	Goal 1 - Enable New Aviation Fuels Derived from Diverse and Domestic Resources to Improve Fuel Supply Security and Price Stability Goal 2 - Advance Development of Technologies and Operations to Enable Significant Increases in the Energy Efficiency of the Aviation System		Goal 3 - Advance Development of Technologies and Operational Procedures to Decrease the Significant Environmental Impacts of the Aviation System	
		Airport Technology Research Program - Environment				
	5 - Established data and methodologies to support certification of alternative fuels for General Aviation aircraft.	NextGen - Alternative Fuels for General Aviation	Goal 3 - Advance Development of Technologies and Operational Procedures to Decrease the Significant Environmental Impacts of the Aviation System			

In FY 2014, 21 percent of total FAA R&D funding is allocated to R&D Principle 3 - Reduce Environmental Impacts. Program funding levels for the 2013 CR Annualized and 2014 President's Request are shown in Table 3.0.2. Percent of Program reflects the part of each program's contribution towards R&D Principle 3 in the 2014 President's Request. Table 3.0.2 also lists the section and page number reference for each budget narrative within the FY 2014 CJ for the President's Budget Request. The link to the FY 2014 CJ is: http://www.dot.gov/sites/dot.dev/files/docs/FAA_FY2014_Budget_Estimates.pdf.

Table 3.0.2: Program Funding for R&D Principle 3 - Reduce Environmental Impacts

2014 BLI	Program	CJ Reference (Section/Page)	Appropriation Account	2013 CR Annualized ($000)	2014 Request ($000)	2014 Percent of Program
A11.m	NextGen - Alternative Fuels for General Aviation	3C/58	RE&D	1,995	5,571	100%
A12.d	NextGen - Weather Technology in the Cockpit	3C/78	RE&D	805	417	10%
A13.a	Environment and Energy	3C/82	RE&D	15,166	14,542	100%
A13.b	NextGen - Environmental Research - Aircraft Technologies, Fuels, and Metrics	3C/87	RE&D	23,644	18,979	100%
A14.a	System Planning and Resource Management	3C/92	RE&D	361	479	21%
1A07D	Environment and Energy - Environmental Management Systems and Advanced Noise and Emissions Reduction	3B/42	F&E	7,915	10,000	100%
1A07F	Safety, Security, Environment – Operational	3B/42	F&E	7,000	8,000	100%
4A08A	Center for Advanced Aviation System Development (CAASD)	3B/323	F&E	1,463	1,313	8%
--	Airport Cooperative Research Program - Environment	3D/36	AIP	5,031	5,000	100%
--	Airport Technology Research Program - Environment	3D/28	AIP	1,500	1,500	100%
	Total ($000)			**64,881**	**65,801**	

3.1 Environment and Energy R&D Goals 1 - 3

Reduced significant community noise impacts in absolute terms.

Reduced impact of aviation emissions on air quality and global climate.

Improved energy efficiency and assured availability of sustainable alternative jet fuels.

3.1.1 Environment and Energy (RE&D - A13.a)

The Environment and Energy Program supports these R&D goals by characterizing aircraft noise and emissions and their consequential impacts on the environment. Subsequently, the program provides guidance on mitigating these impacts. The program provides fundamental knowledge and develops and validates methodologies, models, metrics, and tools. It analyzes and balances the interrelationships between noise and emissions, considers local to global impacts, and determines economic consequences. The program also reduces scientific uncertainties related to aviation environmental issues to support decision-making.

The research milestones and their statuses are shown in Table 3.1.1 below, followed by a summary of the significant progress made in FY 2012 towards achieving these R&D goals.

Table 3.1.1: Environment and Energy Program Milestones

Year	Milestone	Status	Notes
2009	Develop methodologies to quantify and assess the impact of Particulate Matter and Hazardous Air Pollutants	Completed	
2010	Develop a preliminary planning version of an Aviation Environmental Design Tool that will allow integrated assessment of noise and emissions impact at the local and global levels	Completed	
2010	Assess the impacts of aviation on regional air quality, including the effects of nitrogen oxide (NO_x) emissions from aircraft climb and cruise	Completed	
2010	Develop new standards and methodologies to quantify and assess the impact of aircraft noise and aviation emissions	Completed	

Year	Milestone	Status	Notes
2011	Assess the level of certainty of aviation's impact on climate change, with special emphasis on the effects of contrails	Completed	
2011	Complete development of first-generation ground plume model for aircraft engine exhaust	Completed	
2011	Develop a new metric to quantify the environmental impacts of new aircraft types	Completed	
2011	Investigate feasibility of metrics for new aircraft standards for carbon dioxide ($CO_{2)}$ emissions	Completed	
2011	Determine how aviation-generated particulate matter and hazardous air pollutants impact local health, visibility, and global climate	Completed	The NextGen - Environmental Research - Aircraft Technologies, Fuels, and Metrics (A13.b) Program was also responsible for this milestone.
2012	Expand noise data collection to very light jets and supersonic aircraft	Deleted	This milestone has been deleted due to a change in emphasis of the research by the Environment and Energy Program Office. 2012 NARP Status: On schedule
2013	Examine the suitability of aircraft noise and emissions metrics to establish environmental standards	Completed	2012 NARP Status: On schedule
2013	Evaluate noise propagation methodologies to predict surface noise levels	On schedule	This milestone was revised to clarify the research. Old wording: "Update environmental assessment models to incorporate new noise metrics"
2013	Refine the estimates of aircraft contribution to climate change	On schedule	The NextGen - Environmental Research - Aircraft Technologies, Fuels, and Metrics (A13.b) Program is also responsible for this milestone.
2013	Develop a technique to estimate domestic U.S.-wide impacts of aviation emissions on surface air quality	On schedule	This milestone was revised to clarify the research. The NextGen - Environmental Research - Aircraft Technologies, Fuels, and Metrics (A13.b) Program was removed from this milestone to accurately reflect the research execution. Old wording: "Refine estimates of aircraft emitted particulate matter on climate, air quality and human health"

Year	Milestone	Status	Notes
2014	Obtain direct measurements of particulate matter data to update environmental modeling tools	Delayed	This milestone has been delayed from 2013 to 2014 because the focus of the research has changed and has been re-prioritized by the Environment and Energy Program Office. The milestone has been revised to clarify the research. Old wording: "Obtain direct measurements of hazardous air pollutants and particulate matter data to update modeling tools" 2012 NARP Status: On schedule
2014	Complete development and field a fully validated suite of tools, including the Aviation Environmental Design Tool and the Aviation Environmental Portfolio Management Tool	Deleted	This milestone has been deleted and replaced with a similar milestone under the Safety, Security, Environment – Operational Assessments (1A07F) Program. 2012 NARP Status: On schedule
2015	Refine methods and tools to estimate impacts of aviation emissions on air quality in the vicinity of the airport	On schedule	New milestone
2016	Advance the understanding of noise impacts on social welfare and health	On schedule	New milestone
2016	Refine the estimates of aircraft contribution to climate change using the latest methods and knowledge	On schedule	New milestone The NextGen - Environmental Research - Aircraft Technologies, Fuels, and Metrics (A13.b) Program is also responsible for this milestone.

Environment and Energy Program Progress in FY 2012:

- ✓ Completed development of carbon dioxide ($CO_{2)}$ emission metrics for Commercial Aircraft Certification. Aircraft regulatory standards, or aircraft certification requirements with associated stringency levels, are among the set of mechanisms that can be used to analyze emission performance of the existing and new aircraft fleet. The research consisted of defining and identifying a system composed of a metric, correlating parameter, evaluation options, stringency level, and scope of applicability (i.e., type of aircraft). The developed metric standard was accepted by the international community.

3.1.2 Environment and Energy – Environmental Management Systems and Advanced Noise and Emissions Reduction (F&E - 1A07D – NextGen – Systems Development)

The Environment and Energy – Environmental Management Systems and Advanced Noise and Emissions Reduction Program supports these R&D goals by supporting development and implementation of the NextGen Environmental Management System (EMS). The EMS will dynamically manage NextGen environmental impacts and help to define and identify optimum mitigation actions and their benefits. The program also evaluates the benefits of aviation environmental mitigation options and identifies ways to integrate them into the NAS infrastructure and demonstrate any NAS adaptation required to realize their full benefits. These options include new Continuous Lower Emissions, Energy, and Noise (CLEEN) aircraft technologies, alternative fuels, environmental and energy-efficient operational policies and procedures, environmental standards, and market-based measures.

The research milestones and their statuses are shown in Table 3.1.2 below, followed by a summary of the significant progress made in FY 2012 towards achieving these R&D goals.

Table 3.1.2: Environment and Energy – Environmental Management Systems and Advanced Noise and Emissions Reduction Program Milestones

Year	Milestone	Status	Notes
2010	Develop algorithms to optimize ground and airspace operations by leveraging communication, navigation, and surveillance technology in the short- to medium-term to optimize aircraft sequencing and timing on the surface and in the terminal area	Completed	
2013	Identify and pursue the development of a Flight Management System and other system technologies that will be the most effective at producing environmental benefits	Deleted	This milestone has been deleted to ensure alignment with the Capital Investment Plan. 2012 NARP Status: On schedule
2013	Demonstrate collaborative surface management techniques that could reduce fuel burn and emissions	On schedule	This milestone was revised to clarify the research. Old wording: “Demonstrate optimized airport and terminal area operations that reduce or mitigate aviation impacts on noise, air quality, or water quality in the vicinity of the airport”
2013	Evaluate, refine, and apply Environmental Management System decision support tools to the aviation system	On schedule	

Year	Milestone	Status	Notes
2014	Develop report on development and testing of the annual assessment and review process, including an evaluation of progress made towards meeting NextGen environmental goals with an assessment of knowledge gaps and technology needs	On schedule	New milestone
2014	Establish Beta Emergency Management System website and collaboration portal that includes communication materials	On schedule	New milestone
2014	Develop a report on refinements to the program offices' collaboration protocols and reward and recognition program	On schedule	New milestone
2014	Develop an initial approach to integrate National Environmental Policy Act considerations into existing FAA Acquisition Management System guidance	On schedule	New milestone
2014	Develop a report on tests and demonstrations of Continuous Lower Emissions, Energy, and Noise Air Traffic Management-related aircraft technologies	On schedule	New milestone
2014	Develop a report on NAS-wide assessments of environmental benefits of Continuous Lower Emissions, Energy, and Noise aircraft technologies	On schedule	New milestone
2014	Develop a report on exploration, demonstrations and assessments of environmentally and energy efficient gate-to-gate operational procedures	On schedule	New milestone
2014	Develop a report on NAS-wide impacts of environmental standards for aircraft noise and emissions and other policy measures to limit aircraft emissions and noise and increase fuel efficiency	On schedule	New milestone
2014	Assess NAS-wide benefits of environmental mitigation solutions comprised of new technologies, alternative fuels, advanced operational procedures, market measures, and options for policy and noise/emissions standards	Deleted	This milestone has been deleted to ensure alignment with the Capital Investment Plan. 2012 NARP Status: On schedule

Year	Milestone	Status	Notes
2015	Refine and update approaches for Environmental Management System performance tracking	Deleted	This milestone has been deleted to ensure alignment with the Capital Investment Plan. 2012 NARP Status: On schedule

Environment and Energy – Environmental Management Systems and Advanced Noise and Emissions Reduction Program Progress in FY 2012:

- ✓ Conducted flight testing of adaptive trailing edge technology as part of the CLEEN program. Boeing integrated an Adaptive Trailing Edge on a modified 737-800 aircraft, completing ground tests and flight tests. This technology is expected to reduce aircraft fuel burn by up to two percent by increasing wing aerodynamic efficiency and decrease aircraft noise during approach.

3.1.3 NextGen - Environmental Research - Aircraft Technologies, Fuels, and Metrics (RE&D - A13.b)

The NextGen - Environmental Research - Aircraft Technologies, Fuels, and Metrics Program supports these R&D goals by developing solutions to mitigate aviation environmental impacts in absolute terms and increase fuel efficiency. It matures aircraft technologies through the CLEEN Program to reduce noise and emissions at the source level. It assesses, demonstrates, and supports qualification of alternative aviation fuels that reduce emissions that impact air quality and climate change. Availability of alternative aviation fuels also increases energy security. The program also supports research to determine the appropriate goals and metrics to manage NextGen aviation environmental impacts needed to support EMS.

The research milestones and their statuses are shown in Table 3.1.3 below, followed by a summary of the significant progress made in FY 2012 towards achieving these R&D goals.

Table 3.1.3: NextGen - Environmental Research - Aircraft Technologies, Fuels, and Metrics Program Milestones

Year	Milestone	Status	Notes
2010	Complete detailed feasibility study, including economic feasibility, measure environmental impacts, and demonstrate drop-in potential for alternative fuels	Completed	
2011	Determine how aviation-generated particulate matter and hazardous air pollutants impact local health, visibility, and global climate	Completed	The Environment and Energy (A13.a) Program was also responsible for this milestone.

Year	Milestone	Status	Notes
2011	Complete detailed feasibility study, including economic and environmental impacts and an assessment of the potential of renewable alternative fuels for gas turbine engines	Completed	
2011	Establish the relationship between aviation engine exhaust and the gases and particulate matter that are deposited in the atmosphere	Completed	
2011	Complete tests and data collection to determine if the right metrics are being used to assess the impact of aircraft noise	Completed	
2013	Refine the estimates of aircraft contribution to climate change	On schedule	The Environment and Energy (A13.a) Program is also responsible for this milestone.
2013	Demonstrate Continuous Lower Energy, Emissions and Noise Ceramic Matrix Composite nozzle technology	On schedule	This milestone was revised to clarify the research. Old wording: "Identify and pursue the development of engine and airframe technologies that will be the most effective at producing environmental benefits"
2013	Develop plans for Continuous Lower Energy, Emissions and Noise Phase II activities	On schedule	New milestone
2013	Demonstrate compatibility of future alternative jet fuel pathways with existing aircraft and infrastructure to expand feedstock options for sustainable fuel production	On schedule	This milestone was revised to clarify the research. Old wording: "Complete significant demonstration of "drop-in" alternative turbine engine fuels"
2013	Demonstrate airframe and engine technologies to reduce noise and emissions	Deleted	This milestone has been deleted because it is redundant with the milestone "Demonstrate Continuous Lower Energy, Emissions and Noise (CLEEN) Ceramic Matrix Composite nozzle technology". 2012 NARP Status: On schedule
2014	Evaluate the environmental and economic sustainability of future alternative turbine engine fuels	On schedule	This milestone was revised to clarify the research. Old wording: "Complete assessment of renewable alternative turbine engine fuels"

Year	Milestone	Status	Notes
2015	Evaluate novel future alternative jet fuels to ensure their compatibility with existing aircraft and fueling infrastructure	On schedule	This milestone was revised to clarify the research. Old wording: "Complete transition plans for renewable alternative fuels"
2015	Assess the environmental benefits of the first round of Continuous Lower Energy Emissions and Noise airframe and engine technologies	On schedule	This milestone was revised to clarify the research. Old wording: "Assess the environmental benefits of the first round of Continuous Lower Energy, Emissions and Noise airframe and engine technologies through integrated flight demonstration"
2015	Initiate Continuous Lower Energy, Emissions and Noise Phase II activities to demonstrate technologies that can reduce energy use, emissions, and noise	On schedule	New milestone
2016	Refine the estimates of aircraft contribution to climate change using the latest methods and knowledge	On schedule	New milestone The Environment and Energy (A13.a) Program is also responsible for this milestone.
2016	Refine the environmental and economic sustainability assessment of renewable alternative turbine engine fuels using the latest methods and knowledge	On schedule	New milestone
2017	Demonstrate technologies that can reduce energy use, emissions, and noise via the second phase of the Continuous Lower Energy, Emissions and Noise program	On schedule	New milestone

NextGen - Environmental Research - Aircraft Technologies, Fuels, and Metrics Program Progress in FY 2012:

- ✓ Examined the non-CO_2 climate impacts of aviation emissions as part of the Aviation Climate Change Research Initiative (ACCRI) Program. Current and future global scenarios addressing varying aviation capacity growth, technology and operational improvements, and the use of alternative fuels have been computed and specified for use by the ACCRI Consortium. Significant results included: better characterization of uncertainties in the calculation of chemical impacts on NOx-O_3 and NOx-CH_4; improvements in the characterization of moisture fields to enable calculation of the formation of contrails and contrail-induced cirrus clouds; improvements in the optical characterization of aerosols and contrail particles by modeling and laboratory investigations; and estimation of spatial extent and persistence of contrails and contrail-induced cirrus clouds using satellite observations and models.

3.1.4 Safety, Security, Environment – Operational Assessments (F&E - 1A07F – NextGen – Systems Development)

The Safety, Security, Environment – Operational Assessments Program supports these R&D goals by assessing system-wide NAS performance, safety, and environmental impacts. The transition to NextGen requires the conduct of operational assessments to ensure that new capabilities include safety, environmental, and system performance considerations, enabling an integrated implementation of NextGen. The program supports NextGen implementation by performing analyses in three areas: Systems Analysis, Environmental Assessments, and NextGen Performance Snapshots. Systems Analysis prepares quantitative estimates of the anticipated operational benefits of the NextGen portfolio. Environmental Assessments establishes the environmental impacts of the current aviation system to quantify the change in environmental measures from NextGen implementation, using assessment tools such as the Aviation Environment Design Tool (AEDT) and Aviation Environment Portfolio Management Tool. The NextGen Performance Snapshots website provides post-implementation performance information at 21 Metroplexes, as well as at selected airports and airspace.

The research milestones and their statuses are shown in Table 3.1.4 below, followed by a summary of the significant progress made in FY 2012 towards achieving these R&D goals.

Table 3.1.4: Safety, Security, Environment – Operational Assessments Program Milestones

Year	Milestone	Status	Notes
2009	Develop and implement NAS-wide regional environmental analysis capability within the Aviation Environmental Design Tool	Completed	
2010	Implement weather effects in Aviation Environmental Design Tool environmental analyses	Completed	

Year	Milestone	Status	Notes
2011	Enhance regional analysis capability in aviation environmental analysis tools	Completed	
2013	Develop and implement NAS-wide demand forecasting, economic and environmental analysis capability with Aviation Environmental Portfolio Management Tool	Completed	2012 NARP Status: Delayed from 2012 to 2013
2013	Interface/integrate environmental assessment capability with NextGen NAS models	On schedule	This milestone was revised to clarify the research. Old wording: "Explore options to integrate environmental assessment capability with NextGen NAS models"
2013	Complete a customized Performance Data Analysis and Reporting System dataset created for Performance Based Navigation analysis	On schedule	New milestone
2013	Collect and analyze studies from constituent program offices to provide a comprehensive view of NextGen costs and benefits	On schedule	New milestone
2013	Develop the NextGen 2012 Performance Assessment Report	On schedule	New milestone
2014	Release Aviation Environment Design Tool publicly with capability to perform airport to NAS level integrated fuel burn, noise and emissions analyses	On schedule	New milestone
2014	Interface Aviation Environment Design Tool environmental assessment capabilities with NextGen NAS simulation models	On schedule	New milestone
2014	Develop Aviation Environment Portfolio Management Tool for domestic/ regional NAS-wide NextGen environmental performance optimization and impact analysis	On schedule	New milestone
2014	Update document which analyzes and assesses NAS-wide environmental benefits of NextGen implementation	On schedule	New milestone
2014	Update NextGen cost estimates, benefits estimates, and the overall NextGen business case	On schedule	New milestone
2014	Publish an updated NextGen Business Case document	On schedule	New milestone

Year	Milestone	Status	Notes
2014	Evaluate the operational performance impacts of NextGen technologies and procedures, and publish an annual report	On schedule	New milestone
2014	Complete additional upgrades and maintenance of the website for NextGen Performance Snapshots to aid in the tracking and reporting of progress within NextGen	On schedule	New milestone
2014	Update and maintain the NextGen Segment Implementation Plan to aid the planning and deployment of NextGen portfolio in the mid-term timeframe	On schedule	New milestone
2016	Employ the Aviation Environmental Design Tool and the Aviation Environmental Portfolio Management Tool for NAS-wide environmental analyses	Deleted	This milestone has been deleted to ensure alignment with the Capital Investment Plan. 2012 NARP Status: On schedule

Safety, Security, Environment – Operational Assessments Program Progress in FY 2012:

- ✓ Publicly released AEDT version 2a, which replaced the Noise Integrated Routing System legacy tool for National Environmental Policy Act airspace environmental compliance of air traffic airspace and procedure actions.

3.1.5 NextGen - Weather Technology in the Cockpit (RE&D - A12.d)

The NextGen - Weather Technology in the Cockpit Program supports these R&D goals by developing, verifying, and validating requirements to support airworthiness standards for improving the quality and quantity of meteorological information to the aircraft to reduce environment impacts (e.g., lower fuel consumption) of current and NextGen operations.

The research milestones and their statuses are shown in Table 3.1.5 below, followed by a summary of the significant progress made in FY 2012 towards achieving these R&D goals.

Table 3.1.5: NextGen - Weather Technology in the Cockpit Program Milestones

Year	Milestone	Status	Notes
2014	Complete wind modeling simulation framework and initial data plots of wind errors (forecast and Flight Management System) versus fuel burn rates for selected NextGen operational applications	On schedule	New milestone

Year	Milestone	Status	Notes
2016	Complete service analysis on the information and presentations in the cockpit for adverse weather re-route options and ground-air negotiations to enable reduced fuel burn from more efficient reroute decisions due to adverse weather	On schedule	New milestone

NextGen - Weather Technology in the Cockpit Program Progress in FY 2012:

- ✓ Simulated and verified proof of concept for future research on impacts of simple wind conditions, aircraft, and operational procedures on selected NextGen applications.

- ✓ Began planning for pilot-in-the-loop demonstrations of providing Eddy Dissipation Rate / Graphical Turbulence Guidance (EDR/GTG) to cockpits including the completion of a test plan and preliminary assessments of tablet PCs to be used for presenting the EDR/GTG information in the cockpit.

3.1.6 Center for Advanced Aviation System Development (F&E - 4A08A)

The Center for Advanced Aviation System Development Program supports these R&D goals by conducting research on enabling NAS-wide assessment of noise, emissions, and fuel burn impacts of NextGen operational initiatives.

CAASD made the following progress in FY 2012 towards Environment and Energy R&D Goals 1 - 3.

- ✓ Refined the *systemwide*Modeler tool flight trajectory representation for environmental modeling purposes using the AEDT. The enhancements to s*ystemwide*Modeler trajectories included improved trajectory fidelity in the terminal area (through the use of radar track data) and incorporation of speed changes, vectors, and holds as en route delay absorption mechanisms for modeling the delay predicted by the simulation. Research activities included statistical analysis to support the creation of a terminal area path library that represents average annual conditions at the 30 core airports, refinement of trajectory altitude and speed profiles, software development to support AEDT study generation, sample studies for testing the methodology, and publication of findings through conference papers.

3.2 Environment and Energy R&D Goal 4

Established requirements, policies, procedures, and resources to allow airports in the United States to become environmentally-friendly neighbors.

3.2.1 Airport Cooperative Research Program – Environment (AIP)

The Airport Cooperative Research Program – Environment supports this R&D goal by examining the impact an airport has on the surrounding environment and advances the science and technology for creating an environmentally friendly airport system. Projects include the study of airport specific aviation noise and emissions and their environmental impacts, developing strategies and guidance for green airports via reduction in noise and emissions, infrastructure, and benefits of alternative aviation fuels at airport facilities, deicing management, and advanced noise and emissions databases.

The research milestones and their statuses are shown in Table 3.2.1 below, followed by a summary of the significant progress made in FY 2012 towards achieving this R&D goal.

Table 3.2.1: Airport Cooperative Research Program – Environment Milestones

Year	Milestone	Status	Notes
2012	Develop procedures to assess air pollution concentrations in the vicinity of airports	Completed	New milestone
2012	Develop a guidebook of recycling strategies for airport-industry recycling practitioners	Completed	New milestone
2012	Improve the assessment of hazardous air pollutants emissions at airports	Completed	New milestone
2012	Develop a process for monitoring storm water that is subject to runoff containing deicing materials	Completed	New milestone
2012	Assess and mitigate the contribution of ground support equipment to air quality impacts at airports	Completed	New milestone
2012	Publish guidelines for integrating alternative jet fuel into the airport setting	Completed	New milestone
2012	Identify factors in defining a winter design storm for use in sizing airport deicing runoff management systems and components	Completed	New milestone
2012	Define the benefits of incorporating sustainability into traditional airport projects	Completed	New milestone

Year	Milestone	Status	Notes
2012	Publish guidance on how alternative fuels can reduce PM2.5 emissions at airports	Completed	New milestone
2012	Develop guidance for airports to introduce and market alternative fuels to their airport community	Completed	New milestone
2013	Develop an aircraft departure environmental optimization methodology	On schedule	New milestone
2013	Design and implement a measurement campaign of particulate matter emissions from the use of aircraft auxiliary power units and aircraft brake and tire wear during landing	On schedule	New milestone
2013	Develop guidance for airport operators and state and local air quality planners that describes the development of the airport emissions component of a State Implementation Plan	On schedule	New milestone
2013	Identify applicable federal and state statutes and regulations, federal grant assurances, and FAA directives and advisory documents that apply to airport protection of wildlife on-airport or promotion of compatible land use off-airport	On schedule	New milestone
2013	Identify and evaluate metrics for and conditions under which aircraft noise affects student learning	On schedule	New milestone
2013	Develop a noise-power-distance and spectral class database for nominal taxi, break-away, and idle thrust levels for use in FAA's Integrated Noise Model	On schedule	New milestone
2013	Develop a decision tool for airports to identify, evaluate, prioritize, and select sustainability practices	On schedule	New milestone
2013	Identify available and emerging onsite and offsite technologies for treating storm water impacted by airport deicing activities	On schedule	New milestone
2013	Assess the effectiveness of sound insulation programs	On schedule	New milestone
2013	Provide practical mitigation alternatives for managing nuisance microbial communities caused by airport deicing activities	On schedule	New milestone

Year	Milestone	Status	Notes
2013	Develop an interactive electronic tool to assist airport stakeholders in estimating airport construction emissions	On schedule	New milestone
2013	Develop an inventory methodology to help airports quantify aircraft lead emissions at airports	On schedule	New milestone
2013	Develop and validate a research protocol for a large-scale study of aircraft noise exposure-annoyance response relationships across the U.S.	On schedule	New milestone
2013	Assess the predictive accuracy of the FAA's Integrated Noise Model for general aviation aircraft	On schedule	New milestone
2013	Assess the current body of knowledge regarding the impact of airport operations on air quality and public health	On schedule	New milestone
2013	Develop guidelines for airport sound insulation programs	On schedule	New milestone
2014	Create best practices for aviation safety associated with planning, developing and constructing energy production and transmission technologies at and around airports	On schedule	New milestone
2014	Produce guidance on the application of whole effluent toxicity testing to airport deicing runoff	On schedule	New milestone
2014	Develop a method for estimating aircraft takeoff thrust settings for a wide variety of commercial and general aviation aircraft, suitable for use in preparing airport emissions inventories	On schedule	New milestone
2014	Review, evaluate, and document current helicopter noise models and identify potential improvements to the Integrated Noise Model and the Aviation Environmental Design Tool to better capture the unique complexity of helicopter operations	On schedule	New milestone
2014	Improve, enhance, and update the Sustainable Aviation Guidance Alliance website with new and existing sustainable practices data	On schedule	New milestone

Year	Milestone	Status	Notes
2014	Develop a process to evaluate sustainability practices as they relate to the impacts on day-to-day airport operations and maintenance	On schedule	New milestone
2014	Develop tools and guidance for airports that identify and evaluate storm water management options and provide a set of best management practices to minimize hazards posed to aviation by wildlife	On schedule	New milestone
2014	Develop a primer to help airports address federal and state threatened and endangered species issues on or near their airport	On schedule	New milestone

Airport Cooperative Research Program – Environment Progress in FY 2012:

- ✓ Published a report titled *Guidance for Quantifying the Contribution of Airport Emissions to Local air Quality*, which created procedures for using air quality models in combination with on-site measurement equipment to prepare a comprehensive assessment of air pollution concentrations in the vicinity of airports. This guidance helps airports respond to regulatory needs, including those of the National Environmental Policy Act, and generate information desired by local communities as they seek to develop more detailed local air quality assessments.

- ✓ Developed a guidebook of recycling strategies, including a set of fact sheets targeted to specific airport-industry recycling practitioners. The guidebook and fact sheets describe procedures for recycling airport, airline, and flight kitchen waste; recommend action plans to improve recycling and reduce waste disposal costs for airports of varying sizes and characteristics; and identify existing program gaps and how components of the industry could work together to bridge those gaps.

- ✓ Published a report titled *Measurement of Gaseous HAP Emissions from Idling Aircraft as a Function of Engine and Ambient Conditions*, which helps improve the assessment of hazardous air pollutants (HAP) emissions at airports based on specific aircraft operating parameters and changes in ambient conditions.

- ✓ Published the *Guidebook for Selecting Methods to Monitor Airport and Aircraft Deicing Materials*, which provides a step-by-step process for identifying, evaluating, and selecting methods to monitor storm water that is subject to runoff containing deicing materials. The report addresses identifying the parameters to be monitored and discusses the appropriateness of various monitoring methods and instrument types to meet an airport's specific needs. The report also provides guidance for setup, operation, and maintenance of each monitoring method.

- ✓ Published a report titled *Airport Ground Support Equipment (GSE): Emission Reduction Strategies, Inventory, and Tutorial*, which is designed to help assess and mitigate the contribution of ground support equipment to air quality impacts at airports. The report presents an inventory of ground support equipment (GSE) at airports, identifies potential strategies to reduce emissions from powered GSE, and provides a tutorial that describes GSE operations and emission reduction technologies for use by GSE owners and operators.

- ✓ Published a handbook titled *Guidelines for Integrating Alternative Jet Fuel into the Airport Setting* for airport operators and others associated with "drop-in" jet fuel production and delivery that summarizes issues and opportunities associated with locating (on or off-airport) an alternative jet fuel production facility and its storage and distribution requirements. The handbook identifies the types and characteristics of alternative jet fuels; summarizes potential benefits; addresses legal, financial, environmental, and logistical considerations and opportunities; aids in evaluating the feasibility of alternative jet fuel production facilities; and summarizes issues and opportunities associated with locating on- or off-airport alternative jet fuel production facilities and their fuel storage and distribution requirements.

- ✓ Published a report titled *Winter Design Storm Factor Determination for Airports,* which identifies the relevant factors in defining a winter design storm for use in sizing airport deicing runoff management systems and components. The guidebook provides a decision support tool for identifying an appropriate winter design storm for an airport-specific project; a review of regulations as they pertain to deicing runoff; and suggestions for target levels of service, including the acceptable level of risk of the designed system not meeting performance standards.

- ✓ Published the *Guidebook for Incorporating Sustainability into Traditional Airport Projects*, which describes sustainability and its potential benefits, and identifies different applications of sustainable initiatives in traditional airport construction and everyday maintenance projects. The report includes an airport sustainability assessment tool that may be used to assist in identifying sustainability initiatives that might be most applicable to an airport project.

- ✓ Published a document titled *Alternative Fuels as a Means to Reduce PM2.5 Emissions at Airports*, which describes the potential impacts that alternative fuels could have on emissions and ambient air pollution concentrations of fine particulate matter at airports.

- ✓ Published a report titled *Assessing Opportunities for Alternative Fuel Distribution Programs*, which consists of a guidebook and toolkit designed to help airports introduce and market alternative fuels to their airport community, including tenants and consumers off airport. The guidebook includes a step-by-step process to evaluate opportunities and constraints for alternative fuel distribution programs.

3.2.2 Airport Technology Research Program – Environment (AIP)

The Airport Technology Research Program – Environment supports this R&D goal by establishing up-to-date exposure-response relationships for community annoyance and sleep disturbance in the U.S. by collecting extensive data covering a wide variety of airport types and geographic locations. The results will help guide national aviation noise policy, determinations of community noise impacts, land use guidelines around airports, and mitigation funding.

The research milestones and their statuses are shown in Table 3.2.2 below, followed by a summary of the significant progress made in FY 2012 towards achieving this R&D goal.

Table 3.2.2: Airport Technology Research Program – Environment Milestones

Year	Milestone	Status	Notes
2012	Initiate the Aircraft Noise and Annoyance Study	Completed	This milestone was changed to specify the name of the study. Old wording: "Initiate a project to study aircraft noise annoyance data and sleep disturbance around airports" 2012 NARP Status: On schedule
2013	Develop the test plan and selection of surveyed airports for the Aircraft Noise and Annoyance Study	On schedule	New milestone
2014	Develop and gain approval for a survey instrument to collect data for the Aircraft Noise and Annoyance Study	On schedule	New milestone
2015	Complete data collection for the Aircraft Noise and Annoyance Study	On schedule	New milestone
2016	Complete updates to the dose-response curves for U.S. airports using data collected from the Aircraft Noise and Annoyance Study	On schedule	New milestone

Airport Technology Research Program – Environment Progress in FY 2012:

- ✓ Initiated the national Aircraft Noise and Annoyance Study, an extensive multi-year data collection effort to survey communities' level of annoyance in response to aircraft noise. The FAA's current noise policy is based on human response and noise exposure data from the 1960's and 1970's. Since noise is the most immediately objectionable community impact of aviation and requires the most Federal resources to mitigate, it is important the FAA update the scientific evidence of the relationship between aircraft noise exposure and annoyance. The results of the multi-year study will provide the FAA with the additional confidence that a given metric and level of noise are indicative of today's population as well as guide national aviation noise policy and determine community noise impacts and land-use guidelines.

3.3 Environment and Energy R&D Goal 5

Established data and methodologies to support certification of alternative fuels for General Aviation aircraft.

3.3.1 NextGen - Alternative Fuels for General Aviation (RE&D - A11.m)

The NextGen - Alternative Fuels for General Aviation Program supports this R&D goal by addressing the use of alternative and renewable fuels for GA to lessen aviation environmental impacts on air and water quality. The program develops data and methodologies to support certification of alternative aviation fuels for GA aircraft.

The research milestones and their statuses are shown in Table 3.3.1 below, followed by a summary of the significant progress made in FY 2012 towards achieving this R&D goal.

Table 3.3.1: NextGen - Alternative Fuels for General Aviation Program Milestones

Year	Milestone	Status	Notes
2016	Develop engine and fuel test methods to evaluate the performance, safety, durability, and operability of unleaded aviation gasoline	On schedule	

NextGen - Alternative Fuels for General Aviation Program Progress in FY 2012

- ✓ Completed research that characterized, quantified, and documented the effects of engine deposits containing elemental lead on the antiknock performance of alternative unleaded fuels. Results showed significant improvement in antiknock performance of unleaded fuels in an engine containing lead deposits. As a result of the research, certification officials now understand that any engine tested for unleaded fuel must be purged of lead deposits prior to testing, thus ensuring an adequate margin of operating safety.

- ✓ Completed initial full-scale engine tests on reduced-lead aviation gasoline. Unleaded and leaded aviation gasolines with similar specification properties perform differently in full-scale aircraft engines. The research addressed mis-fueling concerns related to performance differences of the two fuels. Test results will be used in an effort to establish a minimum lead requirement in the existing leaded aviation fuel specification.


UNITED STATES OF AMERICA

Chapter 4
R&D Business Management

This chapter reviews the FAA R&D portfolio according to the FY 2014 President's Budget submission. It also summarizes the four budget appropriation accounts, shows how much the FAA is spending on R&D, and describes its R&D program execution.

The FAA R&D portfolio supports regulation, certification, and standards development; modernization of the NAS; and policy and planning. To support FAA R&D principles and goals, the R&D addresses the specific needs of sponsoring organizations, including Aviation Safety, Air Traffic Organization, Airports, Commercial Space Transportation, NextGen, and Policy, International Affairs and Environment. The Research and Development Management Division under the Assistant Administrator for NextGen manages the FAA R&D portfolio for the Agency.

4.1 Appropriation Accounts

All four of the FAA's appropriation accounts fund the R&D portfolio: RE&D; F&E; AIP; and Ops. The following sections provide a summary of the FAA appropriation accounts[7] and how the R&D portfolio is derived from each.

4.1.1 Research, Engineering and Development (RE&D)

The RE&D appropriation account funds R&D programs that improve the NAS by increasing its safety, security, productivity, capacity, and environmental compatibility to meet the expected air traffic demands of the future. The RE&D appropriation account funds roughly half of the programs included in the NextGen R&D portfolio.

4.1.2 Facilities and Equipment (F&E)

The F&E appropriation account funds capital investments relating to air navigation facilities and equipment and aviation safety systems including acquisition costs, installation, testing, initial spares, initial maintenance contracts and training for equipment, facilities, and other construction projects. The F&E appropriation account funds R&D from two groups of programs: Advanced Technology Development and Prototyping and NextGen – System Development. In general, programs from these groups are in the concept development and demonstration phase prior to an FAA investment decision.

Advanced Technology Development and Prototyping R&D programs develop and validate technology and systems that support air traffic services, to include the requirements associated with the evolving air traffic system architecture and improvements in airport safety and capacity. NextGen - System Development R&D programs comprise the other half of the NextGen R&D portfolio and have broad applicability across the NextGen solution sets and to NextGen overall.

[7] FAA Order 2500.8B, Funding Criteria for Operations, Facilities and Equipment (F&E), and Research, Engineering and Development (RE&D) Accounts, dated October 1, 2006

4.1.3 Grants-In-Aid for Airports (AIP)

The AIP appropriation account provides grants to local and state airport authorities to help ensure the safety, capacity, and efficiency of U.S. airports. Through the AIP, the agency funds a range of activities to assist in airport development, preservation of critical facilities, economic competitiveness, and environmental sustainability. This appropriation account funds the administrative expenses of the FAA Office of Airports, as well as airport-related R&D conducted in the Airport Cooperative Research Program (ACRP) and the Airport Technology Research Program (ATRP).

The ACRP organization, its procedures, and its administration by the Transportation Research Board (TRB) were established in a 2005 MOA that was signed by the U.S. Secretary of Transportation, the President of the National Academy of Sciences, and the Administrator of the FAA. The purpose of the ACRP is to research problems shared by airports that are not being addressed by other Federal research programs. Each year, the TRB solicits the public and the aviation industry for research topics on airport issues involving safety, operations, capacity, and environment. The ACRP Oversight Committee reviews the topics submitted and selects the most promising ones for funding.

The purpose of the ATRP is to develop new or improved airport standards or procedures. The FAA Office of Airports sponsors ATRP research projects and reviews project deliverables. Research results are used to update or produce new ACs used by airports and industry to design and construct airport infrastructure, procure airport capital equipment, and support FAA regulatory requirements for airport safety. ATRP research areas include airport safety, airport lighting and marking, airport pavement design and construction, airport design, heliport design, aircraft rescue and firefighting, surface surveillance, airport capacity, mitigation of wildlife hazards, and airport environment.

4.1.4 Operations (Ops)

The Ops appropriation is the primary appropriation account from which the air traffic control operations services and annual operating and maintenance expenses are paid. Items appropriately budgeted and executed from this account include the cost of administration, operation, repair; and maintenance of FAA activities supporting the NAS. The Ops appropriation account funds R&D conducted in the Commercial Space Transportation Safety Program.

4.2 R&D Summary Budget Tables

This section provides five tables presenting the FAA R&D budget by appropriation, program sponsor, R&D category, performance goal, and NextGen R&D. It presents the FY 2013 CR Annualized and FY 2014 President's Request, and planned funding for FY 2015 through 2018, which are estimates and subject to change. The amounts shown for F&E programs reflect only R&D activities and do not include acquisition, operational testing, or other non-R&D activities. The amounts shown for CAASD include only the R&D portion of the total CAASD line item amount, which is 23.5 percent in FY 2013.

4.2.1 Appropriation Account

Table 4.2.1 shows the FAA R&D FY 2013 CR Annualized and FY 2014 President's Request budgets and the estimated funding through FY 2018, grouped by appropriation account. The F&E budget in Table 4.2.1 includes three programs: Advanced Technology Development and Prototyping (ATDP) (1A01), NextGen - System Development (1A07), and CAASD (4A08A). The ATDP and NextGen - Systems Development line items have several programs under them, as shown in the tables. Both the F&E and the Ops appropriations have programs that are not part of the R&D portfolio, as the NARP only presents R&D.

4.2.2 Requesting Organization

Table 4.2.2 shows the FAA R&D FY 2013 CR Annualized and FY 2014 President's Request budgets and the estimated funding through FY 2018, grouped by requesting organization. Requesting (also known as sponsoring) organizations include Aviation Safety; Air Traffic Organization; Airports; Commercial Space Transportation; NextGen; and Policy, International Affairs and Environment.

4.2.3 Research Category

The FAA R&D portfolio includes both applied research and development as defined by the OMB Circular A-11[8]. Applied research is the systematic study to gain knowledge or understanding necessary to determine the means by which a recognized and specific need may be met. Development is the systematic application of knowledge or understanding directed toward production of useful materials, devices, and systems or methods, including design, development, and improvement of prototypes and new processes to meet specific requirements. Table 4.2.3 shows the FAA R&D portfolio according to these categories with the percent of applied research and development for FY 2013 through 2018. In Table 4.2.3, the Commercial Space Transportation Safety Program is 50 percent applied research and 50 percent development.

[8] OMB Circular A-11, Preparation, Submission and Execution of the Budget, August 3, 2012, section 84, page 11 (http://www.whitehouse.gov/OMB/circulars).

4.2.4 Performance Goal

Table 4.2.4 shows the FAA R&D budget by the performance goals defined in Exhibit II of the FAA President's Request for FY 2014. The R&D programs apply to three of the goals in the *U.S. Department of Transportation's Strategic Plan for Fiscal Years 2012–2016*: Safety, Economic Competitiveness, and Environmental Sustainability. Many R&D programs apply to more than one goal. However, for budgeting purposes, most programs are included under only one goal. The table provides information on contract costs and personnel costs requested for FY 2014. For Table 4.2.4, System Planning and Resource Management (A14.a) is considered part of Mission Support for the RE&D appropriation account and is pro-rated across the three DOT goals as follows: Safety at 57 percent; Economic Competitiveness at 22 percent; and Environmental Sustainability at 21 percent. William J. Hughes Technical Center Facility (A14.b) is also considered part of Mission Support and is pro-rated between Safety at 72 percent and Economic Competitiveness at 28 percent.

4.2.5 NextGen R&D

Funded by both RE&D and F&E appropriations, the FAA NextGen R&D portfolio is a subset of the FAA R&D portfolio, reported in the NARP, and also in the *NextGen Implementation Plan*. The FAA NextGen R&D portfolio represents 40 percent of the total requested R&D budget reported in the NARP for FY 2014, and it represents 12 percent of the FAA NextGen portfolio. The FAA R&D portfolio includes the entire RE&D contribution to NextGen, but only part of the F&E contribution to NextGen. Table 4.2.5 provides the FAA NextGen R&D portfolio five-year budget plan by line item and appropriation.

Table 4.2.1: Planned R&D Budget by Appropriation Account

2014 BLI	Program	Appropriation Account	2013 CR Annualized ($000)	2014 Request ($000)	2015 Estimate ($000)	2016 Estimate ($000)	2017 Estimate ($000)	2018 Estimate ($000)
Research, Engineering and Development (RE&D)								
A11.a	Fire Research and Safety	RE&D	7,202	8,313	8,423	8,597	8,728	8,902
A11.b	Propulsion and Fuel Systems	RE&D	2,314	1,974	2,002	2,045	2,078	2,121
A11.c	Advanced Materials/Structural Safety	RE&D	2,550	2,607	2,650	2,713	2,760	2,823
A11.d	Aircraft Icing/Digital System Safety	RE&D	5,437	7,582	7,709	7,904	8,050	8,245
A11.e	Continued Airworthiness	RE&D	11,671	8,167	8,290	8,483	8,628	8,821
A11.f	Aircraft Catastrophic Failure Prevention Research	RE&D	1,154	1,652	1,683	1,728	1,761	1,805
A11.g	Flightdeck/Maintenance/System Integration Human Factors	RE&D	6,200	5,000	4,993	5,048	5,092	5,148
A11.h	System Safety Management	RE&D	10,088	11,583	11,818	12,145	12,389	12,717
A11.i	Air Traffic Control/Technical Operations Human Factors	RE&D	10,427	6,000	7,449	7,524	7,584	7,659
A11.j	Aeromedical Research	RE&D	11,067	8,672	8,714	8,820	8,903	9,008
A11.k	Weather Program	RE&D	16,141	15,279	15,651	16,153	16,524	17,025
A11.l	Unmanned Aircraft Systems Research	RE&D	3,525	7,500	7,669	7,897	8,067	8,296
A11.m	NextGen - Alternative Fuels for General Aviation	RE&D	1,995	5,571	5,663	5,800	5,903	6,040
A11.n	NextGen - Advanced Systems and Software Validation	RE&D	0	1,021	1,039	1,065	1,085	1,111
A12.a	Joint Planning and Development Office (JPDO)	RE&D	5,031	12,057	12,222	12,487	12,684	12,944
A12.b	NextGen - Wake Turbulence	RE&D	10,739	9,267	9,418	9,643	9,813	10,039
A12.c	NextGen - Air Ground Integration Human Factors	RE&D	10,564	10,329	10,455	10,710	10,901	11,157
A12.d	NextGen - Weather Technology in the Cockpit	RE&D	8,049	4,169	4,227	4,321	4,391	4,483
A13.a	Environment and Energy	RE&D	15,166	14,542	14,851	15,279	15,597	16,025
A13.b	NextGen - Environmental Research - Aircraft Technologies, Fuels, and Metrics	RE&D	23,644	18,979	19,296	19,771	20,128	20,606
A14.a	System Planning and Resource Management	RE&D	1,728	2,289	2,303	2,341	2,369	2,406
A14.b	William J. Hughes Technical Center Laboratory Facility	RE&D	3,800	3,447	3,474	3,526	3,566	3,618
	RE&D TOTAL	**RE&D**	**168,492**	**166,000**	**170,000**	**174,000**	**177,000**	**181,000**
Facilities & Equipment (F&E)								
1A01A	Runway Incursion Reduction Program	F&E	2,810	5,000	5,000	5,000	5,000	5,000
1A01B	System Capacity, Planning and Improvements	F&E	5,430	5,600	6,000	6,000	6,500	6,500
1A01C	Operations Concept Validation and Infrastructure Evolution	F&E	4,170	4,000	4,000	4,000	4,000	6,000
1A01D	Major Airspace Redesign	F&E	5,915	5,000	5,000	5,000	5,000	5,000
	Subtotal	**Line 1A01**	18,325	19,600	20,000	20,000	20,500	22,500
1A07A	Air Traffic Control/Technical Operations Human Factors (Controller Efficiency and Air Ground Integration)	F&E	4,165	5,000	5,400	5,900	6,000	6,500
1A07B	New Air Traffic Management Requirements	F&E	18,320	22,000	19,700	21,700	29,000	33,300
1A07C	Operations Concept Validation Modeling	F&E	4,165	5,000	4,500	4,900	5,000	6,000
1A07D	Environment and Energy - Environmental Management Systems and Advanced Noise and Emissions Reduction	F&E	7,915	10,000	8,900	9,900	10,000	10,900
1A07E	Wake Turbulence - Re-categorization	F&E	1,250	1,500	1,300	1,500	3,000	3,400
1A07F	Safety, Security, Environment – Operational Assessments	F&E	7,000	8,000	7,200	7,900	8,000	8,700
1A07G	Safety, Security, Environment – Systems Safety Management Transformation	F&E	6,250	8,000	7,200	7,900	8,000	9,700
1A07H	Networked Facilities - Staffed NextGen Towers	F&E	2,915	2,000	5,400	5,900	6,000	6,900
	Subtotal	**Line 1A07**	51,980	61,500	59,600	65,600	75,000	85,400
4A08A	Center for Advanced Aviation System Development (CAASD)	F&E	18,330	16,450	17,625	17,625	17,625	18,800
	F&E TOTAL	**F&E**	**88,635**	**97,550**	**97,225**	**103,225**	**113,125**	**126,700**
Grants-In-Aid for Airports (AIP)								
--	Airport Cooperative Research Program - Capacity	AIP	5,031	5,000	5,000	5,000	5,000	5,000
--	Airport Cooperative Research Program - Environment	AIP	5,031	5,000	5,000	5,000	5,000	5,000
--	Airport Cooperative Research Program - Safety	AIP	5,030	5,000	5,000	5,000	5,000	5,000
--	Airport Technology Research Program - Capacity	AIP	12,571	12,607	12,607	12,607	12,607	12,607
--	Airport Technology Research Program - Environment	AIP	1,500	1,500	1,500	1,500	1,500	1,500
--	Airport Technology Research Program - Safety	AIP	15,358	15,393	15,393	15,393	15,393	15,393
	AIP TOTAL	**AIP**	**44,521**	**44,500**	**44,500**	**44,500**	**44,500**	**44,500**
Operations (Ops)								
--	Commercial Space Transportation Safety	Ops	1,000	1,000	1,000	1,000	1,000	1,000
	Ops TOTAL	**Ops**	**1,000**	**1,000**	**1,000**	**1,000**	**1,000**	**1,000**
	GRAND TOTAL		**$302,648**	**$309,050**	**$312,725**	**$322,725**	**$335,625**	**$353,200**

Table 4.2.2: Planned R&D Budget by Requesting Organization

2014 BLI	Program	Appropriation Account	2013 CR Annualized ($000)	2014 Request ($000)	2015 Estimate ($000)	2016 Estimate ($000)	2017 Estimate ($000)	2018 Estimate ($000)
Aviation Safety (AVS)								
A11.a	Fire Research and Safety	RE&D	7,202	8,313	8,423	8,597	8,728	8,902
A11.b	Propulsion and Fuel Systems	RE&D	2,314	1,974	2,002	2,045	2,078	2,121
A11.c	Advanced Materials/Structural Safety	RE&D	2,550	2,607	2,650	2,713	2,760	2,823
A11.d	Aircraft Icing/Digital System Safety	RE&D	5,437	7,582	7,709	7,904	8,050	8,245
A11.e	Continued Airworthiness	RE&D	11,671	8,167	8,290	8,483	8,628	8,821
A11.f	Aircraft Catastrophic Failure Prevention Research	RE&D	1,154	1,652	1,683	1,728	1,761	1,805
A11.g	Flightdeck/Maintenance/System Integration Human Factors	RE&D	6,200	5,000	4,993	5,048	5,092	5,148
A11.h	System Safety Management	RE&D	10,088	11,583	11,818	12,145	12,389	12,717
A11.j	Aeromedical Research	RE&D	11,067	8,672	8,714	8,820	8,903	9,008
A11.l	Unmanned Aircraft Systems Research	RE&D	3,525	7,500	7,669	7,897	8,067	8,296
A11.n	NextGen - Advanced Systems and Software Validation	RE&D	0	1,021	1,039	1,065	1,085	1,111
	AVS TOTAL		**61,208**	**64,071**	**64,990**	**66,446**	**67,541**	**68,997**
NextGen (ANG)								
A11.m	NextGen - Alternative Fuels for General Aviation	RE&D	1,995	5,571	5,663	5,800	5,903	6,040
A12.a	Joint Planning and Development Office (JPDO)	RE&D	5,031	12,057	12,222	12,487	12,684	12,944
A12.b	NextGen - Wake Turbulence	RE&D	10,739	9,267	9,418	9,643	9,813	10,039
A12.c	NextGen - Air Ground Integration Human Factors	RE&D	10,564	10,329	10,455	10,710	10,901	11,157
A12.d	NextGen - Weather Technology in the Cockpit	RE&D	8,049	4,169	4,227	4,321	4,391	4,483
A14.a	System Planning and Resource Management	RE&D	1,728	2,289	2,303	2,341	2,369	2,406
A14.b	William J. Hughes Technical Center Laboratory Facility	RE&D	3,800	3,447	3,474	3,526	3,566	3,618
	Subtotal	**RE&D**	41,906	47,129	47,763	48,828	49,627	50,689
1A07A	Air Traffic Control/Technical Operations Human Factors (Controller Efficiency and Air Ground Integration)	F&E	4,165	5,000	5,400	5,900	6,000	6,500
1A07B	New Air Traffic Management Requirements	F&E	18,320	22,000	19,700	21,700	29,000	33,300
1A07C	Operations Concept Validation Modeling	F&E	4,165	5,000	4,500	4,900	5,000	6,000
1A07E	Wake Turbulence - Re-categorization	F&E	1,250	1,500	1,300	1,500	3,000	3,400
1A07F	Safety, Security, Environment – Operational Assessments	F&E	7,000	8,000	7,200	7,900	8,000	8,700
1A07G	Safety, Security, Environment – Systems Safety Management Transformation	F&E	6,250	8,000	7,200	7,900	8,000	9,700
1A07H	Networked Facilities - Staffed NextGen Towers	F&E	2,915	2,000	5,400	5,900	6,000	6,900
	Subtotal	**F&E**	44,065	51,500	50,700	55,700	65,000	74,500
	ANG TOTAL		**85,971**	**98,629**	**98,463**	**104,528**	**114,627**	**125,189**
Air Traffic Organization (ATO)								
A11.i	Air Traffic Control/Technical Operations Human Factors	RE&D	10,427	6,000	7,449	7,524	7,584	7,659
A11.k	Weather Program	RE&D	16,141	15,279	15,651	16,153	16,524	17,025
	Subtotal	**RE&D**	26,568	21,279	23,100	23,677	24,108	24,684
1A01A	Runway Incursion Reduction Program	F&E	2,810	5,000	5,000	5,000	5,000	5,000
1A01B	System Capacity, Planning and Improvements	F&E	5,430	5,600	6,000	6,000	6,500	6,500
1A01C	Operations Concept Validation and Infrastructure Evolution	F&E	4,170	4,000	4,000	4,000	4,000	6,000
1A01D	Major Airspace Redesign	F&E	5,915	5,000	5,000	5,000	5,000	5,000
4A08A	Center for Advanced Aviation System Development (CAASD)	F&E	18,330	16,450	17,625	17,625	17,625	18,800
	Subtotal	**F&E**	36,655	36,050	37,625	37,625	38,125	41,300
	ATO TOTAL		**63,223**	**57,329**	**60,725**	**61,302**	**62,233**	**65,984**
Airports (ARP)								
--	Airport Cooperative Research Program - Capacity	AIP	5,031	5,000	5,000	5,000	5,000	5,000
--	Airport Cooperative Research Program - Environment	AIP	5,031	5,000	5,000	5,000	5,000	5,000
--	Airport Cooperative Research Program - Safety	AIP	5,030	5,000	5,000	5,000	5,000	5,000
--	Airport Technology Research Program - Capacity	AIP	12,571	12,607	12,607	12,607	12,607	12,607
--	Airport Technology Research Program - Environment	AIP	1,500	1,500	1,500	1,500	1,500	1,500
--	Airport Technology Research Program - Safety	AIP	15,358	15,393	15,393	15,393	15,393	15,393
	ARP TOTAL		**44,521**	**44,500**	**44,500**	**44,500**	**44,500**	**44,500**
Policy, International Affairs, and Environment (APL)								
A13.a	Environment and Energy	RE&D	15,166	14,542	14,851	15,279	15,597	16,025
A13.b	NextGen - Environmental Research - Aircraft Technologies, Fuels, and Metrics	RE&D	23,644	18,979	19,296	19,771	20,128	20,606
	Subtotal	**RE&D**	38,810	33,521	34,147	35,050	35,725	36,631
1A07D	Environment and Energy - Environmental Management Systems and Advanced Noise and Emissions Reduction	F&E	7,915	10,000	8,900	9,900	10,000	10,900
	Subtotal	**F&E**	7,915	10,000	8,900	9,900	10,000	10,900
	APL TOTAL		**46,725**	**43,521**	**43,047**	**44,950**	**45,725**	**47,531**
Commercial Space Transportation (AST)								
--	Commercial Space Transportation Safety	Ops	1,000	1,000	1,000	1,000	1,000	1,000
	AST TOTAL		**1,000**	**1,000**	**1,000**	**1,000**	**1,000**	**1,000**
	GRAND TOTAL		**$302,648**	**$309,050**	**$312,725**	**$322,725**	**$335,625**	**$353,200**

Table 4.2.3: Planned R&D Budget by Research Category

2014 BLI	Program	Appropriation Account	2013 CR Annualized ($000)	2014 Request ($000)	2015 Estimate ($000)	2016 Estimate ($000)	2017 Estimate ($000)	2018 Estimate ($000)
Applied Research								
A11.a	Fire Research and Safety	RE&D	7,202	8,313	8,423	8,597	8,728	8,902
A11.b	Propulsion and Fuel Systems	RE&D	2,314	1,974	2,002	2,045	2,078	2,121
A11.c	Advanced Materials/Structural Safety	RE&D	2,550	2,607	2,650	2,713	2,760	2,823
A11.d	Aircraft Icing/Digital System Safety	RE&D	5,437	7,582	7,709	7,904	8,050	8,245
A11.e	Continued Airworthiness	RE&D	11,671	8,167	8,290	8,483	8,628	8,821
A11.f	Aircraft Catastrophic Failure Prevention Research	RE&D	1,154	1,652	1,683	1,728	1,761	1,805
A11.g	Flightdeck/Maintenance/System Integration Human Factors	RE&D	6,200	5,000	4,993	5,048	5,092	5,148
A11.h	System Safety Management	RE&D	10,088	11,583	11,818	12,145	12,389	12,717
A11.i	Air Traffic Control/Technical Operations Human Factors	RE&D	10,427	6,000	7,449	7,524	7,584	7,659
A11.j	Aeromedical Research	RE&D	11,067	8,672	8,714	8,820	8,903	9,008
A11.k	Weather Program	RE&D	16,141	15,279	15,651	16,153	16,524	17,025
A11.l	Unmanned Aircraft Systems Research	RE&D	3,525	7,500	7,669	7,897	8,067	8,296
A11.m	NextGen - Alternative Fuels for General Aviation	RE&D	1,995	5,571	5,663	5,800	5,903	6,040
A11.n	NextGen - Advanced Systems and Software Validation	RE&D	0	1,021	1,039	1,065	1,085	1,111
A12.a	Joint Planning and Development Office (JPDO)	RE&D	5,031	12,057	12,222	12,487	12,684	12,944
A12.b	NextGen - Wake Turbulence	RE&D	10,739	9,267	9,418	9,643	9,813	10,039
A12.c	NextGen - Air Ground Integration Human Factors	RE&D	10,564	10,329	10,455	10,710	10,901	11,157
A12.d	NextGen - Weather Technology in the Cockpit	RE&D	8,049	4,169	4,227	4,321	4,391	4,483
A13.a	Environment and Energy	RE&D	15,166	14,542	14,851	15,279	15,597	16,025
A13.b	NextGen - Environmental Research - Aircraft Technologies, Fuels, and Metrics	RE&D	23,644	18,979	19,296	19,771	20,128	20,606
A14.a	System Planning and Resource Management	RE&D	1,728	2,289	2,303	2,341	2,369	2,406
A14.b	William J. Hughes Technical Center Laboratory Facility	RE&D	3,800	3,447	3,474	3,526	3,566	3,618
	Subtotal	**RE&D**	168,492	166,000	170,000	174,000	177,000	181,000
--	Airport Cooperative Research Program - Capacity	AIP	5,031	5,000	5,000	5,000	5,000	5,000
--	Airport Cooperative Research Program - Environment	AIP	5,031	5,000	5,000	5,000	5,000	5,000
--	Airport Cooperative Research Program - Safety	AIP	5,030	5,000	5,000	5,000	5,000	5,000
--	Airport Technology Research Program - Capacity	AIP	12,571	12,607	12,607	12,607	12,607	12,607
--	Airport Technology Research Program - Environment	AIP	1,500	1,500	1,500	1,500	1,500	1,500
--	Airport Technology Research Program - Safety	AIP	15,358	15,393	15,393	15,393	15,393	15,393
	Subtotal	**AIP**	44,521	44,500	44,500	44,500	44,500	44,500
--	Commercial Space Transportation Safety	Ops	500	500	500	500	500	500
	Subtotal	**Ops**	500	500	500	500	500	500
	Applied Research TOTAL		**213,513**	**211,000**	**215,000**	**219,000**	**222,000**	**226,000**
	Applied Research PERCENT		**70.5%**	**68.3%**	**68.8%**	**67.9%**	**66.1%**	**64.0%**
Development								
1A01A	Runway Incursion Reduction Program	F&E	2,810	5,000	5,000	5,000	5,000	5,000
1A01B	System Capacity, Planning and Improvements	F&E	5,430	5,600	6,000	6,000	6,500	6,500
1A01C	Operations Concept Validation and Infrastructure Evolution	F&E	4,170	4,000	4,000	4,000	4,000	6,000
1A01D	Major Airspace Redesign	F&E	5,915	5,000	5,000	5,000	5,000	5,000
1A07A	Air Traffic Control/Technical Operations Human Factors (Controller Efficiency and Air Ground Integration)	F&E	4,165	5,000	5,400	5,900	6,000	6,500
1A07B	New Air Traffic Management Requirements	F&E	18,320	22,000	19,700	21,700	29,000	33,300
1A07C	Operations Concept Validation Modeling	F&E	4,165	5,000	4,500	4,900	5,000	6,000
1A07D	Environment and Energy - Environmental Management Systems and Advanced Noise and Emissions Reduction	F&E	7,915	10,000	8,900	9,900	10,000	10,900
1A07E	Wake Turbulence - Re-categorization	F&E	1,250	1,500	1,300	1,500	3,000	3,400
1A07F	Safety, Security, Environment – Operational Assessments	F&E	7,000	8,000	7,200	7,900	8,000	8,700
1A07G	Safety, Security, Environment – Systems Safety Management Transformation	F&E	6,250	8,000	7,200	7,900	8,000	9,700
1A07H	Networked Facilities - Staffed NextGen Towers	F&E	2,915	2,000	5,400	5,900	6,000	6,900
4A08A	Center for Advanced Aviation System Development (CAASD)	F&E	18,330	16,450	17,625	17,625	17,625	18,800
	Subtotal	**F&E**	88,635	97,550	97,225	103,225	113,125	126,700
--	Commercial Space Transportation Safety	Ops	500	500	500	500	500	500
	Subtotal	**Ops**	500	500	500	500	500	500
	Development TOTAL		**89,135**	**98,050**	**97,725**	**103,725**	**113,625**	**127,200**
	Development PERCENT		**29.5%**	**31.7%**	**31.2%**	**32.1%**	**33.9%**	**36.0%**
	GRAND TOTAL		**$302,648**	**$309,050**	**$312,725**	**$322,725**	**$335,625**	**$353,200**

Table 4.2.4: Planned R&D Budget by Performance Goal (Budget Exhibit II)

2014 BLI	Program	Appropriation Account	2014 Contract Costs ($000)	2014 Personnel Costs ($000)	2014 Other In-house Costs ($000)	2014 Total Request ($000)
1. Safety						
A11.a	Fire Research and Safety	RE&D	4,826	3,333	154	8,313
A11.b	Propulsion and Fuel Systems	RE&D	1,209	752	13	1,974
A11.c	Advanced Materials/Structural Safety	RE&D	1,771	785	51	2,607
A11.d	Aircraft Icing/Digital System Safety	RE&D	5,543	1,950	89	7,582
A11.e	Continued Airworthiness	RE&D	5,448	2,560	159	8,167
A11.f	Aircraft Catastrophic Failure Prevention Research	RE&D	1,264	373	15	1,652
A11.g	Flightdeck/Maintenance/System Integration Human Factors	RE&D	1,446	3,386	168	5,000
A11.h	System Safety Management	RE&D	9,375	2,146	62	11,583
A11.i	Air Traffic Control/Technical Operations Human Factors	RE&D	0	5,797	203	6,000
A11.j	Aeromedical Research	RE&D	2,660	5,884	128	8,672
A11.k	Weather Program	RE&D	14,536	674	69	15,279
A11.l	Unmanned Aircraft Systems Research	RE&D	6,586	831	83	7,500
A11.m	NextGen - Alternative Fuels for General Aviation	RE&D	5,267	296	8	5,571
A11.n	NextGen - Advanced Systems and Software Validation	RE&D	1,000	21	0	1,021
A14.a	System Planning and Resource Management	RE&D	576	661	61	1,299
A14.b	William J. Hughes Technical Center Laboratory Facility	RE&D	991	1,400	82	2,473
	Subtotal	**RE&D**	62,498	30,850	1,344	94,692
1A01A	Runway Incursion Reduction Program	F&E	5,000	0	0	5,000
	Subtotal	**F&E**	5,000	0	0	5,000
--	Airport Cooperative Research Program - Safety	AIP	4,903	97	0	5,000
--	Airport Technology Research Program - Safety	AIP	13,654	1,739	0	15,393
	Subtotal	**AIP**	18,557	1,836	0	20,393
--	Commercial Space Transportation Safety	Ops	1,000	0	0	1,000
	Subtotal	**Ops**	1,000	0	0	1,000
	1. Safety TOTAL		**87,055**	**32,686**	**1,344**	**121,085**
2. Economic Competitiveness						
A12.a	Joint Planning and Development Office (JPDO)	RE&D	9,799	2,150	108	12,057
A12.b	NextGen - Wake Turbulence	RE&D	8,673	368	226	9,267
A12.c	NextGen - Air Ground Integration Human Factors	RE&D	9,929	364	36	10,329
A12.d	NextGen - Weather Technology in the Cockpit	RE&D	3,503	618	48	4,169
A14.a	System Planning and Resource Management	RE&D	227	261	24	512
A14.b	William J. Hughes Technical Center Laboratory Facility	RE&D	390	552	32	974
	Subtotal	**RE&D**	32,521	4,312	474	37,308
1A01B	System Capacity, Planning and Improvements	F&E	5,600	0	0	5,600
1A01C	Operations Concept Validation and Infrastructure Evolution	F&E	4,000	0	0	4,000
1A01D	Major Airspace Redesign	F&E	5,000	0	0	5,000
1A07A	Air Traffic Control/Technical Operations Human Factors (Controller Efficiency and Air Ground Integration)	F&E	5,000	0	0	5,000
1A07B	New Air Traffic Management Requirements	F&E	22,000	0	0	22,000
1A07C	Operations Concept Validation Modeling	F&E	5,000	0	0	5,000
1A07D	Environment and Energy - Environmental Management Systems and Advanced Noise and Emissions Reduction	F&E	10,000	0	0	10,000
1A07E	Wake Turbulence - Re-categorization	F&E	1,500	0	0	1,500
1A07F	Safety, Security, Environment – Operational Assessments	F&E	8,000	0	0	8,000
1A07G	Safety, Security, Environment – Systems Safety Management Transformation	F&E	8,000	0	0	8,000
4A08A	Center for Advanced Aviation System Development (CAASD)	F&E	16,450	0	0	16,450
	Subtotal	**F&E**	90,550	0	0	90,550
--	Airport Cooperative Research Program - Capacity	AIP	4,903	97	0	5,000
--	Airport Technology Research Program - Capacity	AIP	11,183	1,424	0	12,607
	Subtotal	**AIP**	16,086	1,521	0	17,607
	2. Economic Competitiveness TOTAL		**139,157**	**5,833**	**474**	**145,465**
4. Environmental Sustainability						
A13.a	Environment and Energy	RE&D	12,295	1,986	261	14,542
A13.b	NextGen - Environmental Research - Aircraft Technologies, Fuels, and Metrics	RE&D	18,394	509	76	18,979
A14.a	System Planning and Resource Management	RE&D	213	244	22	479
	Subtotal	**RE&D**	30,902	2,739	359	34,000
1A07H	Networked Facilities - Staffed NextGen Towers	F&E	2,000	0	0	2,000
	Subtotal	**F&E**	2,000	0	0	2,000
--	Airport Cooperative Research Program - Environment	AIP	4,903	97	0	5,000
--	Airport Technology Research Program - Environment	AIP	1,331	169	0	1,500
	Subtotal	**AIP**	6,234	266	0	6,500
	4. Environmental Sustainability TOTAL		**39,136**	**3,005**	**359**	**42,500**
	GRAND TOTAL		**265,348**	**41,524**	**2,178**	**309,050**

Table 4.2.5: NextGen R&D Funding

2014 BLI	Program	Appropriation Account	2013 CR Annualized ($000)	2014 Request ($000)	2015 Estimate ($000)	2016 Estimate ($000)	2017 Estimate ($000)	2018 Estimate ($000)
NextGen - System Development								
1A07A	Air Traffic Control/Technical Operations Human Factors (Controller Efficiency and Air Ground Integration)	F&E	4,165	5,000	5,400	5,900	6,000	6,500
1A07B	New Air Traffic Management Requirements	F&E	18,320	22,000	19,700	21,700	29,000	33,300
1A07C	Operations Concept Validation Modeling	F&E	4,165	5,000	4,500	4,900	5,000	6,000
1A07D	Environment and Energy - Environmental Management Systems and Advanced Noise and Emissions Reduction	F&E	7,915	10,000	8,900	9,900	10,000	10,900
1A07E	Wake Turbulence - Re-categorization	F&E	1,250	1,500	1,300	1,500	3,000	3,400
1A07F	Safety, Security, Environment – Operational Assessments	F&E	7,000	8,000	7,200	7,900	8,000	8,700
1A07G	Safety, Security, Environment – Systems Safety Management Transformation	F&E	6,250	8,000	7,200	7,900	8,000	9,700
1A07H	Networked Facilities - Staffed NextGen Towers	F&E	2,915	2,000	5,400	5,900	6,000	6,900
	F&E TOTAL	**F&E**	**51,980**	**61,500**	**59,600**	**65,600**	**75,000**	**85,400**
NextGen RE&D								
A11.m	NextGen - Alternative Fuels for General Aviation	RE&D	1,995	5,571	5,663	5,800	5,903	6,040
A11.n	NextGen - Advanced Systems and Software Validation	RE&D	0	1,021	1,039	1,065	1,085	1,111
A12.a	Joint Planning and Development Office (JPDO)	RE&D	5,031	12,057	12,222	12,487	12,684	12,944
A12.b	NextGen - Wake Turbulence	RE&D	10,739	9,267	9,418	9,643	9,813	10,039
A12.c	NextGen - Air Ground Integration Human Factors	RE&D	10,564	10,329	10,455	10,710	10,901	11,157
A12.d	NextGen - Weather Technology in the Cockpit	RE&D	8,049	4,169	4,227	4,321	4,391	4,483
A13.b	NextGen - Environmental Research - Aircraft Technologies, Fuels, and Metrics	RE&D	23,644	18,979	19,296	19,771	20,128	20,606
	RE&D TOTAL	**RE&D**	**60,022**	**61,393**	**62,321**	**63,798**	**64,904**	**66,381**
	NextGen R&D TOTAL		**112,002**	**122,893**	**121,921**	**129,398**	**139,904**	**151,781**

4.3 R&D Evaluation

Since R&D tends to be far-term in nature, it does not lend itself to traditional return-on-investment analysis, such as net present value. The FAA conducts evaluation through formal and informal reviews by internal and external groups.

4.3.1 Internal Portfolio Reviews

The FAA R&D portfolio receives continuous internal review to ensure that it meets customer needs, high quality standards, and management excellence.

R&D Executive Board

The FAA's R&D Executive Board (REB) includes senior executives representing the major FAA R&D sponsors. When R&D portfolio formulation is complete, the REB provides portfolio approval. This process helps the FAA establish research priorities to meet its strategic goals and objectives. To ensure effective engagement with research stakeholders, the REB uses Program Planning Teams comprised of internal sponsors and researchers to review program outcomes and outputs, prioritize and plan research efforts, recommend research priorities and programs, and prepare research portfolios.

Joint Resources Council

The Joint Resources Council (JRC) is the FAA's corporate-level acquisition decision-making body that provides strategic guidance for the R&D portfolio process and ensures that the research requirements support the FAA NAS program. The JRC reviews and approves the proposed R&D portfolio.

4.3.2 External Portfolio Reviews

The FAA R&D portfolio receives periodic external review from advisory committees to ensure that it meets customer needs and is technically sound. The FAA also seeks feedback from the National Academies and through user surveys and discussion groups. Researchers present their progress reports at public forums and science reviews, publish and present technical papers, obtain formal peer validation of science, and maintain and share lessons learned.

Research, Engineering, and Development Advisory Committee

Established in 1989, the REDAC provides advice and recommendations to the FAA Administrator on the needs, objectives, plans, approaches, content, and accomplishments of the aviation research portfolio. The Committee also assists in ensuring FAA research activities are coordinated with other government agencies and industry.[9] The REDAC considers aviation research needs in five areas: NAS operations, airport technology, aviation safety, human factors, and environment and energy. During 2012, the REDAC held two committee meetings and 10 subcommittee meetings and produced two reports documenting their recommendations. The following link provides the recommendations from these reports and the Agency responses. http://www.faa.gov/about/office_org/headquarters_offices/ang/offices/ac_td/research_planning/redac/.

Commercial Space Transportation Advisory Committee

Established in 1984, the Commercial Space Transportation Advisory Committee (COMSTAC) provides information, advice, and recommendations to the FAA Administrator on matters concerning the U.S. commercial space transportation industry. Currently, the Committee has 27 members. Members' professional affiliations constitute a broad cross-section of the commercial space transportation field, including such domains as: commercial expendable and reusable launch vehicle activities, commercial launch site operations, satellite manufacturing and operations, space policy and education, space law, insurance and finance, state government and economic development programs, space advocacy, and trade as well as technical associations. The COMSTAC provides recommendations, findings, and observations concerning commercial space transportation initiatives and may comment as appropriate on R&D reports and activities. For more information, see: http://www.faa.gov/about/office_org/headquarters_offices/ast/advisory_committee/.

Transportation Research Board

The National Research Council established the TRB in 1920 as the National Advisory Board on Highway Research. In 1974, the Board was renamed TRB to reflect its expanded services to all modes of transportation. The TRB mission is to promote innovation and progress in transportation through research. It fulfills this mission through the work of its standing committees and task forces. The TRB manages the ACRP for the FAA with program oversight and governance provided by representatives of airport operating agencies.

The ACRP Oversight Committee announced their FY 2013 projects in August 2012. The selected research projects will examine different research areas that target near-term solutions to problems facing airport operators and industry stakeholders. The projects will report on the state of the practice in critical areas within the industry. These projects include standard subjects in the areas of safety, environment, and capacity. For more information, see: http://www.trb.org/ACRP/Public/.

[9] 49 USC § 44508 - Research advisory committee

Chapter 5
Partnership Activities

The FAA enhances and expands its R&D capabilities through partnerships with other government, industry, academic, and international organizations. Such partnerships help the FAA leverage critical resources and capabilities to ensure that the Agency can achieve its goals and objectives. By partnering with other organizations, the FAA gains access to both internal and external innovators, promotes the transfer of FAA technologies to the private sector for other civil and commercial applications, and expands the U.S. technology base. The FAA uses a variety of partnership mechanisms described in this chapter.

5.1 Federal Government

Other federal departments and agencies conduct aviation-related R&D that directly or indirectly supports the FAA goals and objectives. To leverage this R&D, researchers at the FAA collaborate with their colleagues in government, both foreign and domestic, through cooperative agreements, such as Memoranda of Understanding (MOU), Memoranda of Agreement (MOA), Interagency Agreements, and International Agreements. The FAA also creates partnerships with other agencies through a variety of interagency committees.

5.1.1 Cooperative Agreements

Both MOUs and MOAs support joint research activities between departments or agencies. An MOU is a high-level agreement describing a broad area of research that fosters cooperation between departments or agencies and develops a basis for establishing joint research activities. An MOU does not require either party to obligate funds and does not create a legally binding commitment. An MOA is an agreement describing a specific area of research under a broader MOU that creates a legally binding commitment and may require the obligation of funds. An MOA may include IAs, which are written agreements between the FAA and other agencies in which the FAA agrees to receive or exchange supplies or services with the other agency. International Agreements establish an R&D relationship between the FAA and foreign governments or quasi-governmental entities.

The National Aeronautics and Space Administration (NASA) and the DoD are the FAA's closest R&D partners in the federal government. Both agencies cooperate on research with the FAA through an MOU. The FAA also works closely with the Transportation Security Administration (TSA). FAA provides $5 million per year to the TSA through an MOA that establishes the procedures to conduct research in the areas of intruder detection, baggage screening, and equipment evaluation. The MOA also provides for the ability of the ACRP to provide security research topics to TSA for consideration of funding under this TSA research airport program.

5.1.2 Interagency Committees

The FAA creates partnerships with other agencies through a variety of interagency committees and groups. Some of the interagency committees and groups that the FAA is associated with are described below.

The Federal Interagency Committee on Aviation Noise

The Federal Interagency Committee on Aviation Noise was formed by the FAA in 1993 to provide forums for debate over future research needs to better understand, predict and control the effects of aviation noise, and to encourage new technical development efforts in these areas. For more information, see: http://www.fican.org/.

Global Earth Observation System of Systems

The Global Earth Observation System of Systems (GEOSS) provides an umbrella for 15 federal departments and agencies and several White House offices to work collaboratively to address a wide range of environmental issues, including those pertaining to aviation. These include enhanced weather observation; modeling; and forecasting and air and water quality monitoring, modeling, and emissions. Under GEOSS, the FAA works with the Environmental Protection Agency to address air quality and emissions issues facing aviation. For more information, see: http://www.epa.gov/geoss/.

The U.S. Global Change Research Program

The U.S. Global Change Research Program (USGCRP) began as a presidential initiative in 1989. It was mandated by Congress in the Global Change Research Act of 1990 (P.L. 101-606), which called for "a comprehensive and integrated U.S. research program which will assist the Nation and the world to understand, assess, predict, and respond to human-induced and natural processes of global change." Thirteen federal departments and agencies participate in the USGCRP including the DOT. The FAA contributes by assessing and identifying potential measures to reduce fuel consumption and greenhouse gas emissions and by conducting research to support USGCRP Goal 2, leveraging research with other U.S. Government agencies to reduce uncertainties surrounding aviation emissions and their effect on climate change. For more information, see: http://www.globalchange.gov/.

5.2 Industry

The FAA complies with all applicable federal guidelines and legislation concerning the transfer of technology. The FAA's goal is to transfer knowledge, facilities, equipment, or capabilities developed by its laboratories and R&D programs to the private sector. This helps expand the U.S. technology base and leverage federal R&D investments. The FAA does this through the following groups and mechanisms:

Commercial Aviation Safety Team

Founded in 1998, the Commercial Aviation Safety Team (CAST) has developed an integrated, data-driven strategy to reduce the commercial aviation fatality risk in the U.S. and promote new government and industry safety initiatives throughout the world. The CAST charters working group stakeholders to conduct in-depth analysis of the top accident categories in commercial aviation for which safety enhancements are identified. Successes of CAST prove that the concept of industry and government working together on common commercial air travel accident prevention strategies is highly effective. Members of CAST (not all-inclusive) include Airbus, Boeing, GE Aviation, Air Line Pilots Association, Allied Pilots Association, International Civil Aviation Organization (ICAO), Flight Safety Foundation, International Air Transport Association, European Aviation Safety Authority, FAA, NASA, National Air Traffic Controllers Association, Regional Airline Association, Transport Canada Civil Aviation, and DoD.

General Aviation Joint Steering Committee

As part of the Safer Skies Focused Safety Agenda launched in 1998, the FAA and the GA community agreed to a goal of reducing the overall GA fatal accident rate. The General Aviation Joint Steering Committee (GAJSC), co-chaired by the FAA and the Aircraft Owners and Pilots Association (AOPA) Air Safety Institute, is the primary conduit for government and aviation industry cooperation, communication, and coordination for aircraft accident mitigation. The GAJSC conducts its activities through three working groups: personal/sport aviation, technically advanced aircraft/automation, and turbine aircraft operations. Members of GAJSC include the FAA, AOPA, AOPA Air Safety Institute, Experimental Aircraft Association, General Aviation Manufacturers Association, Helicopter Association International, National Air Transportation Association, National Business Aviation Association, NTSB, and the NWS.

Cooperative Research and Development Agreements

A Cooperative Research and Development Agreement (CRDA) is collaborative in nature and allows the FAA to share facilities, equipment, services, intellectual property, personnel, and other resources with private industry, academia, and state and local government agencies. CRDAs are a highly effective way to meet congressionally mandated technology transfer requirements. For more information, see: http://faa.gov/go/techtran.

Patents Issued through the U.S. Patent and Trademark Office

The FAA encourages its inventors to patent new technologies through the U.S. Patent and Trademark Office. A patent is a grant of a property right and gives the owner the right to exclude anyone else from making, using, or selling the invention. Inventions patented by FAA inventors are available for commercial licensing with royalty payments shared with the inventor and the agency. Legislation allows inventors to receive up to $150,000 per year over their salary from royalty payments. The FAA has identified approximately 60 active patents resulting from FAA funded agreements. These patented technologies are available for use by the government and its contractors on a cost-free basis when used for government purposes. The agency's Technology Transfer Program Office promotes the agency's patents for commercialization. For more information, see: http://faa.gov/go/techtran.

Small Business Innovation Research

These contracts encourage the private sector to invest in long-term research that helps the federal government meet its R&D objectives. Eligible small businesses compete for Phase I contracts to conduct feasibility-related experimental or theoretical research. The government awards a Phase II contract based on the results of Phase I, which is the actual research phase. The government encourages contractors to pursue other funding sources for Phase III and to attract venture capitalists to commercialize the innovation.

Aerospace Vehicle Systems Institute

The Aerospace Vehicle Systems Institute is a cooperative industry, government, and academic venture for investigation and standardization of aerospace vehicle systems to reduce life-cycle cost and accelerate development of systems, architectures, tools, and processes. For more information, see: http://www.avsi.aero/.

5.3 Academia

The FAA has an extensive program to foster research and innovative aviation solutions through the nation's colleges and universities. By doing so, it leverages the nation's significant investment in basic and applied research and helps to build the next generation of aerospace engineers, managers, and operators. The FAA works with academia in three ways: the Joint University Program (JUP), aviation research grants, and Air Transportation Centers of Excellence (COEs).

5.3.1 Joint University Program

The JUP is a research partnership between the FAA and Ohio University, Massachusetts Institute of Technology, and Princeton University. The program aids in the development of a safer and more efficient air transportation system by identifying promising targets for development, conducting long-term research, and educating technological leaders. The FAA and NASA benefit directly from the results of the research and gain valuable feedback from university researchers regarding the goals and effectiveness of government programs. An additional benefit of JUP is the creation of a talented cadre of engineers and scientists who will form a core of advanced aeronautical expertise in industry, academia, and government. For more information, see: http://u2.princeton.edu/~jup/.

5.3.2 Aviation Research Grants

Public Law 101-508 Section 9205 authorizes the FAA to establish research grant programs that encompass a broad spectrum of aviation research activities. These programs encourage and support innovative and advanced research with potential benefit to the FAA mission. All colleges, universities, and other non-profit research institutions qualify for research grants. This FAA program also supports the long-term growth of the aviation industry by encouraging academic institutions to establish and nurture aviation research programs that increase the talent base in aviation.

5.3.3 Air Transportation Centers of Excellence

The FAA recognizes the need to develop the nation's technology base and to concurrently support related outreach goals through the efforts of the next generation of engineers and scientists. To accomplish this, the FAA establishes COEs through long-term cooperative agreements with the nation's universities to conduct research and develop expertise in specific aviation-related technologies. The COE relationships encourage collaboration between government, academia, and industry to advance aviation technologies, and COE universities are legislatively required to match FAA grants, dollar for dollar, through partnerships with industry affiliates and state and local governments. COEs may also receive funds through cost-share contracts.

The cooperative agreement allows the FAA to support a competitively established COE over a period of 10 years after which the agency intends for each entity to become a self-sufficient national aviation resource. Because of the developed expertise, COE members are expected to generate support from others and be able to compete for and conduct research activities with industry and other government entities. By being self-sufficient, the FAA may continue to utilize the COE members while others become the primary stakeholders and provide base funding.

Since the inception of the COE program, the FAA has competitively established 10 COEs and generated more than $250M in matching contributions to help off-set R&D costs. Three of the centers, Computational Modeling of Aircraft Structures, Aviation Operations Research (NEXTOR), and Airworthiness Assurance have satisfied requirements, and NEXTOR continues to operate as a national resource. In 2012, the FAA Administrator concurred with the request to establish a new COE for Alternative Jet Fuels and Environment, and with the addition of the new COE for GA safety team selected by the Administrator in 2012, the FAA currently sponsors seven active centers with academic institutions throughout the United States. These include:

- COE for Commercial Space Transportation
- COE for Research in the Intermodal Transport Environment
- Joint COE for Advanced Materials
- COE Partnership for AiR Transportation Noise and Emissions Reduction
- COE for General Aviation Research
- COE for General Aviation Safety, Accessibility and Sustainability
- COE for Airport Technology

COE for Commercial Space Transportation

On August 18, 2010, the U.S. Secretary of Transportation announced the establishment of the Center of Excellence for Commercial Space Transportation (COE CST) and announced the university team selected by the FAA Administrator. The COE CST is a partnership of academia, industry, and government developed to create a world-class consortium that addresses current and future challenges for commercial space transportation. The COE CST focuses on strategic research, education, and training to support commercial space initiatives over the next decade. The COE CST member universities include the Florida Institute of Technology, Florida State University, the New Mexico Institute of Mining and Technology, New Mexico State University, Stanford University, the University of Central Florida, the University of Colorado at Boulder, the University of Florida, and the University of Texas Medical Branch at Galveston. The COE CST R&D efforts include four major research areas: Space Traffic Management and Operations; Space Transportation Operations, Technologies and Payloads; Human Spaceflight; and Space Transportation Industry Viability. In FY 2012, the COE CST generated more than $2M in matching contributions. The Commercial Space Transportation Safety Program, funded by the Ops budget appropriation, is the FAA R&D Program associated with the COE CST. For more information, see: http://www.coe-cst.org/.

COE for Research in the Intermodal Transport Environment

In 2004, the FAA Administrator selected the COE for Airliner Cabin Environment Research with Harvard University and Purdue University as the technical leads and Auburn University as the administrative lead. Following the Phase I evaluation, the COE expanded scope from airliner cabin research activities to include the intermodal transport environment. In 2008, it was renamed the COE for Research in the Intermodal Transport Environment (RITE). This COE conducts R&D on cabin air quality, chemical and biological threats, and related topics. The FAA expects this COE to become self-sufficient by 2014 and has entered into seven final cooperative agreements with members in preparation for the COE transition. The current team includes the COE administrative lead, Auburn University, the new technical lead, Kansas State University, and member universities: Harvard University, Purdue University, Boise State University, the University of California at Berkeley, and the University of Medicine and Dentistry of New Jersey. This center generated matching contributions in excess of $1.7M in FY 2012. The Aeromedical Research Program, funded by the RE&D budget appropriation, is the FAA R&D Program associated with RITE. For additional information, see: http://www.acer-coe.org/.

Joint COE for Advanced Materials

In 2003, the FAA Administrator selected the Joint COE for Advanced Materials (JAMS) with the University of Washington and Wichita State University as the lead members. This COE conducts R&D on material standardization and shared databases, bonded joints, structural substantiation, damage tolerance and durability, maintenance practices, advanced material forms and processes, cabin safety, life management of materials, and nanotechnology for composite structures. Together with the lead members, the FAA entered into twelve extended COE cooperative agreements with member universities: Edmonds Community College, Northwestern University, Oregon State University, Purdue University, University of California at Los Angeles, University of Delaware, Florida International University, University of Utah, Tuskegee University, and Washington State University. This center generated matching contributions in excess of $2M in FY 2012. The Advanced Materials/Structural Safety Program, funded by the RE&D budget appropriation, is the FAA R&D Program associated with JAMS. For additional information, see http://www.jams-coe.org/.

COE Partnership for AiR Transportation Noise and Emissions Reduction

In 2003, the Administrator selected the COE Partnership for AiR Transportation Noise and Emissions Reduction (PARTNER) with Massachusetts Institute of Technology as the lead member. This FAA COE is co-sponsored by NASA and Transport Canada and conducts R&D to identify, understand, measure, and mitigate the impacts of aircraft noise and aviation emissions. PARTNER seeks to reduce uncertainty in issues dealing with climate impact and the health and welfare effects of emissions to actionable levels. The FAA expects this COE to become self-sufficient by FY 2013. Funded through both grants and contract awards, member universities include: Harvard University, Pennsylvania State University, Purdue University, Stanford University, Missouri University of Science and Technology (formerly University of Missouri - Rolla), University of North Carolina - Chapel Hill, Georgia Institute of Technology, the University of Illinois, Boston University, and the University of Pennsylvania. This center generated matching contributions in excess of $6.5M in FY 2012. For additional information, see http://web.mit.edu/aeroastro/partner/.

COE for General Aviation Research

Established in 2001, Embry-Riddle Aeronautical University has served as the lead member for the COE for General Aviation Research. This COE conducts safety-related R&D with application to non-commercial aviation in the following areas: NextGen ADS-B, weather technology in the cockpit, safety management systems, remote airport lighting systems, training standards, and unmanned aircraft systems. The FAA issued extensions to each of the four cooperative agreements to allow an adequate transition for orderly phase down during 2013. Funded through both grants and contract awards, core university members include Wichita State University, University of North Dakota, and the University of Alaska - Fairbanks and Anchorage**.** This center generated matching contributions in excess of $1M in FY 2012. For additional information, see http://www.cgar.org/.

COE for General Aviation Safety, Accessibility and Sustainability

On September 27, 2012, the U.S. Secretary of Transportation announced the selection of the new COE for the general aviation team, the Partnership to Enhance General Aviation Safety, Accessibility and Sustainability. This COE will be fully operational in 2013 and will focus on the following GA topic areas: flight safety; communication, navigation and surveillance; human factors; weather; airport technology; propulsion and structures; continued airworthiness; system safety management, and other GA research areas. For additional information, see https://www.pegasas.aero/.

COE for Airport Technology

In 1995, the Administrator selected the COE for Airport Pavement Research with the University of Illinois at Urbana-Champaign as the lead member and North Carolina A&T University as a participating member. This COE initially focused on pavement issues. In 2005, Rensselaer Polytechnic Institute joined the COE and the FAA expanded the scope to include R&D on wildlife hazard mitigation, lighting, and other airport safety topics, and the COE changed its name to the Center of Excellence for Airport Technology. This COE became self-sufficient in 2012 and has generated matching contributions in excess of $21M since inception. For further information, see http://www.ceat.uiuc.edu/.

5.4 International

The FAA uses cooperative agreements with European and North American aviation organizations to participate in aviation safety and ATM modernization programs and to leverage research activities that harmonize operations and promote a seamless and safe air transportation system worldwide.

The European Organisation for the Safety of Air Navigation

The European Organisation for the Safety of Air Navigation (EUROCONTROL) is a civil and military organization with the goal of developing a seamless, pan-European ATM system. In 1986, EUROCONTROL and the FAA established the first memorandum of cooperation (MOC), which they updated in 1992 and again in 2004. The aim of the MOC and its governance structure is to broaden the scope of the cooperation between the two organizations and their respective partners in the areas of ATM research, strategic ATM analysis, technical harmonization, operational harmonization, and safety and environmental factor harmonization. For more information, see: http://www.eurocontrol.int/.

Atlantic Interoperability Initiative to Reduce Emissions

Established in 2007, the Atlantic Interoperability Initiative to Reduce Emissions (AIRE) provides a foundation for cooperation between the FAA and the European Commission to promote and harmonize environmental initiatives and procedures in European and North American airspace. In addition to facilitating transatlantic interoperability between aviation authorities and industry partners, such as aircraft manufacturers, air operators, and providers of aviation navigation services, AIRE promotes information sharing and demonstration of procedures and practices that reduce noise and environmental emissions. Demonstrations have occurred annually since 2008 and include optimizations in all phases of flight: airport surface, terminal area, and en route oceanic. Demonstrations have resulted in savings in fuel and emissions across all three of these domains. For more information, see: http://ec.europa.eu/transport/modes/air/environment/aire_en.htm.

Transport Canada

In the spring of 2004, Transport Canada joined FAA and NASA as a sponsor of the PARTNER COE. Transport Canada has studied and will continue to study air quality at Canadian airports to develop and implement practices that reduce air pollution from airports. Canada, as a member state of the ICAO, works to reduce smog-forming pollutants from the aviation sector and participates in the COE partnership to advance the state of knowledge in many key areas. For additional information, see http://www.tc.gc.ca/eng/menu.htm.

The Asia and Pacific Initiative to Reduce Emissions

The Asia and Pacific Initiative to Reduce Emissions (ASPIRE), established in 2008, is a partnership of Asian and Pacific ANSPs focused on environmental stewardship in the Pacific Ocean region. Under ASPIRE, current and future partners pledge to adopt and promote best practices to reduce fuel consumption and engine emissions. ASPIRE demonstrations have consisted of green flights that use existing efficiency procedures in an ideal, unconstrained air traffic environment. As a result of these successful demonstration flights, ASPIRE-Daily was launched in 2011 to promote the use of best practices such as user-preferred routing, Dynamic Airborne Reroute Procedures, and optimizations during arrival and departure between selected city pairs to promote daily fuel-savings. For more information, see: http://www.aspire-green.com/.

International Helicopter Safety Team

Attendees at the 2005 International Helicopter Safety Symposium agreed upon the need to reduce the helicopter accident rate by 80 percent by 2016. To achieve this goal, the attendees agreed to form an independent group known as the International Helicopter Safety Team (IHST).
The IHST is co-chaired by the FAA and industry. Major industry participants include the Helicopter Association International, the American Helicopter Society International, the Helicopter Association of Canada, Bell Helicopter, Sikorsky Helicopter, Eurocopter, Shell Aircraft, CHC helicopter, and AgustaWestland. IHST members also established international partnerships in countries with significant helicopter operations and worked to encourage the overseas industries to carry out accident analysis and develop safety interventions. Worldwide partners now supporting the work of the IHST include government and industry participants from the United States, Canada, Brazil, Japan, Australia, India, Russia, and multiple countries in Europe and in the Middle East/North Africa region. To facilitate a data-driven approach to safety, the IHST initiates joint government and industry teams to analyze accidents, conduct causal analyses, and recommend intervention implementation strategies. While completing these analyses of helicopter accidents and their causes, the IHST and its worldwide partners develop safety toolkits, instructional and educational safety videos, and specific safety recommendations aimed at helping members of the helicopter industry enhance their safety practices and reduce the accident rate. By the end of 2012, the accident rate had been reduced 30 percent since 2001-2005. For more information, see: http://www.ihst.org/Default.aspx?tabid=1507&language=en-US.


American
American

Acronyms and Abbreviations

Acronym	Definition
1-9	
4D	Four-Dimensional
A	
AA-IADS	Aerospace Accident Injury and Autopsy Data System
AC	Advisory Circular
ACAS-X	Airborne Collision Avoidance System X
ACCRI	Aviation Climate Change Research Initiative
ACRP	Airport Cooperative Research Program
ADS-B	Automatic Dependent Surveillance-Broadcast
AEDT	Aviation Environmental Design Tool
AEROS	Airport Emergency Response Operations Simulation
AIP	Grants-In-Aid for Airports Appropriation
AIRE	Atlantic Interoperability Initiative to Reduce Emissions
ANSP	Air Navigation Service Provider
AOPA	Aircraft Owners and Pilots Association
APM	Automated People Mover
ASIAS	Aviation Safety Information Analysis and Sharing
ASPIRE	Asia and Pacific Initiative to Reduce Emissions
ATC	Air Traffic Control
ATDP	Advanced Technology Development and Prototyping
ATM	Air Traffic Management
ATO	Air Traffic Organization
ATRP	Airport Technology Research Program
B	
BOS	Boston Logan International Airport
C	
CAASD	Center for Advanced Aviation System Development
CAST	Commercial Aviation Safety Team
CDTI	Cockpit Display of Traffic Information
CJ	Congressional Justification
CLEEN	Continuous Lower Energy, Emissions and Noise
CO_2	Carbon Dioxide
COE	Center of Excellence
COE CST	Center of Excellence for Commercial Space Transportation
COMSTAC	Commercial Space Transportation Advisory Committee
CR	Continuing Resolution
CRDA	Cooperative Research and Development Agreement

Acronym	Definition
CVF	Ceiling and Visibility Forecast
D	
DARWIN®	Design Assessment Of Reliability With Inspection
Data Comm	Data Communications
DFW	Dallas/Fort Worth International Airport
DoD	U.S. Department of Defense
DOT	U.S. Department of Transportation
E	
EDR	Eddy Dissipation Rate
eFAROS	Enhanced Final Approach Runway Occupancy Signal
EMS	Environmental Management System
EUROCONTROL	European Organisation for the Safety of Air Navigation
F	
F&E	Facilities and Equipment Appropriation
FAA	Federal Aviation Administration
FAARFIELD	FAA Rigid and Flexible Iterative Elastic Layered Design
FCI	Future Communications Infrastructure
FY	Fiscal Year
G	
GA	General Aviation
GAJSC	General Aviation Joint Steering Committee
GEOSS	Global Earth Observation System of Systems
GSE	Ground Support Equipment
GTG	Graphical Turbulence Guidance
H	
H_2O_2	Hydrogen Peroxide
HAP	Hazardous Air Pollutants
HSI	Human-System Integration
I	
ICAO	International Civil Aviation Organization
IHST	International Helicopter Safety Team
IROPS	Irregular Operations
ISAM	Integrated Safety Assessment Model
ITS	Intelligent Transportation Systems
J	
JAMS	Joint COE for Advanced Materials
JPDO	Joint Planning and Development Office
JRC	Joint Resources Council
JUP	Joint University Program

Acronym	Definition
L	
LCGS	Low Cost Ground Surveillance
LDACS	L-band Digital Aviation Communications System
LED	Light-Emitting Diode
M	
MANTRA	Medical Analysis TRAcking
MAP	Mutual Aid Program
MEM	Memphis International Airport
MOA	Memorandum/a of Agreement
MOC	Memorandum/a of Cooperation
MOU	Memorandum/a of Understanding
N	
N_2O	Nitrous Oxide
NARP	National Aviation Research Plan
NAS	National Airspace System
NASA	National Aeronautics and Space Administration
NextGen	Next Generation Air Transportation System
NEXTOR	National Center of Excellence for Aviation Operations Research
NOx	Nitrogen Oxide
NSTC	National Science and Technology Council
NTSB	National Transportation Safety Board
NWS	National Weather Service
O	
OMB	Office of Management and Budget
Ops	Operations Appropriation
OSHA	U.S. Occupational Safety and Health Administration
OST	Office of the Secretary of Transportation
P	
PAPI	Precision Approach Path Indicator
PARTNER	Partnership for AiR Transportation Noise and Emissions Reduction
PBN	Performance-Based Navigation
PoD	Probability of Detection
R	
R&D	Research and Development
RA	Resolution Advisory
RE&D	Research, Engineering and Development Appropriation
REB	Research and Development Executive Board
REDAC	Research, Engineering, and Development Advisory Committee
RIL	Runway Intersection Lights

Acronym	Definition
RITE	COE for Research in the Intermodal Transport Environment
RNAV	Area Navigation
RNP	Required Navigation Performance
RTCA	Radio Technical Commission for Aeronautics
S	
SAA	Sense and Avoid
SAVI	System Architecture Virtual Integration
SESAR	Single European Sky ATM Research
SEVS	Synthetic Vision Systems and Enhanced Flight Vision Systems
SFO	San Francisco International Airport
SNT	Staffed NextGen Towers
SSRI	Selective Serotonin Reuptake Inhibitors
SWIM	System Wide Information Management
T	
TBO	Trajectory-Based Operations
TCAS	Traffic Alert and Collision Avoidance System
TFM	Traffic Flow Management
TRB	Transportation Research Board
TSA	Transportation Security Administration
U	
UAS	Unmanned Aircraft System
U.S.	United States
U.S.C	United States Code
USGCRP	U.S. Global Change Research Program

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