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Federal Aviation Administration
National Aviation Research Plan

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Table of Contents

Executive Summary ..... **i**

1.0 FAA R&D Program Overview **1-1**

1.1 National Aviation Research Plan (NARP) *1-1*

1.2 FAA R&D – New Challenges and New Solutions *1-1*
1.2.1 Long Term – National Plan for Transforming the Air Transportation System 1-2
1.2.2 Mid Term – Technical and Financial Planning 1-2
1.2.2.1 NAS Architecture 1-2
1.2.2.2 NAS Capital Investment Plan (CIP) 1-2
1.2.2.3 Operational Evolution Plan (OEP) 1-3
1.2.2.4 Target System Description (TSD) 1-3
1.2.3 Near Term – FAA Flight Plan 2004-2008 1-3

1.3 R,E&D Advisory Committee (REDAC) *1-3*

1.4 FAA/NASA Program Coordination *1-3*

1.5 R&D Reporting *1-4*

1.6 FY 2005 R&D Funding *1-4*

1.7 FAA R&D Strategic Plan *1-4*
1.7.1 R&D Issues, Challenges, and Opportunities 1-4
1.7.2 R&D Planning Framework 1-6

1.8 FAA R&D Program Structure *1-7*

1.9 FAA R&D Performance Structure *1-9*
1.9.1 William J. Hughes Technical Center 1-9
1.9.1.1 Ongoing WJHTC Research Involvement 1-9
1.9.1.2 R&D Partnerships 1-10
1.9.1.2.1 Working with Industry 1-10
1.9.1.2.2 Working with Government Partners 1-11
1.9.1.2.3 Working with Partners in Academia 1-11
1.9.2 Civil Aerospace Medical Institute 1-11
1.9.3 Centers of Excellence 1-13
1.9.3.1 Center of Excellence for Advanced Materials 1-13
1.9.3.2 Center of Excellence for Aircraft Noise and Aviation Emissions Mitigation .. 1-13
1.9.3.3 Center of Excellence for General Aviation 1-13
1.9.3.4 Center of Excellence for Airworthiness Assurance 1-13
1.9.3.5 Center of Excellence for Operations Research 1-13
1.9.3.6 Center of Excellence for Airport Technology 1-14
1.9.4 International Activity 1-14

1.10 Long-Term Research *1-14*

2.0 Program Information 2-1

2.1 Aviation Safety Research and Development Goal Area Description 2.1-1
Advanced Materials / Structural Safety 2.1-6
Aeromedical Research 2.1-11
Aging Aircraft 2.1-17
Air Traffic Control / Airway Facilities Human Factors 2.1-22
Aircraft Catastrophic Failure Prevention Research 2.1-28
Airports Technology – Safety 2.1-33
Atmospheric Hazards / Digital Systems Safety 2.1-37
Aviation Safety Risk Analysis 2.1-43
Commercial Space Transportation Safety 2.1-49
Fire Research and Safety 2.1-56
Flightdeck / Maintenance System Integration Human Factors 2.1-61
General Aviation and Vertical Flight Technology (GA&VF) 2.1-67
NAS Safety Assessments 2.1-72
Propulsion and Fuel Systems 2.1-76
Runway Incursion Reduction 2.1-81
Safe Flight 21 – Alaska Capstone 2.1-84
Safer Skies 2.1-88
Weather Program – Safety 2.1-92

2.2 Aviation Capacity Research and Development Goal Area Description 2.2-1
Airports Technology – Capacity 2.2-6
Automatic Dependent Surveillance – Broadcast (ADS-B) 2.2-10
Aviation System Capacity Improvement (ASCI) 2.2-14
Center for Advanced Aviation System Development (CAASD) R&D Program 2.2-19
Domestic Reduced Vertical Separation Minima (DVRSM) 2.2-23
Environment and Energy 2.2-27
NAS Requirements Development 2.2-35
National Plan for Transformation for Air Transportation 2.2-38
Operations Concept Validation 2.2-42
Safe Flight 21 – Ohio River Valley 2.2-47
Separation Standards 2.2-53
Wake Turbulence 2.2-58

2.3 Operational Excellence in Aviation Research and Development Goal Area Description 2.3-1
Systems Planning and Resource Management 2.3-4
William J. Hughes Technical Center Laboratory Facility 2.3-8

APPENDIX A – Research Engineering and Development Advisory Committee.....A-1
Recommendations on Fiscal Year 2005 R&D Investments, dated December 3, 2002 ..... A-2
Committee/Subcommittee Guidance on Fiscal Year 2005-2009 R&D Investments, dated June 3, 2003..... A-8
Report on Recommendations for Aviation Communications Research Investments, dated June 3, 2003..... A-17
Joint Recommendations from NASA's Aerospace Technology Advisory Committee and FAA's R,E&D Advisory Committee on the Joint Planning Office Status, dated September 23, 2003 ..... A-19

APPENDIX B – Alphabetical Listing of National Aviation Research Plan Budget Line Items B-1

APPENDIX C – Numerical Listing of National Aviation Research Plan Projects C-1

APPENDIX D – Acronyms and Abbreviations D-1

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Executive Summary

Purpose

An Executive Summary has been added to the 2004 *National Aviation Research Plan* (NARP) to highlight significant changes since last year, either to FAA R&D or to the NARP itself.

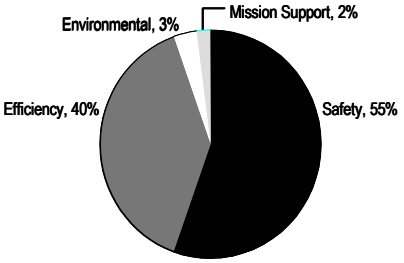
R&D and Related FAA Strategic Planning Efforts

Section 1.2 of the 2004 NARP Overview briefly describes the temporal relationship between R&D planning, the FAA's near-term mission goals, as stated in *Flight Plan 2004-2008*, and longer-term planning efforts, including the NAS Architecture, the NAS Capital Investment Plan (CIP), the Operational Evolution Plan (OEP), the Target System Description (TSD), and the newly-established Joint Planning Office (JPO). The *R&D Strategic Plan*, described in Overview Section 1.7 positions agency research programs to identify and develop technology solutions for implementation fifteen years or more into the future. In its 2002 version, this document was known as the *R&D Strategy*. A major update to the plan is being prepared for release later this year. The updated document will present a conceptual framework that responds to both the near-term strategic goals of the agency and the longer-term requirements characteristic of R&D.

Changes to R&D Funding

Figure ES-1 shows new directions in FAA R&D funding for FY 2005. Total funding has decreased by nearly $2M. Airports technology funds previously requested in the Airport Improvement Program (AIP) appropriation are now requested through the Facilities and Equipment (F&E) appropriation. The strategic goal structure, against which accomplishments are to be reported, now merges environmental concerns into a Greater Capacity goal rather than the former Environmental Compatibility enabling goal. The percentage of funding now directed toward increasing NAS capacity, with proper attention to the environment, has decreased to 40% from the 43% previously shared by the Efficiency and Environmental goals. Safety programs have increased their share of funding from 55%, to 58%. The small percentage of funding (2%) that was spent on Mission Support in FY 2004 will now be associated with achieving the agency's new goal for Organizational Excellence.

Applicable Goal or Activity	FY 2004 Level (R,E&D)	FY 2004 Level (F&E)	FY 2004 Level (AIP)	Total FY 2004 Level
Safety	$ 87,039,000	$ 35,400,000	$ 9,667,000	$ 132,106,000
Efficiency	$ 50,848,000	$ 35,700,000	$ 7,750,000	$ 94,298,000
Environmental	$ 7,975,000	$ 0	$ 0	$ 7,975,000
Mission Support	$ 4,686,000	$ 0	$ 0	$ 4,686,000



Applicable Goal or Activity	FY 2005 Level (R,E&D)	FY 2005 Level (F&E)	Total FY 2005 Level
Increased Safety	$ 88,932,000	$ 47,800,000	$ 136,732,000
Greater Capacity	$ 23,404,000	$ 72,560,240	$ 95,964,240
Operational Excellence	$ 4,664,000	$ 0	$ 4,664,000

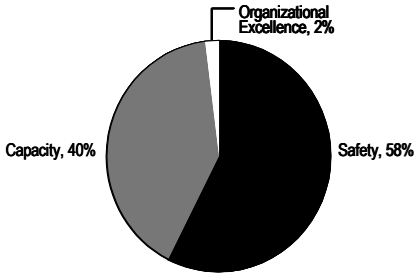


Figure ES-1: Sources of FY 2004 and 2005 R&D Funding and Relative Percentages Directed Toward FAA Mission Goals

Programs Added

Three programs are reported in Section 2.2, Greater Capacity, of 2004 NARP that did not appear separately last year:

- *National Plan for the Transformation of Air Transportation* – This program is funded through the R,E&D appropriation. It enables FAA involvement in the inter-departmental Joint Planning Office, with its mandate to prepare a vision for future air transportation that will allow the nation to remain a highly mobile society and a leader in aviation within the global marketplace.
- *Wake Turbulence* – This program is also funded through the R,E&D appropriation. It enables the FAA to build upon previous efforts to develop technologies that can improve on-time arrival performance metrics by at least one percentage point per year.
- *Automatic Dependent Surveillance – Broadcast (ADS-B)* – This program is funded through the Safe Flight 21 Program in the F&E appropriation. It enables the FAA to continue working to further develop and demonstrate the effectiveness of technologies that derive the position and velocity of equipped aircraft operating in terminal, en route, and oceanic airspace.

Programs Deleted

Five programs do not appear in this document either because they are not receiving funding in FY 2005 or because they have evolved into full programs within the Ops Appropriation:

- Airspace Management Laboratory
- Software Engineering
- Cyber Security for NAS Development
- Required Navigation Performance (RNP) [Ops Appropriation]
- Priority Research Program of Free Flight Phase 2

1.0 FAA R&D Program Overview

1.1 National Aviation Research Plan (NARP)

Delivery of the 2004 NARP fulfills the annual reporting requirement placed upon the Federal Aviation Administration by Section 44501(c) of the United States Code, to: "*...prepare and publish annually a national aviation research plan and submit the plan to the Committee on Commerce, Science, and Transportation of the Senate and the Committee on Science of the House of Representatives.*"

This Overview provides insight into FAA research activities and their relationship to the agency's mission and goals. An Executive Summary has been added to highlight program changes from previous years. In the body of the NARP, individual program descriptions are grouped and described according to the mission needs of the goal areas.

The five year planning cycle described in the 2004 *NARP* spans Fiscal Years 2005 through 2009. Current projections of costs and associated research activities for these years are provided in the program schedules that follow individual project descriptions.

FAA R&D is funded annually by Congress, primarily through the FAA Research, Engineering and Development (R,E&D) Appropriation, but also through the Facilities and Equipment (F&E), and Operations (Ops) Appropriations. Appendixes B and C classify R&D projects by their funding source.

1.2 FAA R&D – New Challenges and New Solutions

The National Airspace System (NAS) is operating in a period of reduced demand. While forecasts have varied as to precisely when demands for aviation services will return to previous levels, within a year or two, expanding NAS capacity is generally expected to re-emerge as an urgent national priority.

In March of 2003, the FAA Aerospace Forecasts: Fiscal Years 2003-2014[1] predicted:

- Both U.S. large carrier domestic and international passenger traffic will achieve positive growth in 2003, with international markets growing significantly faster than domestic markets (4.7 versus 3.5 percent annually) over the 12-year forecast period.
- Combined aviation activity at FAA and contract facilities will grow at rates of 1.7 percent annually over the 12-year forecast period.

The FAA's new strategic plan, *Flight Plan 2004-2008*, [2] acknowledges that the 21st Century poses challenges that "demand nothing less than transforming the system." In building the new NAS, the agency will strive to achieve:

- Increased Safety,
- Greater Capacity,
- International Leadership, and
- Organizational Excellence.

In *Securing the Future of U.S. Air Transportation: A System in Peril,*[3] the National Research Council looks at these challenges, specifically addresses the crucial role of R&D in preparing new aviation technologies, and cautions that researchers must not work apart from visionaries and planners: "Research should be guided by a consistent set of system performance requirements, operational concepts, system architectures, and implementation plans."

Several mutually supportive planning efforts, concentrating on varying timeframes, are underway at the FAA to bring vision and discipline to the agency's R&D.

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[1] Available on the Internet at: http://www.api.faa.gov/foreca02/2003tab/EXECSUM.doc.
[2] Available on the Internet at: http://www2.faa.gov/apo/strategicplan/FAA_Flight_Plan.pdf.
[3] Available on the Internet at: http://www.nap.edu/books/0309090709/html.

1.2.1 Long Term – National Plan for Transforming the Air Transportation System

In its final report, released on November 18, 2002, the Commission on the Future of the United States Aerospace Industry offered the following recommendation to the White House:

> *The Administration should immediately create a multi-agency task force … assigned the leadership role to establish a Next Generation Air Transportation System Joint Program Office that brings together needed participation from the FAA, NASA, DoD, Office of Homeland Security, National Oceanographic and Atmospheric Administration, and other government organizations.*[4]

Administrator Marion Blakey has repeatedly assured members of the aviation community that, as a complement to the agency's participation on the newly established Joint Planning Office (JPO), the FAA welcomes their help and resources in transforming the nations air transportation system to meet the needs of the 21st Century.

The new JPO is comprised of a small staff and senior executives who serve as liaisons to the Departments of Commerce, Department of Transportation, Department of Defense and Department of Homeland Security and the National Aeronautics and Aerospace Administration. The Office operates as change agents and innovators selected from among the partner agencies as a catalyst: challenging its member agencies to examine the opportunities for transformation and engaging the Senior Policy Committee on forward thinking policies. The JPO is ultimately accountable to the Senior Policy Committee, and reports directly to the FAA Administrator for delivery of required materials including but not limited to the "National Plan," policy recommendations, and national positions.

1.2.2 Mid Term – Technical and Financial Planning

Over the past generation at the FAA, an inter-related set of technical and financial plans and controls has evolved to focus agency programs and investments upon targets varying from five to approximately fifteen years into the future. Each of these documents acknowledges its debt to contributions from the aviation community, particularly from the *National Airspace System Concept of Operations and Vision for the Future of Aviation,*" published and updated by RTCA.[5]

1.2.2.1 NAS Architecture

The FAA forecasts future air travel demand and resulting agency workload to gauge the size and complexity of systems that will be needed for the agency to continue its mission. Drawing on these estimates and the latest "Concept of Operations," planners decide upon and configure many types of required systems and software, and they establish a schedule for the products' development and implementation. This detailed path to modernization is the *NAS Architecture*, now available on the Internet in Version 5.[6]

1.2.2.2 NAS Capital Investment Plan (CIP)

In implementing the systems called for in the *NAS Architecture*, the FAA continually ensures that its investments are managed to keep pace with advances in technology. Since FY 2000, these investments have been priced and defended, on a line-item basis, in the five-year *NAS Capital Investment Plan* submitted annually with the President's Budget. The CIP submitted to Congress in February 2004 forecasts system investments through September 2008.[7]

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[4] From the "Executive Summary," page vii, available on the Internet at: http://www.aerospacecommission.gov/AeroCommissionFinalReport.pdf.
[5] Available from RTCA at: http://www.rtca.org.
[6] Available on the Internet at: http://www.nas-architecture.faa.gov/cats/.
[7] Available on the Internet at: http://www2.faa.gov/asd/cip04/CIP04-08Complete_Internet.pdf.

1.2.2.3 Operational Evolution Plan (OEP)

The first OEP was published by the FAA in 2003 to engage all segments of the aviation community (including the airlines, cargo carriers, airports, manufacturers, general aviation, DoD, NASA, and the National Weather Service) in creating a "rolling ten-year plan" that will increase the capacity and efficiency of the NAS without compromising safety, security, or proper attention to the environment. This cooperative approach has already increased arrival and departure rates, decreased en route congestion, and improved flight during unfavorable conditions affecting operations at airports and en route. The current OEP applies to operations through 2013.[8]

1.2.2.4 Target System Description (TSD)

The Joint Concept of Operations published by RTCA in 2003 describes an air traffic control system envisioned for the year 2020 – slightly short of the JPO planning goal of 2025 and beyond. The FAA has announced its intentions to produce a TSD of systems that will complement the *NAS Architecture* and extend its projections into a more visionary time frame. Over the next two years, the TSD effort will develop the structure, analyze potential benefits, and clarify evolutionary steps that will update the Architecture to the year 2015.

1.2.3 Near Term – FAA Flight Plan 2004-2008

Shortly after the FY 2004 President's Budget went to Congress, Administrator Blakey announced work on the FAA *Flight Plan 2004-2008*. Now available, this plan retains safety as the agency's highest goal and makes a strong commitment to specific programs with strong potential to improve all aspects of aviation safety. The plan also folds the agency's existing commitment to preserving the environment into a goal now named capacity rather than efficiency. Significantly, the Administrator has pledged to community groups that this plan has been costed out, and "will be followed."

1.3 R,E&D Advisory Committee (REDAC)

Established by Congress in 1989, the REDAC reports to the FAA Administrator on research and development issues and provides a liaison between the agency's R&D program and similar efforts within industry, academia, and other government agencies. The committee considers aviation research requirements in air traffic services, airport technology, aircraft safety, aviation information security, human factors, and the environment.

A maximum of thirty members serve on the REDAC for alternating two-year terms. They represent corporations, universities, associations, consumers, and other government agencies. The full committee meets twice during the year, typically in April and in September.

Recent REDAC recommendations appear in Appendix A of the NARP.

1.4 FAA/NASA Program Coordination

NASA's Aero-Space Technology Advisory Committee and the REDAC conduct joint meetings to assess and improve support to inter-agency R&D modernization goals in the areas of improving safety and improving capacity in an environmentally sound manner.

Since 1980, the FAA and NASA have provided members to a common R&D coordinating committee. In 1998, that committee was restructured into the "FAA/NASA Executive Committee" and was charged with the coordination of all joint R&D efforts. Many joint efforts are coordinated by the FAA/NASA Interagency Air Traffic Management (ATM) Integrated Product Team (IAIPT), as described in the introductory material to sections 2.1 and 2.2 of the NARP.

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[8] Available on the Internet at: http://www2.faa.gov/programs/oep/

According to the agreement that created the new committee, the role of NASA in national aviation R&D is to perform research, development, verification, and transfer activities on technologies offering potential for long and short-term NAS improvement. The FAA's complementary R&D role is to select and prepare identified technologies for introduction into the NAS. FAA research provides the technology base and analyses, as well as the regulations and procedures, required for the evolving NAS; FAA also conducts limited research to refine relatively mature systems for specific uses. The activities of the FAA/NASA Interagency Air Traffic Management Integrated Product Team, described in the introduction to Section 2.2 of the NARP, coordinate environmentally sound research and implementation projects between the agencies with the shared goal of improving NAS capacity.

1.5 R&D Reporting

In 2002, the FAA *Research and Development Highlights* was first published to bring public attention to recent and cumulative accomplishments of the agency's R&D programs. This publication now appears annually as the FAA *R&D Annual Report*.

1.6 FY 2005 R&D Funding

Figure 1-1 shows the appropriation sources of requested FY 2005 R&D funding and the relative percentages of the funds directed toward meeting FAA strategic goals. A small, Headquarters-based R&D Mission Support activity is also associated with the agency's new goal of achieving Organizational. Excellence.

Applicable Goal or Activity	FY 2005 Level (R,E&D)	FY 2005 Level (F&E)	Total FY 2005 Level
Increased Safety	$ 88,932,000	$ 47,800,000	$ 136,732,000
Greater Capacity	$ 23,404,000	$ 72,560,240	$ 95,964,240
Operational Excellence	$ 4,664,000	$ 0	$ 4,664,000

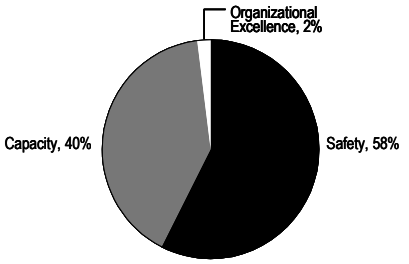

Figure 1-1: Sources of FY 2005 R&D Funding and Relative Percentages Directed Toward FAA Mission Goals

1.7 FAA R&D Strategic Plan

In September of 2002, the Office of Aviation Research published the first issue of the *R&D Strategy* to guide research activities addressing FAA needs extending from the present until at least ten to fifteen years into the future. The 2004 update to that publication, renamed the *R&D Strategic Plan*, will present a revised planning framework based on the agency's new *Flight Plan 2004-2008* mission goals as well as other key program and policy documents relevant to future research needs.

1.7.1 R&D Issues, Challenges, and Opportunities

The 2002 *R&D Strategy* associates research challenges with FAA strategic goals to improve aviation safety and efficiency, as well as the enabling goal to improve the compatibility of aviation activities with the environment. *Flight Plan 2004-2008* incorporates the environmental goal into its goal for achieving greater capacity for the NAS. The following 2002 research and development concerns map readily to the agency's new strategic goal structure.

Ongoing R&D Issues Related to the Flight Plan 2004-2008 Goal for Increased Safety:

- Reduce the potential for terminal area and airport surface collisions
- Introduce and certify new technologies, with special emphasis on software reliability and failure modes in critical highly automated applications
- Research new concerns associated with aging aircraft, e.g., mechanical and electrical systems, and "aging software," particularly in embedded systems
- Research human factors issues regarding the integration of increased flightdeck and ground automation
- Research new human-centered designs in cockpit/flightdeck and air traffic control and management systems
- Clarify the roles and responsibilities of flight crews and controllers in high-technology automation-rich environments
- Collect and analyze safety-relevant operational data
- Introduce new technologies with possible new failure modes
- Define the unintended adverse safety consequences associated with security countermeasures
- Anticipate an increase in the numbers of commercial space launches and landings, and associated sites, and increased complexity of space launch vehicles
- Protect, detect, respond and recover from malicious cyber attacks (Note: There is an integral relationship between the FAA's safety and security goals and the R&D required to achieve them.)
- Minimize accidents associated with icing, convection, ceiling, and reduced visibility
- Mitigate risk from bird and wildlife strikes
- Improve airport rescue and firefighting capabilities

Ongoing R&D Issues Related to the Flight Plan 2004-2008 Goal for Greater Capacity:

- Reduce system delays
- Improve system performance in bad weather, especially low ceilings and visibility
- Increase the flexibility and adaptability of system architecture to allow for data sharing to support collaborative decision making and common situational awareness
- Increase system capacity to meet domestic and global demand in an environmentally sound manner
- Improve the rate of technical and procedural evolution of the air traffic management system through:
  - Implementation
  - Human performance and limitations
- Improve pavement design and construction standards
- Provide air traffic services for a wider range of aircraft—dirigibles, unmanned air vehicles, next-generation general aviation aircraft, high-performance business jets, jumbo airliners, space vehicles, and payloads
- Update and apply satellite-based navigation and positioning system technology, and ensure the FAA's role in shaping and exploiting that evolution
- Increase power and affordability of information technologies, particularly with respect to automation applications
- Reduce the impacts caused by the large growing variances between expected computational power and the capability to effectively transport exponentially increasing amounts of data and information
- Create an environmentally sound global aerospace transportation system
- Harmonize U.S. and international standards

- Conduct comprehensive environmental assessments, including both air and land operations, through models and data
- Analyze and simulate alternative environmental impact mitigation strategies, including economic factors and stakeholder impacts

1.7.2 R&D Planning Framework

Often the results of today's research must await the opening of, or bring about, tomorrow's implementation window. Therefore, for research to be fully effective in supporting FAA mission goals and responsibilities, a long time perspective is essential. The *R&D Strategy* was introduced in 2002 to provide a roadmap to help ensure that that all relevant offices in the agency will participate together with the broad aviation community in planning the future, and that agreements will be in place when the time comes to implement selected technologies and related procedures. The 2004 *R&D Strategic Plan* will incorporate the guidance and priorities of *Flight Plan 2004-2008* and reflect the current plans embodied in the Operational Evolution Plan, the Target System Description, and the work of the Joint Planning Office (see Section 1.2 of this Overview).

The 2004 *R&D Strategic Plan* will preserve the top-down planning framework of Figure 1-2 and will "derive" additional R&D goals from the *Flight Plan* and other guidance documents. These Derived Goals, which must be met to achieve the new mission goals, imply a set of R&D Performance Objectives, Challenges, and Strategies that together will help ensure that FAA research programs contribute to the agency's continuing success.

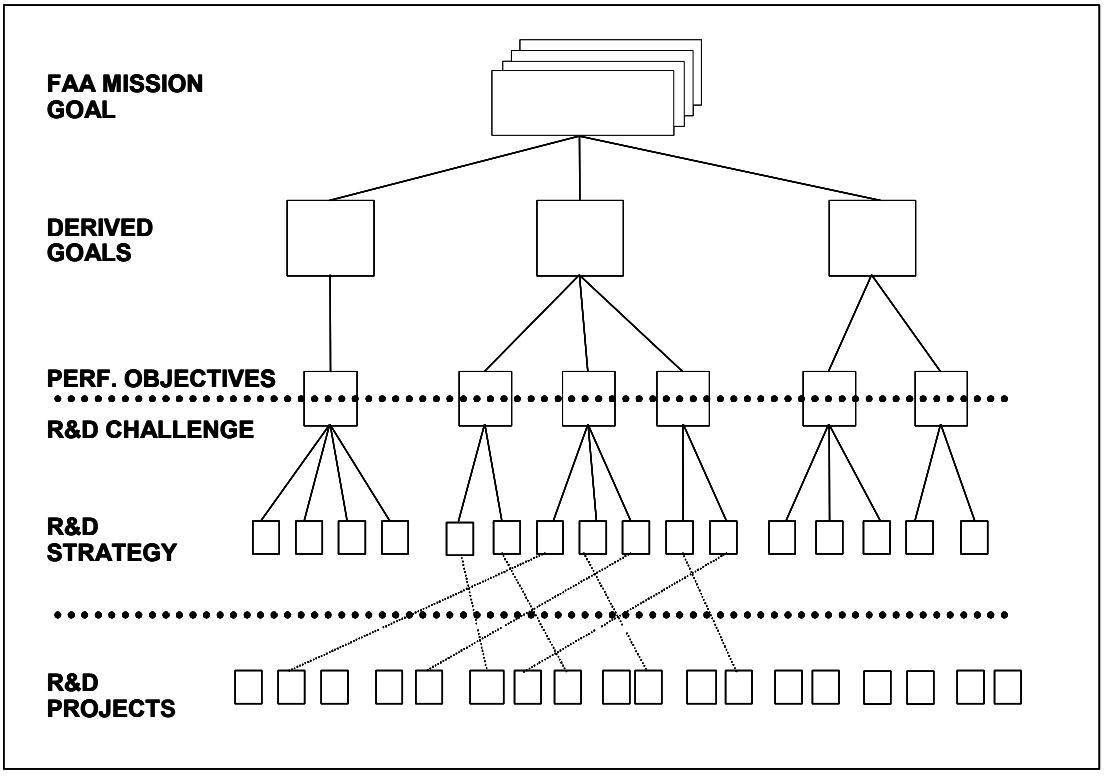

Figure 1-2: R&D Planning-Performance Hierarchy

As shown in Figure 1.3, the long-term research "challenges" described in the 2004 *R&D Strategic Plan* will map to near-term *Flight Plan 2004-2008* "objectives" as well as other FAA goals for the aviation system beyond 2008.

R&D CHALLENGES DEFINED IN THE *FAA R&D STRATEGY*		SAFETY												CAPACITY												
FLIGHT PLAN OBJECTIVES		Safety Information Sharing and Analysis	System Safety and Risk Management	Hazards of the Flight Environment	Failures of Aircraft Structures and Systems	Human Performance	Terminal Area Safety	Safety of Reusable Launch Vehicles	Aircraft Fire Safety	Aircraft Crashworthiness and Crash Survival	Airport Crash Response Capabilities	Protection of NAS Information Infrastructure	Cabin Environment Health Impacts	Increased Airport Arrival/Departure Rates	Increased En Route Capacity	Reduced Airport Weather Impacts	Reduced En Route Weather Impacts	Expanded Access and Service Availability	Future Capacity Enhancements	Improved NAS Predictability	Greater NAS Flexibility	Reduced Cost of Providing NAS Services	Reduced Cost of Airport Infrastructure	Enhanced Environmental Knowledge Base	Minimization of Noise Impacts	Minimization of Air Quality Impacts
Safety Objectives	*Reduce the Commercial Airline Fatal Accident Rate*	X	X	X	X	X	X		X	X	X		X													
	Reduce the Number of Fatal Accidents in General Aviation	X		X	X	X	X			X																
	Reduce Accidents in Alaska	X		X		X				X								X								
	Reduce the Risk of Runway Collisions	X	X			X	X																			
	Reduce Cabin Injuries Caused by Turbulence			X																						
	Measure the Safety of the US Civil Aviation Industry with a Composite Index	X																								
	Ensure the Safety of Commercial Space Launches							X																		
	Enhance the Safety of FAA's Air Traffic Systems		X			X						X														
Capacity Objectives	*Increase Airport Capacity to Meet Projected Demand*													X		X			X				X			
	Make Air Traffic Flow over Land and Sea More Efficient														X		X		X		X	X				
	Increase or Improve Airspace Capacity in the Eight Major Metropolitan Areas													X		X			X		X					
	Increase On-Time Performance of Scheduled Carriers													X	X	X	X			X	X					
	Address Environmental Issues Associated with Capacity Enhancements													X						X	X			X	X	X

Figure 1-3: Mapping of R&D Challenges to Flight Plan 2004-2008 Objectives

1.8 FAA R&D Program Structure

FAA R&D is performed within program areas defined originally by the agency's traditional lines of business and subsequently by the effects of congressional and other R&D funding requirements. Actual research and development work is performed through a combination of appropriations, at agency-funded research centers, and in partnership with other institutions.

For planning purposes, FAA R&D programs group as follows:

- *Air Traffic Services*—R&D focuses on increasing system safety and capacity and enhancing the flexibility and efficiency of air traffic management operations. Improved decision support tools are key to enabling FAA air traffic specialists to collaborate with the user community in managing traffic flows as efficiently as possible. Researchers are exploring a highly integrated, highly secure common information network (CIN) and system-wide information management (SWIM) concept as well as the value of using network-centric operations. FAA researchers also collaborate with their international counterparts to develop new technologies that will improve the accuracy of weather, navigational, and

landing guidance and help to reduce the occurrence of runway incursions, midair collisions, and aircraft encounters related to the effects of wake vortices and hazardous weather. In the communications arena, research develops technologies that improve the reliability of pilot-controller communications and permit the exchange of large data files to pilots.

- *Airport Technology*—R&D develops and evaluates technologies and materials designed to help ensure safe and efficient airport operations. Research focuses on the development and evaluation of advanced, innovative technologies involving pavement design, construction, and maintenance; airport lighting and marking; rescue and firefighting equipment and procedures; runway friction; and wildlife control techniques. Research results are used to update FAA standards for the design, construction, and operation of airports and airport equipment. They are also incorporated into guidance material used by airport operators, consultants, and equipment manufacturers.

  Section 712 of the Vision 100 – Century of Aviation Reauthorization Act establishes a four-year pilot program, authorized at $10M per year, to identify critical problems in airport safety and efficiency that: are shared by airport operators; can be solved through applied research; and are not adequately addressed in other federal research programs. This program will be administered through an arrangement between the FAA and the National Academy of Sciences.

- *Aircraft Safety*—R&D focuses on ensuring the safe design, manufacture, and maintenance of aircraft. It addresses the hazards to all aircraft in service, as well as the special hazards endemic to select portions of the civil aircraft fleet. Older aircraft are more susceptible to structural and nonstructural problems associated with degradation, damage, fatigue, and corrosion. New aircraft with digital flight control and avionics systems and associated embedded software are more susceptible to disruption from external electromagnetic interference. Research focuses on developing technologies and standards for maintenance and modification of in-service aircraft to help ensure ongoing airworthiness. This work includes studies in the continued airworthiness of airframes, engines, and nonstructural systems; maintenance and repair of composites; atmospheric hazards; crashworthiness; fire safety; and the development of fire resistant materials.
- *Information Security and Technology*—R&D in this area continues to transition legacy and emerging FAA information systems to the high levels of security required to protect the flying public and critical national infrastructure, and to help ensure uninterrupted aviation operations.

  Three mutually-supportive "tech base" programs that were funded in previous FAA budgets do not appear as line items in either the FY 2005 R,E&D or F&E budgets. Therefore, they are not reported in this year's NARP. These programs are: Cyber Security, Information System Security, and Software Engineering. Some funding continues for the FAA to work collaboratively on these critical issues with other agencies, including the Departments of Defense and State, NASA, and the National Science Foundation. These small but viable efforts directly support the *Flight Plan 2004-2008* strategic goal of Increased Safety.

- *Human Factors and Aeromedical Research*— Research focuses on enhancing performance and mitigating errors by the human component in aviation systems operations and maintenance. It addresses human capabilities and limitations in areas of information management and display, human-centered automation, selection and training, and human performance assessment across commercial and general aviation, and air traffic services. Additionally, research in the bioaeronautics area addresses issues related to performance, safety and survivability in the cockpit and cabin environments.
- *Environmental*—R&D develops analytical tools, technical information, standards, and procedures to mitigate the environmental impact of aircraft operations, particularly upon noise and air pollution emissions. The program seeks to identify and balance technology, operations, and land-use measures with special emphasis on developing assessment methodologies that give insight into the system-wide consequences of alternative courses of action.

- *Commercial Space Transportation*—The overall mission of the Office of the Associate Administrator for Commercial Space Transportation (AST) is to protect public health and safety, protect the safety of property, and protect U.S. foreign policy and national security interests; to encourage, facilitate, and promote U.S. commercial space launches and reentries; to enhance the international competitiveness of the U.S. commercial space transportation industry; to further compliance with international obligations of the U.S.; and to facilitate new or improved U.S. space transportation infrastructure.
- *Aviation Research Mission Support*—Activities include the management, planning, control, and support activities associated with formulating the FAA R&D program. These efforts help to ensure that the program is a cohesive and integrated effort, consistent with FAA strategic goals and objectives, and fully coordinated with stakeholders and customers.

The above distribution of organizationally-based interests facilitates outside assessment of FAA R&D investments. R&D mission support management also encourages research partnerships with industry, universities, and other government agencies that enable the FAA to leverage its research dollars.

While the FAA no longer includes aviation security as a primary R&D responsibility, the agency retains the responsibility to coordinate effectively with the R&D activities of the Transportation Security Administration.

1.9 FAA R&D Performance Structure

FAA research and development is performed through an integrated network of world-class research facilities that provide breakthrough results in NAS modernization, human factors, navigation and surveillance, and other key research areas.

1.9.1 William J. Hughes Technical Center

The FAA William J. Hughes Technical Center (WJHTC) is one of the world's leading engineering, research, development and testing facilities for nearly every aspect of aviation, including the maintenance and operation of the FAA airborne laboratory fleet.

1.9.1.1 Ongoing WJHTC Research Involvement

- *NAS Modernization*—The center uses currently fielded and newly developed systems to perform R&D encompassing every aspect of air traffic operations. Its laboratories contain current and advanced radar display systems capable of intricate simulations for the testing, development, and evaluation of both air and ground traffic procedures and en route operational concepts.
- *Services and Operations*—Every NAS service provided by the FAA is either on-site or is accessible from the center. The Integration Interoperability Facility (I2F) allows staff to simulate actual operating conditions, including adverse weather, to test and evaluate systems without impacting air traffic operations or employees of the Air Route Traffic Control Center (ARTCC).
- *Air Traffic Management*—The powerful capability of the Traffic Flow Management Laboratory allows for a "fast-tracked" development approach ideal for meeting escalating NAS modernization needs without extensive, traditional prototyping.
- *Human Factors*— Human factors researchers employ the multiple assessment, prototyping, and simulation capabilities of the Research, Development and Human Factors Laboratory. They systematically apply scientific principles to the design and evaluation of next-generation NAS capabilities such as displays, workstations, facilities and procedures. Since NAS modernization involves the transition of enhanced automation capabilities and advanced technologies to the field, integrated and reliable computer-human interfaces are essential to achieving intended levels of human performance and mitigating human error.
- *Navigation and Surveillance*—FAA scientists conduct flight tests with actual Global Positioning System (GPS) signals and prototype ground stations to maximize GPS accuracy in connection with

existing and projected communications capabilities. They also perform tests and evaluations of Automatic Dependent Surveillance – Broadcast (ADS-B) capabilities to provide reliable aircraft position data to airborne and ground-based users and conduct static tests to determine data accuracy and integrity. Support initial pockets of ADS-B traffic and weather services, performed by the ADS-B control facility, will provide insight and aid in assessment of future implementation plans.

- *Terminal Areas*—Improving capacity at our airports is a difficult problem facing NAS modernization. Center staff work with simulation tools and test environments to refine proposed changes in takeoff and landing patterns, improvements in lighting and visual aids, and new procedures.
- *Security*—Now under the direction of the Transportation Security Administration, the Aviation Security Laboratory conducts extensive simulated and live testing in the areas of explosives and weapons detection, aircraft hardening, human factors, and security technology integration to provide the civil aviation system with maximum security while minimizing the adverse impacts on airline and airport operations. Responsibility for FAA Information Security remains with the FAA in the Office of the Chief Information Officer (AIO).
- *Safety*—The Airport and Aircraft Safety R&D Division conducts research in continued airworthiness using some unique, world-class facilities. Fire and accident testing on aircraft, components, and engines requires very specialized facilities and experienced people. The center's facilities in these and areas such as the vertical drop tower and full-scale curved panel testing are the finest in the world.
- *Software Technology*—The Software Engineering Resource Center (SERC) is an FAA-wide resource to improve both the software technology base of the FAA and the software engineering competencies of its staff. The SERC maintains a collateral focus on systems engineering technologies and staff competencies and serves as a focal point for software and systems engineering research, education, advice and evaluation. The Center leverages government, academic and industry resources to efficiently analyze and solve mission-critical problems, maintains a close watch on evolving technologies, and extends the state of the art and practice of software engineering at the FAA and its system suppliers.
- *Airport Technology*—Work is ongoing to improve airport safety and efficiency through research in pavement technology, airport lighting and marking, addressable maker boards, ground marker technology, airport fire and rescue, and mitigation of wildlife hazards at airports. The National Airport Pavement Test Facility provides pavement test data to support development of guidance and standards for pavement design and construction.

1.9.1.2 R&D Partnerships

Researchers at the Technical Center collaborate with their colleagues in industry, government, and academia through various organizational mechanisms.

1.9.1.2.1 Working with Industry

Resident at WJHTC, the FAA Technology Transfer Program addresses the need for government-private sector cooperation by enabling companies, institutions of learning, and federal laboratories to work together to develop innovative technologies and marketable products.

The FAA has designed its Technology Transfer Program to meet the objectives of the Stevenson-Wydler Technology Innovation Act of 1980, the Bayh-Dole Act of 1980, the Federal Technology Transfer Act of 1986, and Executive Orders 12591 and 12618: Facilitating Access to Science and Technology. The release of software is controlled per FAA Order 1370.85, Software Release.

Projects overseen by the Technology Transfer Program Office include:

- Effective use of meteorological measurement and sensing equipment at airports with terrain-induced turbulence and in regions prone to in-flight icing

- Development of a generic model for predicting the transport and validating the dispersal of glycols
- Industrial validation of an acoustic emissions technology system prototype for use with onboard hazardous materials containers
- Development and evaluation of internationally applicable alternative user interface display options and requirements for a next generation voice communication system
- Test and evaluation of an unleaded high octane fuel formulation for general aviation piston engines
- Measurement of the interaction/interference between a selected set of personal medical electronic devices and the magnetic fields emitted by walk-through metal detectors

Cooperative Research and Development Agreements (CRDAs) have proven highly effective in meeting congressionally mandated technology transfer requirements where little or no funding has specifically been available to meet those needs.

Marketing is a critical component of the FAA Technology Transfer Program. The agency maintains membership in a wide range of professional organizations and on high-visibility committees that include private industry as well as all levels of government participants.

The Technology Transfer Program Office is also responsible for the Small Business Innovation Research (SBIR) program. After eligible small business contractors complete the second phase of the SBIR cycle, the office encourages them to enter into CRDAs with the FAA to strengthen their ability to perform well in Phase III, as well as to attract and negotiate successfully with venture capitalists.

1.9.1.2.2 Working with Government Partners

The Phased Array Radar (PAR) weather partnership is intended to research and test the application of military radar technology to provide improved aircraft tracking and weather information for pilots, air traffic controllers, and meteorologists. This research is being conducted by a tri-agency partnership consisting of the FAA, the Office of Naval Research (DoD), and the National Severe Storms Laboratory (National Oceanic and Atmospheric Administration). The Center leads the integration testing effort with existing weather systems aircraft tracking.

The FAA and other interested federal agencies established the Federal Interagency Committee on Aviation Noise (FICAN) to encourage debate and agreement over needs for future aviation noise abatement and resulting new research efforts. FICAN conducts annual public forums in different geographic regions with the intent to better align noise abatement research with local public concerns.

Through a series of memoranda of agreement, the FAA works closely with NASA to identify source abatement technologies for noise and emissions. The FAA is an active participant in the Quiet Aircraft Technology (QAT) project managed by NASA.

1.9.1.2.3 Working with Partners in Academia

The FAA/NASA Joint University Program for Air Transportation Research (JUP) is a research partnership of three universities, which conducts scientific and engineering research on problems of a long-term nature related to the ultimate improvement and development of the NAS. This includes Massachusetts Institute of Technology, Ohio University, and Princeton University. JUP research covers a broad scope of technical disciplines that contribute to civil aviation, including but not limited to air traffic control theory, human factors, satellite navigation and communications, aircraft flight dynamics, avionics and meteorological hazards.

1.9.2 Civil Aerospace Medical Institute

The FAA Civil Aerospace Medical Institute (CAMI) is a unique, internationally recognized aeromedical facility located at the Mike Monroney Aeronautical Center in Oklahoma City, Oklahoma. The institute maintains a cadre of in-house scientific specialists who emphasize human-centered safety research that includes:

- *Advanced Air Traffic Control (ATC) Systems Human Factors Research*—Using rapid prototyping techniques with advanced real-time ATC simulation capabilities, scientists analyze advanced ATC

system designs and their effects on workload and performance, develop metrics of performance and workload, assess the applications of innovative control and design concepts, and identify and evaluate the applications of intelligent systems to enhance aviation safety.

- *Behavioral Stressors Research*—Human factors researchers investigate variables that could compromise safety by impairing both air traffic controller and pilot job performance levels (e.g., shift management, age, fatigue, color perception and a range of impairments induced by drugs or alcohol) and assess the effectiveness of policies, procedures, individual coping strategies, and countermeasures to reduce performance decrements and enhance individual performance.
- *Organizational Effectiveness Research*—Through field research, analytic information is developed to measure progress toward achieving agency change goals and for agency guidance on the relative merits of various innovations intended to enhance safety, efficiency, effectiveness, workforce health and satisfaction, and system performance. Relationships between psychological characteristics (e.g., work attitudes, organizational perceptions) and the work environment (e.g., business practices, organizational climate) are explored.
- *Flight Crew Performance Assessment*—General aviation human factors research emphasizes design of flightdeck controls and displays related to emerging technology, development and validation of performance-based criteria for use in certification and regulation, and the successful integration of training devices into existing instructional systems to enhance flight crew performance and reduce accidents and incidents.
- *Selection, Validation, and Team Performance Research* —Human factors researchers use laboratory and field studies to develop scientific evidence of the job validity of criteria within aviation selection and training systems. Cognitive strategies and processes underlying aviation skill acquisition through training are identified, and assessment measures of individual and team performance are developed to determine effects of advancing technologies on individual and work-team safety, efficiency, and effectiveness.
- *Aircraft Accident Research*—CAMI scientists maintain comprehensive bioinformatics databases and conduct extensive analyses involving the human factors, medical, physiological, and pathological aspects of aviation mishaps. Preventive measures and proactive interventions that will enhance aviation safety in the next millennium are rigorously investigated.
- *Forensic Toxicology Research*—Impeccable procedural integrity and robust toxicological and biochemical analyses of human samples from fatal aircraft accidents are required by the National Transportation Safety Board to help ensure continuous safety of the NAS. Scientists evaluate the underlying human basis for mishaps to prevent future tragedies in our transportation systems. State-of-the-art analytical and molecular biological techniques, including DNA analyses and gene expression, are developed to assist in identifying human causes or influences associated with aviation fatalities.
- *Biodynamics Research*—When failures do arise in aviation, occupant survival may depend directly upon the design of the seating and restraint systems in the aircraft. Evaluating the design and modeling of these systems, and ensuring their protective characteristics, requires both scientific and engineering talents.
- *Cabin Safety Research*—The ability to survive aircraft-related emergencies depends upon the systems, structures, and procedures that are developed and investigated in CAMI's aircraft evacuation facility. Here researchers conduct occupant evacuations from current aircraft configurations and develop evacuation research for larger, more complex aerospace vehicles of the future.
- *Aerospace Environment Safety Research*—Breathing and oxygen delivery systems for all aircraft occupants in normal and emergency situations are investigated. Threats to visual integrity and pilot performance from intense light emitters and ground-based lasers are defined. Improved measures of galactic cosmic radiation levels at various altitudes are developed by CAMI scientists to help ensure that those who work and travel in the aerospace system are not at a disproportionate risk for health

problems from radiation exposures. Cabin air quality research is aimed at ensuring the health and safety of all aircraft occupants.

1.9.3 Centers of Excellence

Air Transportation Centers of Excellence (COEs) are established through cooperative agreements among academic institutions, their affiliate partners in industry, and the FAA. COEs are established to assist the FAA in the pursuit of mission-critical research in technologies pertinent to developing and maintaining a safe and efficient national aerospace transportation system. Centers may be funded in three phases over a period of three to ten years. Thereafter, they are expected to be self-supporting. The FAA is currently operating six COEs.

1.9.3.1 Center of Excellence for Advanced Materials

The Center of Excellence for Advanced Materials was established in December 2003. The center, awarded jointly to the University of Washington and Wichita State University, will conduct research, engineering, and prototype development toward the safe and reliable use of advanced materials and composites in large commercial aircraft. Other academic institutions participating in the new center are Washington State University, Northwestern University, Oregon State University, Purdue University, Tuskegee University, University of California at Los Angeles, University of Delaware, and Edmonds Community College, Washington.

1.9.3.2 Center of Excellence for Aircraft Noise and Aviation Emissions Mitigation

The Center of Excellence for Aircraft Noise Mitigation and Aviation Emissions was established in the past year to foster breakthrough technical, operational, and workforce capabilities enabling quieter and cleaner aircraft. Its core members are Massachusetts Institute of Technology (Lead), Boise State University, Florida International University, the Pennsylvania State University, Purdue University, Stanford University, University of Central Florida, and the University of Missouri-Rolla. The Center's research will initially develop information, tools, methods, and technologies that will help us to understand and mitigate the adverse impacts of aircraft noise and aviation emissions upon the environment, and upon human health and well being. NASA and the FAA are co-sponsors of this Center.

1.9.3.3 Center of Excellence for General Aviation

The Center of Excellence for General Aviation (GA) was established in April 2001 with Embry-Riddle Aeronautical University (ERAU) as the lead of a team, composed of Wichita State University, the University of North Dakota, Florida A&M, and the University of Alaska. The universities are teaming with industry and other government agencies to conduct GA safety-related research and development programs. Recent agreements between ERAU and the Safe Flight 21 program will foster the implementation of ADS-B technology.

1.9.3.4 Center of Excellence for Airworthiness Assurance

The Center of Excellence for Airworthiness Assurance was established in 1997. In FY 2004, the center entered its third three-year phase with 29 academic members. The Center of Excellence for Airworthiness Assurance is a multi-institutional, multi-disciplinary team. Their mission is to contribute towards significant improvements in aviation safety by reducing the aviation accident rate, especially with regard to fatalities. Teaming with industry and other government partners, the Center conducts research in the areas of maintenance, inspection and repair, crashworthiness, and propulsion and fuel systems safety. During the past year, research has begun in new areas, such as nanotechnology, software and digital systems safety, and propeller safety.

1.9.3.5 Center of Excellence for Operations Research

The University of California (Berkeley), Massachusetts Institute of Technology, Virginia Polytechnic Institute, the University of Maryland , and George Mason University co-lead the Center of Excellence for Operations Research. This team includes eleven additional university partners and twenty industrial affiliates. Funded through grant and contract awards, the center's areas of research involvement include traffic management and control, human factors,

system performance and assessment measures, safety data analysis, scheduling, workload management and distribution, navigation, communications, data collection and distribution, and aviation economics.

1.9.3.6 Center of Excellence for Airport Technology

The Center of Excellence for Airport Technology was established in 1995 with the University of Illinois (Urbana-Champaign) as Lead. It is also supported by Northwestern University, Embry-Riddle Aeronautical University, and North Carolina A&T State University. The Center's areas of research include Material Characterization and Modeling, Non-destructive Evaluation of Pavement, Structural Behavior and Modeling, Airport Pavement Design Concepts and Procedures, and Wildlife Hazard Mitigation. Pavement research focuses on new technologies to handle the estimated stress loads foreseen in the next generation of high-volume, commercial aircraft. The COE also supports the test design and analysis work at the FAA's Pavement Test Facility at the William J. Hughes Technical Center.

1.9.4 International Activity

Global harmonization of Communication, Navigation, Surveillance, and Air Traffic Management (CNS/ATM) technologies and standards holds the key to the future success of all aviation systems. The United States (through the FAA) continues to position itself to be a leader in international efforts to maintain the safety, security, efficiency, and environmental compatibility of civil aviation. Progress towards a globally harmonized CNS/ ATM system has accelerated since the adoption of the Global Plan for CNS/ATM Implementation by the International Civil Aviation Organization's (ICAO) Tenth Air Navigation Conference.

The FAA has continued to support CNS/ATM implementation by participating in ICAO technical panels, committees, study groups, and regional planning groups as well as by entering into numerous bilateral cooperative research and development agreements with countries and civil aviation organizations in every region of the world. These ICAO forums and international agreements provide the FAA opportunities to work directly with key research, engineering, and development organizations and decision makers in order to make significant contributions toward international coordination of air traffic services.

The FAA works closely with internationally recognized standards developing organizations, such as RTCA and the European Organization for Civil Aviation Equipment, to reach consensus with industry and the user community on standardizing and certifying evolving aviation technologies.

The FAA is also working with the Joint Aviation Authorities and Transport Canada Civil Aviation to encourage international cooperation in identifying and developing technologies needed to support safety regulatory activity. The pilot program, begun in FY 2000, is designed to encourage technical cooperation in limited areas through exchange of information. Continued airworthiness and regulatory concerns, exchange of information among the research communities on safety-related research, and identifying areas for collaborative research will focus initially on cabin safety, flightdeck human factors, and aircraft icing issues. The agency also shares software, as controlled by FAA Order 1370.85, Software Release.

1.10 Long-Term Research

As stipulated in the Aviation Safety Research Act of 1988, a research project that is "unlikely to result in a final rulemaking action within five years, or in the initial installation of operational equipment within ten years after the date of the commencement of such project" is classified as long-term research.

Of the $100M requested for R,E&D efforts in FY 2004, 30% of these funds are earmarked for long-term research, with the remainder devoted to developmental/near-term efforts. The $117M FY 2005 congressional budget submission for R,E&D designates 25% of the total request for long-term research. These percentages satisfy the agency's congressional mandate for conducting long-term research.*

The "long range view" section concluding each program area description in the 2004 NARP provides insight into technologies identified for support through long-term research.

2.0 Program Information

The program descriptions in this section are grouped according to the primary contribution each makes toward achieving the FAA's strategic goals in the areas of Increased Safety, Greater Capacity, and Organizational Excellence. Each subsection begins with a goal area description, and each program description consists of a narrative, a summary of financial details, and a high-level schedule of tasks for the current and "out years."

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2.1 Aviation Safety Research and Development Goal Area Description

Mission

The unifying mission of the FAA Aviation Safety R&D Goal area is to support the Agency's Safety Goal: "*To achieve the lowest possible accident rate and constantly improve safety.*"

Figure 2.1-1 indicates the percentage of the total requested FY 2005 R&D funding that will be devoted to the support of Aviation Safety research.

Programs within this research area develop information, tools, methods, and technologies that, when applied to the establishment or improvement of aerospace (aviation and space) safety standards and acceptable practices, help to ensure optimally safe operation of the civil air transportation system and space transportation vehicles.

Figure 2.1-1: Percentage of Requested FY 05 R&D Funding Supporting the FAA Goal for Increased Safety

Goal area Structure

Research emphases reported within the Aviation Safety Research and Development Program Area include:

- Aviation Weather Research *
- Advanced Technology Development and Prototyping **
  - Runway Incursion Reduction
  - General Aviation and Vertical Flight Technology (GA&VF)
  - NAS Safety Assessments
  - Safer Skies
  - Airports Technology
- Safe Flight 21 (Alaska Capstone) **
- Aircraft Safety *
  - Fire Research and Safety
  - Propulsion and Fuel Systems
  - Advanced Materials/Structural Safety
  - Atmospheric Hazards/Digital Systems Safety
  - Aging Aircraft
  - Aircraft Catastrophic Failure Prevention Research
  - Aviation Safety Risk Analysis
- Commercial Space Transportation Safety ***
- Human Factors and Aerospace Medicine *
  - Flightdeck/Maintenance/System Integration Human Factors
  - Air Traffic Control/Airway Facilities Human Factors
  - Aeromedical Research

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* R,E&D Budget Request

** F&E Budget Request

*** Ops Budget Request

Program Challenges and Strategies

A conceptual framework of R&D challenges to FAA mission goals is being prepared to reflect the requirements of *Flight Plan 2004-2008* in combination with current aviation system needs, circumstances and issues. Scheduled for presentation in the 2004 *R&D Strategic Plan,* the full framework will be consistent with the preliminary high-level mapping, shown in Figure 2.1-2, of Safety objectives from the Flight Plan to relevant R&D Challenges.

	FLIGHT PLAN OBJECTIVES	Safety Information Sharing and Analysis	System Safety and Risk Management	Hazards of the Flight Environment	Failures of Aircraft Structures and Systems	Human Performance	Terminal Area Safety	Safety of Reusable Launch Vehicles	Aircraft Fire Safety	Aircraft Crashworthiness and Crash Survival	Airport Crash Response Capabilities	Protection of NAS Information Infrastructure	Cabin Environment Health Impacts	Increased Airport Arrival/Departure Rates	Increased En Route Capacity	Reduced Airport Weather Impacts	Reduced En Route Weather Impacts	Expanded Access and Service Availability	Future Capacity Enhancements	Improved NAS Predictability	Greater NAS Flexibility	Reduced Cost of Providing NAS Services	Reduced Cost of Airport Infrastructure	Enhanced Environmental Knowledge Base	Minimization of Noise Impacts	Minimization of Air Quality Impacts
Safety Objectives	*Reduce the Commercial Airline Fatal Accident Rate*	X	X	X	X	X	X		X	X	X		X													
	Reduce the Number of Fatal Accidents in General Aviation	X		X	X	X	X			X																
	Reduce Accidents in Alaska	X		X		X				X								X								
	Reduce the Risk of Runway Collisions	X	X			X	X																			
	Reduce Cabin Injuries Caused by Turbulence			X																						
	Measure the Safety of the US Civil Aviation Industry with a Composite Index	X																								
	Ensure the Safety of Commercial Space Launches							X																		
	Enhance the Safety of FAA's Air Traffic Systems		X			X						X														

Figure 2.1-2: Mapping of Safety R&D Challenges to *Flight Plan 2004-2008* Safety Objectives

Goal Area Outputs

Detailed outputs of all FAA Aviation Safety R&D can be found in the individual descriptions of the component programs that follow this goal area description.

Products of the Aviation Safety Weather Program include improved weather forecasting algorithms and technical input to the development of safer standards and procedures for avoiding or mitigating weather-related aviation hazards.

Evaluations and recommendations produced by the Advanced Technology Development and Prototyping Program shape long-term investment decisions regarding potential technologies for improving the safety of Air Traffic Services, procedures, runway safety technology initiatives, and infrastructure.

Similarly, the Safe Flight 21 Program conducts studies and demonstrations in operating environments to validate the potential of selected advanced communications, navigation and surveillance technologies, combined with the development of prototype hardware and databases and with related air traffic procedures, to increase NAS safety.

In support of sponsor requirements, the Aircraft Safety Program provides the technical research basis to develop the standards, rules, regulations, and guidance materials that can help to ensure aviation safety. The program's research products are typically directed toward aviation manufacturers, aircraft and avionics maintenance facilities, and aircraft operators.

The Airports Technology Program's advisory circular (AC) system is the FAA's principal means of communicating with the nation's airport planners, designers, operators, and equipment manufacturers. ACs publish the standards used in the design, construction, installation, maintenance, and operation of airports and airport equipment. In all projects funded through the Airport Improvement Program (AIP), project work must meet standards set in one of these ACs.

The developmental outputs of the Commercial Space Transportation (AST) R&D program vary in scope from human spaceflight standards and concepts, to modeling and simulation studies, and emergent technology evaluations, to the procedures, standards, and guidance required to perpetuate the safe record of our national introduction of space traffic into the NAS.

The Human Factors Research Program provides the scientific and technical information to improve pilot, maintainer, and controller performance through guidelines, handbooks, advisory circulars, rules and regulations critical to the design, operation, maintenance and certification of equipment, training and procedures. The Aeromedical Research Program provides critical information for regulation and certification activities related to cabin and passenger safety and security, protective devices, toxicology, and recommendations for medical standards.

FAA Collaborative R&D (Safety)

In August 2000, NASA and the FAA signed the *FAA-NASA Integrated Safety Research Plan*. This plan extends existing inter-agency relationships to accomplish the following important objectives:

- Build upon the national plan for research described in the National Research and Development Plan for Aviation Safety, Security, Efficiency and Environmental Compatibility, as published by the National Science and Technology Council (NSTC)
- Provide the ability to analyze the agencies' combined research portfolios in a simple, clear format, including making needed programmatic adjustments
- Describe how the agencies will achieve ongoing communication and the coordination of safety research in pursuit of common safety goals
- Establish a strategy for the agencies to make complementary, coordinated research investment decisions

The FAA and NASA have worked together through memoranda of understanding on specific topics such as human factors, aging aircraft, aircraft icing, the airworthiness of new classes of aircraft, crashworthiness, energy efficiency, and noise reduction.

Three mutually-supportive "tech base" programs that were funded in previous FAA budgets do not appear as line items in either the FY 2005 R,E&D or F&E budgets. Therefore, they are not reported in this year's NARP. These programs are: Cyber Security, Information System Security, and Software Engineering. Some funding continues for the FAA to work collaboratively on these critical issues with other agencies, including the Departments of Defense and State, NASA, and the National Science Foundation. These small but viable efforts directly support the Flight Plan 2004-2008 strategic goal of Increased Safety through:

- Introduction and certification of new technology, with special emphasis on software reliability and mitigation of failure in critical, highly-automated applications
- Mitigation of unintended adverse safety consequences associate with national security countermeasures
- Development of means to protect, detect, respond and recover from malicious cyber attacks
- Increased flexibility and adaptability of system architecture to accomplish data sharing required for collaborative decision-making and common situational awareness
- Increased power and affordability of information technology, particularly with respect to automated applications

The NSTC's national R&D plan provides an "Aviation Safety Roadmap" to achieve the national goal for safety. The initiative encompasses the following research issues:

- **Accident Precursor Identification and Safety Risk Management**—Accidents rarely have a single cause. The detection and mitigation of anomalous operating conditions can actually avoid many accidents. Jointly, the FAA and NASA are working to develop the Aviation Performance

Measurement System (APMS) to help all segments of the aviation community achieve safety improvements from normally collected data.

- **Accident Prevention**—Together with DoD, the FAA and NASA are working to improve the effectiveness of their long-term commitment to aircraft safety. The FAA is working closely with industry in aviation safety areas including the improvement of propulsion and fuel systems, the prevention of aircraft catastrophic failure, the elimination or containment of in-flight fires, and the creation of safer airport materials and systems. NASA research is developing new technologies to afford better visibility to pilots and flight crews experiencing adverse conditions, to improve the overall health of pilots and crews, and to allow pilots to maintain control of their aircraft when engines or systems fail in flight.
- **Accident Mitigation**—When aviation accidents do occur, their effects can be lessened through attention to factors such as aircraft crashworthiness, occupant protection, fire safety, evacuation equipment and procedures, and airport emergency services. The FAA is conducting detailed and innovative aeromedical research to improve the chances that more passengers and crew members will survive aviation accidents. The Agency also works to improve airport systems to provide better materials, methods and equipment to increase survival rates. NASA partners with the FAA on research to improve the structural crashworthiness of aircraft and the fire resistance of aircraft and fuels.

Intended Outcomes

Detailed anticipated benefits and recent accomplishments of all FAA Aviation Safety R&D can be found in the individual descriptions of the component programs that follow this goal area description.

The development and availability of more accurate and rapid weather forecasting directly support the 2003 *ARA Performance Plan* strategy to: "Identify, develop, and conduct research to improve methods, procedures, and technologies to reduce fatal accident rates due to operational hazards." Weather Safety research also supports anticipated outcomes of the Agency's "Safer Skies" initiative and delivers aviation efficiency benefits to the NAS, as described in a separate goal area.

The Advanced Technology Development and Prototyping programs listed in the "Structure" section of this Goal area Description are associated in the current *FAA Capital Investment Plan* (CIP) with the achievement of the FAA Safety Goal. These programs develop technologies with high potential to reduce air carrier fatality rates, general aviation fatality rates, operational errors, and runway incursions. The runway safety initiatives related to runway status lights, ground marker system evaluation, enhanced lighting and addressable marker boards are closely aligned with the Runway Safety Blueprint goals to reduce the risk of runway incursions.

Benefits derived from the Aircraft Safety Program include: the improved safety of aging aircraft; the prevention of catastrophic failure; the promotion of flight safety and reduction of the effects of atmospheric hazards; the improved safety of aircraft propulsion and fuel systems; the reduction of risk from aviation-related fires; the promotion of safer aviation materials and structures; and the improved risk assessment of aircraft, safety performance measurement, and the sharing of safety-related data.

The Airports Technology Program works to enable the nation's airports to accommodate projected traffic growth within an operational environment that is ideally free of accidents and fatalities. To the extent that accidents cannot be avoided, the program strives to save lives through improvements in firefighting and post-crash rescue technologies and procedures.

R&D conducted by the Commercial Space Transportation Program underlies the development of regulations, guidance, and licensing criteria for facilities that accomplish the safe merging of space transportation vehicles with the other forms of aircraft using the NAS, and provide for safety standards for commercial Reusable Launch Vehicles (RLVs). It also encompasses medical and equipment criteria to ensure safe human spaceflight.

The activities of the Information Security and Technology Program are intended to improve the safety of the flying public, to better protect the nation's critical infrastructure, and to enable uninterrupted operations of FAA systems

through the identification and development of available, emerging data technologies and the establishment of procedures for the optimal implementation and use of resulting systems.

The Safe Flight 21 Alaska Capstone Program is an excellent example of an FAA research project designed to demonstrate, validate, and implement advanced information handling technologies in a real world operational context. In the lower 48 states, a prototype surface moving map database and procedures are being developed, along with implementation pockets of ADS-B traffic and weather services, to support the GA user community.

The Human Factors and Aerospace Medicine Program directly responds to the *FAA Strategic Plan* goals to "eliminate accidents and incidents caused by human error" and to "implement new decision support systems and associated functional improvements that fully account for the proper role of people in the system."

Data-driven human factors research provides guidance materials to support development of user-friendly flight controls and displays; identifies the need and direction for aircrew, controller, and maintenance crew training innovations; and contributes to more effective certification procedures. All of these applications of human factors research enhance safety as well as reduce performance inefficiencies.

Aerospace Medicine research improves the health, safety, protection, security, and the ability of aerospace passengers and crews to survive accidents through identification of human failure modes and development of formal recommendations for counteracting human failure conditions.

Long-Range View

The Air Traffic Services (ATS) R&D projects in the Advanced Technology Development and Prototyping Program maintain a long-term view of the research requirements needed to continue safe and efficient operation, maintenance, and use of the NAS into the future. The composition of the R&D program portfolio can be expected to change over time. As some of today's technologies transition to full-scale development, other technologies with potential for improving safety will take their place. Thus, the need for continued funding for ATS technology development and verification continues.

Much work remains to be done before the timely and accurate forecasting of weather can optimally help the FAA stay abreast of increasing demands for a safer, more efficient NAS. New and better forecasting algorithms must be found, and better use must be made of automation and communications to make weather information available to all who need it.

The Safe Flight 21 Program will continue to assess, validate, and demonstrate ADS-B, as well as other technology initiatives and applications that have a high probability to enhance NAS capacity and safety.

As air traffic continues to increase, and as aircraft continue to age, the need for safety and safety-related research will also continue indefinitely. Research in aircraft safety must be continued so planners can understand the full impact of changes in technology on current regulatory safety standards, certification procedures, and acceptable practices.

Commercial space transportation is a research-oriented concern of government and industry. As space traffic continues to increase, the need for safety and safety-related research will continue indefinitely. Research in space safety must be continued to clarify the impact of technology changes on current regulatory and operational practices.

The Information Systems Security and Technology Program was recently established with strong support within the legislative and executive branches of the U.S. Government. The tragedies of September 11, 2001 and subsequent aviation security events underscore the need for, and will intensify public demand for, research applications of this type.

Human Factors research funding will continue to be directed towards multi-year programs with high potential to improve aviation safety. New human-system performance measurement strategies also will be developed to help ensure that the designs of new systems, procedures and training reflect known human performance capabilities and limitations when setting intended safety benefits.

The Aviation Medicine program will continue to work toward mitigating accidents and reducing the severity of injuries that result from events such as evacuating passengers from an aircraft as a safety precaution. Also, the program will increasingly examine data collected around the world to assess their adequacy and appropriateness for establishing regulations and taking other actions to prevent fatalities and injuries.

ADVANCED MATERIALS / STRUCTURAL SAFETY

Goal:

GOALS:

Intended Outcomes: The Advanced Materials/ Structural Safety Program contributes to achievement of the FAA's strategic goal in the area of aviation safety and reduction of aviation fatalities. Specifically, the Program works to ensure the safety of civil aircraft constructed of advanced materials and to increase the ability of passengers to survive aviation accidents.

The study of advanced materials focuses on:

- Developing analytical and testing methods for worldwide standardization
- Understanding how design, loads carried, and damages sustained can affect the remaining life and strength of composite aircraft structures
- Developing maintenance and repair methods that are standardized and correlated with training and repair station capabilities

The study of structural safety focuses on:

- Enhancing occupant survivability and reducing personal injury from accidents
- Improving crash characteristics of aircraft structures, cabin interiors, auxiliary fuel tank systems, and occupant seat/restraint systems
- Improving the efficiency of aircraft certification through use of better analytical modeling of crash events that occur on land and water

Agency Outputs: The Advanced Materials/Structural Safety Program provides technical support for rulemaking and develops guidance to help the aviation industry to comply with agency regulations.

Advanced Materials

The FAA establishes rules for the certification of safe and durable materials for use in aircraft construction. While the rules are the same for composite or metal structure, different behavioral characteristics of structural materials call for different means of compliance. Although Advisory Circular (AC) 20-107A, "Composite Structure" has been published, advances in technologies and materials require periodic updates and expansion of the AC. The FAA National Resource Specialist Program disseminates current technical information to regulatory personnel through technical reports, handbooks, and guidance. The goal of this data exchange is to allow regulatory processes to keep pace with industry advances and benefit from state-of-the-art technology and design.

Structural Safety

The FAA revises or updates crashworthiness-related Federal Aviation Regulations to accommodate new information for overhead stowage bins, auxiliary fuel tanks, aircraft configurations, and seat/restraint systems.

Customer/Stakeholder Involvement: The Advanced Materials/Structural Safety Program complies with or cooperates with the following legislation and industrial/government groups:

- Public Law 100-591, the Aviation Safety Research Act of 1988, and House of Representatives Report 100-894 – sets priorities to develop technologies, conduct data analysis for current aircraft, and anticipate problems related to future aircraft
- The Aviation Rulemaking Advisory Committee (ARAC)
- The Aircraft Safety Subcommittee of the FAA Research, Engineering and Development Advisory Committee (REDAC) – subcommittee representatives from industry, academia, and other government agencies review the activities of the Advanced Materials/Structural Safety Program annually

- Technical Community Representative Groups (TCRGs) – representatives from industry, academia, and other government agencies review the activities of the Aircraft Catastrophic Failure Prevention Program annually
- Recent accident investigation of AA587 A-300 has indicated that more research is needed in composite structures

Accomplishments: The Advanced Materials/Structural Safety Program has provided technical reports, handbooks, ACs, and certification guidance to aircraft manufacturers, maintainers, and operators as follows:

Advanced Materials

- Released a major FAA policy memorandum on the procurement and processing of composites that has resulted in a published AC
- Issued/updated two ACs, four handbooks, and over 60 technical reports, articles and papers
- Co-sponsored four technical conferences during the past two years involving over 1,100 experts
- Disseminated a three-volume report on recommended applications of state-of-the-art composites testing methods; a resulting industry standard, released by the American Society for Testing and Materials (ASTM), has led to an alternative compliance method now being used worldwide
- Developed an economical data reduction method including the use of shared databases to statistically characterize composite materials for General Aviation industry but which is now used worldwide

Structural Safety

- Disseminated ten reports on in-house aircraft crash testing and numerous reports on aircraft water impacts, such as ditching and flotation
- Published proposed rules for commuter seat/restraint systems as a result of in-house crash testing
- Published research findings making in-service overhead stowage bins more resilient to crash impacts
- Developed computer models of B737 fuselage sections and the ATR42 regional transport airplane

R&D Partnerships: The advanced materials and the structural safety areas benefit from a close working relationship with the Center of Excellence for Airworthiness Assurance. The research performed under this program is leveraged by the monetary and intellectual contributions of its core universities.

Advanced Materials

To better leverage research expenditures, the FAA concentrates on safety and certification issues, including testing, while NASA retains the lead in analysis and design issues. Plans are underway for closer cooperation with DoD. The FAA also partners with the Rotorcraft Industry Technology Association (RITA) to share in rotorcraft composite materials research.

With the U.S. Army, the FAA co-sponsors MIL-HDBK-17, a primary and authoritative handbook for the statistical characterization data of current and emerging composite materials. The best available data and technology source for testing and analysis, this international reference tool also includes guidance on data development and usage. On recommendations by the ARAC, material data contained in this handbook will be acceptable for use in the certification process.

Structural Safety

The program maintains cooperative interagency agreements in the structural safety area with the National Highway Traffic Safety Administration (NHTSA), the U.S. Army and U.S. Navy.

Memoranda of cooperation and exchange of personnel have been established between the program and the French, Italian, and Japanese Governments in the crash testing area. A cooperative research program in the development of crash modeling software tools is underway with the United Kingdom. The program has also worked closely with Wichita State University and Drexel University to develop dynamic crash computer modeling codes.

MAJOR ACTIVITIES AND ANTICIPATED FY 2004 ACCOMPLISHMENTS:

Advanced Materials

- Standardize materials and process specifications to better control material properties
- Continue validating analytical methods for bonded joints
- Develop in-flight load and environmental criteria software for certifying general aviation airplanes; establish related guidelines
- Validate analytical methodology to predict residual strength of a composite sandwich structures following an impact event

Structural Safety

- Continue to develop human neck injury criteria for side-facing aircraft seats
- Publish interim technical report on computer modeling of aircraft water impacts to determine revised rotorcraft water impact/ditching standards
- Publish final report on ATR42-300 dynamic crash test results with emphasis on determining the seat track loads during a crash event

FY 2005 PROGRAM REQUEST:

Ongoing Activities

The program will continue to focus on the areas listed at the beginning of the GOALS section above. Specific areas will concentrate upon the aging composite control surfaces on transport airplanes. The repair of these structures, as well as the training of their repairmen and inspectors will be addressed. There will also be program linkage to aircraft safety issues involved with control surface performance. In addition, the program will continue to develop data applicable to rotorcraft and fan blades, including high-cycle fatigue. Research will continue on certification methodology for new materials and applications.

Research will continue into: identifying occupant injury protection criteria applicable to side-facing seating in business jets; the analytical modeling of aircraft water impact crash events; and crash resistant fuel systems.

New Initiatives

In the future, several new initiatives will address the use of ceramics and nanomaterials in aircraft parts, particularly in aircraft engines. These applications, involving standardization of testing at elevated temperatures, will be based on previous work on polymer composites. In the maintenance area, plans aare to investigate imbedding sensors in the materials to damage as it occurs.

KEY FY 2005 PRODUCTS AND MILESTONES:

Advanced Materials

- Initiate assessment of the severity of control surface stiffness degradation and its effect on dynamic characteristics
- Create a template for control of woven materials and processes including adhesives
- Identify maintenance and repair actions that need to be standardized and correlated with training requirements and repair station capabilities

Structural Safety

- Continue side-facing airplane seat human neck injury criteria research
- Publish a final report on aircraft water impact analytical modeling in order to revise the current water impact requirements for helicopters
- Publish technical report on the design criteria for Crash Resistant Fuel Systems (CRFS)

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2003)	$68,408
FY 2004 Enacted	7,223
FY 2005 Request	2,197
Out-Year Planning Levels (FY 2006-2009)	9,364
Total	$87,192

Budget Authority ($000)	**FY 2001 Enacted**	**FY 2002 Enacted**	**FY 2003 Enacted**	**FY 2004 Enacted**	**FY 2005 Request**
Contracts:					
Advanced Materials	975	962	921	5,676	632
Structural Safety	819	808	797	202	105
Personnel Costs	937	1,091	1,058	1,234	1,345
Other In-house Costs	60	113	75	111	115
Total	**2,791**	**2,974**	**2,851**	**7,223**	**2,197**

OMB Circular A-11, Conduct of Research and Development ($000)	**FY 2001 Enacted**	**FY 2002 Enacted**	**FY 2003 Enacted**	**FY 2004 Enacted**	**FY 2005 Request**
Basic	0	0	0	0	0
Applied	2,791	2,974	2,851	7,223	2,197
Development (includes prototypes)	0	0	0	0	0
Total	**2,791**	**2,974**	**2,851**	**7,223**	**2,197**

Advanced Materials/Structural Safety Product and Activities	FY 2005 Request ($000)	Program Schedule					
		FY 2004	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009
062-111 Advanced Materials Structures							
Advanced Materials	**$632**						
Develop Analytical Methods for Bonded Joints		◆					
Validate Analysis to Predict Residual Strength after Impact		◆					
Develop Software and Criteria for Environment and Loads		◆					
Develop Standard Specifications to Better Control Material Properties		◆					
Identify Maintenance and Repairs for Standardization			◇				
Create Template to Control Woven Materials and Adhesives			◇				
Ascertain the Effect of Stiffness Loss Due to Damage			◇				
Develop Analytical Models that Predict Durability of Woven Materials				◇			
Develop Certification Methodology for High Cycle Fatigue					◇		
Identify Data for Certification of Materials At Elevated Temperatures						◇	
Initiate Research In Ceramic Composites							◇
062-110 Structural Safety							
Structural Safety	**$105**						
Complete Interim Report on Computer Modeling of Aircraft Water Impact Research		◆					
Publish Final Report on Aircraft Water Impact Analytical Modeling in Order to Revise the Current Water Impact for Helicopters			◇				
Report on a Vertical Drop Test of High-Wing ATR42-300 Commuter Aircraft		◆					
Develop Neck Injury Criteria for Side-Facing Seats					◇		
Publish Technical Report on Crash Resistant Fuel Systems			◇				
Personnel and Other In-House Costs	**$1,460**						
Total Budget Authority	**$2,197**	**$7,223**	**$2,197**	**$2,254**	**$2,310**	**$2,366**	**$2,434**

◆ - Activities Accomplished ◇ - Activities Planned

NOTE: OUT YEAR NUMBERS ARE FOR PLANNING PURPOSES ONLY. ACTUAL FUNDING NEEDS WILL BE DETERMINED THROUGH THE ANNUAL BUDGET PROCESS.

AEROMEDICAL RESEARCH

Goal:

The Aeromedical Research Program contributes to achievement of the FAA's aviation safety strategic goal.

The FAA safety mission requires the Agency to:

- Investigate and analyze injury and death patterns in civilian flight accidents and incidents to determine their cause and develop preventive strategies
- Support FAA regulatory and medical certification processes that develop safety and health regulations covering all aerospace craft occupants and their flight environments
- Recommend equipment, technology and procedures for the optimal:
  - Evacuation and egress of all humans from aerospace craft
  - Dynamic protection and safety of all humans on aerospace craft

The identification of pilot, flight attendant, and passenger medical conditions that are incompatible with in-flight physiological and performance demands, both in the absence and in the presence of emergency flight conditions, relates directly to the above mission requirements. Bioaeronautical data and research results are shared effectively with the aviation community through advanced, computational modeling and visualization technologies.

Intended Outcomes: Research program outcomes are improved health, safety, security, protection, and survivability of aerospace craft passengers and aircrews.

The Civil Aerospace Medical Institute (CAMI) is authorized and uniquely equipped to exploit new and evaluate existing bioaeronautical guidelines, standards, and models for aerospace craft cabin equipment, procedures, and environments. Aeromedical research serves as the basis for new regulatory action and evaluation of existing regulations to continuously optimize human performance and safety at the minimum cost to the aviation industry.

This research program analyzes pilot medical and flight data, information from accidents and incidents, and advanced biomedical research results to propose standards and assess certification procedures that optimize performance capability. The complex mix of pilot, flight attendant and passenger activities in a wide range of environmental, behavioral, and physiological factors is evaluated to propose standards and guidelines that will enhance the health, safety and security of all aerospace travelers.

Agency Outputs: Aeromedical Research has accomplished experimental projects in support of the following regulatory and certification operations:

- Integrated analysis of biomedical, toxicological and molecular biological factors and stressors in uneventful flight and in aerospace craft incidents and accidents
- Quantitative bioengineering criteria related to:
  - Optimum aerospace craft seat and restraint system certification
  - Enhanced egress, flotation and onboard life support/rescue equipment certification
- Quantitative bioaeronautical data associated with:
  - Health, safety and security risks for flightdeck, cabin crew and other occupant regulatory oversight
  - Aerospace radiation and environmental factors and their threat to all aerospace craft occupants
  - Bioaeronautical, bioengineering and performance factors required to support cabin evacuation certification
- Quantitative biomedical and performance criteria and recommendations to support development of:
  - Optimum life support equipment, emergency medical equipment, and operational procedures certification
  - Aircrew medical standards, assessment/certification procedures, and pilot special medical issuance

Customer/Stakeholder Involvement: The Aeromedical Research program direction is consistent with the bioaeronautics agenda set forth in the *National Plan for Civil Aviation Human Factors: An Initiative for Research and Application:*

> "Improve the health, safety, protection, survivability and security of aerospace craft passengers and crews through identification of human tolerances, capabilities, and failure modes (physiological, psychological, and performance) both in uneventful flight, and during incidents and accidents."

The program is an integral participant and research provider under the FAA, Joint Aviation Authorities (JAAs), and Transport Canada Aviation (TCA) Aircraft Cabin Safety Research Plan established in 1995 as a coordinated, living plan to maximize the cost-benefit of aerospace craft cabin safety research nationally and internationally. The research budget assignment satisfies the Congressional mandates for the Agency in the Wendell H. Ford Aviation Investment and Reform Act of the 21st Century enacted in 2000 and the FY 1994 Appropriation Act. It has supported various multi-year collaborative studies by the FAA and other government and industrial entities to evaluate flight crew and passenger symptomatology and disease.

Accomplishments: Program highlights include:

- Integrated toxicological and biomedical data of all aerospace craft accidents and significant incidents
- Advanced integrated data analysis and recommendations are continuously provided to research sponsors

  Current findings indicate that about one in four of the pilots fatally injured in civilian aircraft accidents shows evidence of using a prescription drug; one in six has taken an over-the-counter drug; one in twenty has ingested "significantly positive" alcohol; and one of sixteen is using a significant controlled dangerous substance. State of the art techniques and methodology are continuously maintained in this world-class research program.

- Advanced modeling of aerospace crash dynamics and cabin egress

  The application of the Mathematical Dynamic Model (MADYMO) in biodynamic testing is evaluated in relation to actual sled test events. The model has been used to support development of a head-neck injury criteria (HIC) test device. Evaluations of the HIC device were conducted to determine its effectiveness as a component level test device and to provide information to assist in defining component testing that can be used to replace some high cost biodynamic sled tests for seat certification. Development of computer-modeling tools will help preclude the need for human participants in actual aircraft evacuation research/full scale demonstration, and will provide faster, safer, more cost-effective aircraft certification decisions.

- Computational fluid dynamics model of aircraft airflow and particle distribution

  Initiated in FY 2000, this modeling investigates the distribution of contaminants and/or chemical-Biological agents within aircraft cabins. Supported by cabin airflow research conducted in the CAMI 747 Aircraft Environment Research Facility. The model focuses on quantitative definition of potential cabin contamination and sensor/warning system development. The threat of terrorist attack, intensified by the events of 9/11/2002, and contagious disease transmission, such as SARS has magnified requirements for this research thrust. The FAA has collaborated with the American Society of Heating, Refrigeration and Air-conditioning Engineers (ASHRAE) to ensure completion of congressionally mandated cabin air quality research recommended by the National Research Council.

- Web-based advisory materials for enhancing human health

  Information on in-flight cosmic and solar radiation exposures and cabin air quality is continuously provided for all human occupants of aerospace craft.

R&D Partnerships: The program collaborates and leverages its research activities with many government and non-government colleagues, organizations and agencies.

The program staff cooperates directly on research processes with manufacturers responsible for safety products (seats, restraint systems, oxygen masks, evacuation slides, etc.). They are also integral members of the Cabin Safety Harmonization Working Group, Seat Certification Streamlining Effort, Airbus Industries A380 Cabin Safety Working Group and National Safety Council, and hold memberships, fellowships and leadership positions in all scientific, medical and bioengineering societies associated with aerospace medicine.

FAA investigators also serve on every Society of Automotive Engineers committee addressing safety research related to the work of this program. Program personnel serve on subgroups of organizations such as the Aerospace Medical Association, the Civil Aviation Medical Association, and the Professional Aeromedical Transport Association. They directly collaborate with the U.S. military and NASA on research issues involving crashworthiness, aerospace medicine, eye injury from lasers, and exposure to cosmic radiation. They also work with NATO aerospace medical advisory groups, the European Union, and many independent scientific organizations.

The National Research Council (NRC), through its Associateship Program, has approved the CAMI research program with scientists now participating in molecular biology and space medicine research studies at CAMI. Academic collaboration (with more than 10 students/faculty annually participating in aeromedical research) rounds out the full scope of medical and scientific partnerships of the world-renown program.

MAJOR ACTIVITIES AND ANTICIPATED FY 2004 ACCOMPLISHMENTS

The following program results are expected, to be achieved in FY 2004:

- Complete:
  - Final report on non destructive inspection/non destructive testing (NDI/NDT) vision standards
  - Evaluation of a HIC component test device for assessing head impact severity and reducing seat certification cost
  - Epidemiological assessments of biochemical, toxicological and molecular biological factors associated with fatal civilian aviation accidents
- Evaluate:
  - Autopsy data from fatal aviation accidents to support the development of a safety index
- Develop:
  - Support basis for FAA and ASHRAE cabin air quality sampling and research programs
  - Program to support recommendations for life support equipment and medical requirements in civilian spacecraft
  - Warning time requirements to support NASA developmental system to warn cabin crew of approaching clear air turbulence using the narrow body Cabin Evacuation Research Facility (CERF)
  - Biodynamic testing on side-facing seats and restraint devices for use in rule-making

FY 2005 PROGRAM REQUEST:

Complex medical decisions, based on epidemiological assessments, accompany initial and follow-up medical assessments of airmen who request special medical issuances to allow them to continue flying despite clinical abnormalities without resulting in unexpected or increased aircraft accident risk. Cabin safety, health and security for all human occupants of civilian aerospace craft requires careful, cost-effective certification and regulation. The following research is planned to continually improve on aeromedical certification through provision of a sound scientific basis for all decisions.

Ongoing Activities

- Evaluate:
  - Trends in toxicological, biochemical, molecular biological, physiological, and clinical findings from all major civil aviation aircraft crashes using advanced bioinformatics analytical systems
  - In-flight medical kit/automatic external defibrillator use to determine their effectiveness and utility
  - Effectiveness of programs dedicated to the enhancement of passenger safety, health, security and performance in emergencies and uneventful flight
  - Performance and protection characteristics of aircrew eye/respiratory protective equipment, including protection from chemical/biological agents
  - Risk posed by pilots with special medical issuances
- Recommend:
  - Safer aircraft cabin evacuation certification guidelines/procedures
  - Effective limits to radiation exposure (laser and ionizing)
  - Methods to reduce head, neck, torso, and extremity injuries in aircraft crash environments and improve certification procedures
- Support Aviation Rule-Making Advisory Committee reviews of cabin air quality and altitude safety rules
- Develop user-friendly aeromedical research accident database that quickly provides advanced statistical and graphical analyses for aerospace regulation and certification functions

New Initiatives

- Implement molecular biological techniques in forensic toxicological investigations of aircraft accidents
- Support development of a coordinated review/research effort to define cabin air quality and analyze requirements for occupant protection and aircraft decontamination
- Collect and analyze data for use in modeling of passenger/crew injury patterns in accidents and incidents

KEY FY 2005 PRODUCTS AND MILESTONES

- Analyze:
  - Bioaeronautical research data supporting aeromedical certification to reduce in-flight sudden or subtle incapacitation
  - Accuracy of pilot-reported medication usage compared with actual toxicology findings
  - Molecular biological laboratory methods to enhance forensic toxicological investigation of aircraft accidents/incidents
  - Effectiveness of an enhanced narrow body cabin egress test facility designed to allow simulation of more aircraft types and configurations
  - Rate at which postmortem alcohol can be produced in specimens from fatal aviation accident victims to aid in the discrimination between ethanol ingestion and postmortem formation
- Develop:
  - Component tests for improved aircraft seat certification criteria and anthropomorphic test devices to establish the correlation of neck injury and measured impact dynamics
  - Educational and guidance materials associated with new and ongoing vision research initiatives designed to maintain and enhance aviation safety

- Enhance guidelines for maintaining aircraft cabin occupant health, including the CARI-6 radio-biological computer program covering large solar particle events
- Initiate research on crew and passenger safety requirements for very high altitude air or spacecraft

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2003)	$89,917
FY 2004 Enacted	8,830
FY 2005 Request	6,660
Out-Year Planning Levels (FY 2006-2009)	28,538
Total	$133,945

Budget Authority ($000)	**FY 2001 Enacted**	**FY 2002 Enacted**	**FY 2003 Enacted**	**FY 2004 Enacted**	**FY 2005 Request**
Contracts:					
Aeromedical Research	938	491	385	2,801	357
Personnel Costs	3,893	4,268	4,451	4,611	4,761
Other In-house Costs	1,156	1,362	1,357	1,418	1,542
Total	**5,987**	**6,121**	**6,193**	**8,830**	**6,660**

OMB Circular A-11, Conduct of Research and Development ($000)	**FY 2001 Enacted**	**FY 2002 Enacted**	**FY 2003 Enacted**	**FY 2004 Enacted**	**FY 2005 Request**
Basic	0	0	0	0	0
Applied	5.987	6,121	6,193	8,830	6,660
Development (includes prototypes)	0	0	0	0	0
Total	**5,987**	**6,121**	**6,193**	**8,830**	**6,660**

Aeromedical Research Product and Activities	FY 2005 Request ($000)	Program Schedule					
		FY 2004	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009
086-110 Aeromedical Research							
Cabin Health and Environmental Guidelines	**$25**						
Assess Flight Crew Health Risks During a Flying Career		◆	◇	◇	◇	◇	◇
Model Air Flow and Disease/Chemical-Biological Agent Transmission/Dissemination in Aircraft Cabins		◆	◇	◇			
Human Survival and Protection in Civil Aviation	**$178**						
Analyze the Suitability for Component Tests as an Alternative for Showing Regulatory Compliance with Crashworthiness Standard for Aircraft		◆	◇	◇	◇	◇	◇
Assess Impact Protection Performance of Aircraft Seating Systems		◆	◇	◇			
Develop Performance-Based Narrow and Wide-Bodied Aircraft Cabin Evacuation Approval Guidelines		◆	◇	◇	◇	◇	◇
Develop Protective Equipment Fit, Comfort, and Performance Standards		◆	◇	◇	◇	◇	◇
Develop Dynamic Modeling Capabilities in Support of Cabin Safety, Protection, and Aircraft Accident Research		◆	◇	◇	◇	◇	◇
Medical/Toxicology Factors of Accident Investigations	**$154**						
Perform Epidemiological Assessment of Toxicology Factors from Fatal Civilian Aviation Accidents		◆	◇	◇	◇	◇	◇
Develop Guidelines to Reduce In-flight Sudden/Subtle Incapacitation		◆	◇	◇	◇	◇	◇
Evaluate Autopsy Data from Fatal Aviation Accidents to Determine Protective Equipment and Design Practices		◆	◇	◇	◇	◇	◇
Develop Advanced Molecular Biochemical Techniques to Enhance Aviation Forensic Toxicology			◇	◇	◇	◇	◇
Develop Instructional Material on the Radiation (Cosmic and Visual) Environment during Air Travel		◆	◇	◇	◇		
Establish an Aircraft Accident Medical Database		◆	◇	◇	◇		
Develop Vision Standards for Maintenance Non Destructive Inspection and Testing		◆	◇	◇	◇		
Analyze Advanced Aeromedical Accident and Pilot Certification Data		◆	◇	◇	◇	◇	◇
Personnel and Other In-House Costs	**$6,303**						
Total Budget Authority	**$6,660**	**$6,830**	**$6,660**	**$6,848**	**$7,033**	**$7,221**	**$7,436**

◆ - Activities Accomplished ◇ - Activities Planned

NOTE: OUT YEAR NUMBERS ARE FOR PLANNING PURPOSES ONLY. ACTUAL FUNDING NEEDS WILL BE DETERMINED THROUGH THE ANNUAL BUDGET PROCESS.

AGING AIRCRAFT

Goal:

Intended Outcomes: The Aging Aircraft Program contributes to achievement of the FAA's strategic goal in the area of aviation safety by developing technologies, technical information, procedures, and practices to help ensure the continued airworthiness of aircraft structures and systems in the civil transport fleet.

Program areas of emphasis include:

- Assessing causes and consequences of widespread fatigue damage of aging aircraft structures
- Ensuring the continued safe operation of aircraft electrical and mechanical systems
- Detecting and quantifying damage such as cracking, corrosion, disbonding, and material processing defects through nondestructive techniques
- Acquiring, analyzing and publishing operational loads usage data to update and validate airworthiness standards
- Establishing damage-tolerant design and maintenance criteria for rotorcraft and commuter airplanes
- Standardizing methods and data for aircraft certification and continued airworthiness

Agency Outputs: The FAA publishes rules for aircraft design, construction, modification, inspection, maintenance, and repair. Aircraft operators and manufacturers refer to these materials to learn how to comply safely and efficiently with related FAA regulations.

The agency also provides limited-distribution technical and policy materials to its field personnel..

Customer/Stakeholder Involvement: The Aging Aircraft Research Program directly supports the Aviation Safety Research Act of 1988 (Public Law 100-591), the legislation that first directed the FAA to focus on maintaining the airworthiness of the aging commercial fleet. The program also addresses the safety recommendations of the White House Commission on Safety and Security to maintain and improve aging non-structural systems on the fleet.

Program staff coordinate with an extensive network of government and industry groups including:

- The Subcommittee on Aircraft Safety (SAS) of the FAA Research, Engineering and Development Advisory Committee (REDAC) – subcommittee representatives from industry, academia, and other government agencies review the activities of the Aging Aircraft Research Program annually
- Technical Community Representative Groups (TCRGs) – representatives from FAA headquarters and the directorates apply formal guidelines to ensure that the program's R&D projects support new rulemaking and comply with existing rules
- The Aviation Rulemaking Advisory Committee (ARAC) – ARAC proposes cost-effective rulemaking and research to address aging aircraft issues
- The Aging Transport Systems Rulemaking Advisory Committee (ATSRAC) – ATSRAC provides public recommendations regarding revisions to the Federal Aviation Regulations and associated guidance material to ensure the continued airworthiness of aging non-structural systems in transport airplanes

Accomplishments: In the course of its aviation community involvement, the program has:

- Developed and flight tested two aircraft arc-fault circuit breaker (AFCB) prototypes. AFCBs are now in limited production and at least two operators have installed AFCBs in select circuits on their commercial aircraft. The use of arc-fault circuit breakers is expected to reduce the incidence of electrically ignited in-flight fires and multiple-system failures resulting from cascading arc-faults.
- Completed testing of four fuselage panels at the Full-Scale Aircraft Structural Test Evaluation and Research (FASTER) facility, at the FAA William J. Hughes Technical Center. The tests confirmed

the ability of advanced computational models developed by the FAA and NASA to simulate crack growth and residual strength in panels that have sustained multiple-site damage.

- Published first version of FAA-accepted material properties handbook "Metallic Materials Properties Development Standards" (MMPDS), the replacement document to MIL-HDBK-5. With the disappearance of MIL-HDBK-5 the aircraft design community was faced with the prospect of individually qualifying materials for aircraft application – a significant burden for both the FAA and aircraft manufacturers. FAA has temporarily accepted the custodianship of the document while efforts proceed to develop a government-industry consortium to maintain the document indefinitely.
- Developed and tested the following new and enhanced inspection technologies and structural repair techniques in support of rulemaking:
  - Assessed the efficacy of second and third-layer crack inspection procedures and suggested procedural changes to improve crack detectability
  - Developed and tested novel eddy-current and thermal-ultrasonic technologies for detecting small cracks that may indicate the onset of widespread fatigue damage
  - Developed a composite repair patch that may prove to be less disruptive to aircraft structure and more cost-effective for aircraft operators than mechanically fastened repair patches
- Sponsored the development of Supplemental Structural Inspection Documents (SSIDs) for two typical small aircraft. These SSIDs demonstrate the feasibility and practicality of maintaining older aircraft to safer and more effective damage-tolerance standards.
- Acquired, analyzed, and published flight and ground loads operational usage data for civil transport aircraft of all sizes and at a variety of airports. The data is currently being used by ARAC to update the FAA rules and policy.
- In collaboration with the engine industry, developed and tested new and enhanced inspection technologies for nickel billet and titanium forgings.

R&D Partnerships: Program activities are closely coordinated with related initiatives being undertaken by industry, NASA and the DOD. Interagency agreements are in place between the FAA and NASA, the U.S. Navy, the U.S. Air Force, and the DOE. The FAA, the DOD, and NASA have cosponsored seven joint Aging Aircraft Conferences.

The FAA collaborates closely with several private and public organizations including:

- The FAA Center of Excellence for Airworthiness Assurance (AACE) – a consortium consisting of twenty-nine core universities partners with Sandia National Laboratories
- The Center for Aviation Systems Reliability (CASR) – a consortium of three lead universities, Iowa State University, Northwestern University, and Wayne State, and several adjunct institutions
- The Airworthiness Assurance Nondestructive Inspection Validation Center (AANC) – an FAA partnership with Sandia National Laboratory to test and evaluate inspection techniques and to enhance technology transfer
- The Engine Titanium Consortium (ETC) – comprised of Iowa State University, Pratt & Whitney, General Electric, and Honeywell, formed to develop methods for the inspection of engine components
- The National Institute for Aviation Research (NIAR) at Wichita State University
- The Center for Aviation Research and Aerospace Technology (CARAT) – comprised of Ohio State University and the University of Dayton Research Institute

Cooperative Research and Development Agreements (CRDAs) are in place with several airline operators as part of the flight loads data collection program.

MAJOR ACTIVITIES AND ANTICIPATED FY 2004 ACCOMPLISHMENTS:

- Complete modification of the Full-Scale Aircraft Structural Test Evaluation and Research (FASTER) facility to accommodate extended fatigue testing of high-time fuselage structure

- Complete coupon fatigue testing and recommend mix mission load spectra for fatigue life prediction of typical commuter aircraft; apply results to the revision of AC 23-13
- Complete prototype remote field eddy-current inspection device and perform laboratory assessment of its capability
- Complete assessment of requirements for aircraft wire separation and segregation
- Complete first phase airworthiness evaluation of two high-time Cessna 402 airplanes
- Install enhanced flight data recorders on Cessna 172, BE-1900D and T-34 model aircraft
- Test under field conditions:
  - A field prototype thermo-sonic inspection system for small crack detection
  - An advanced prototype ultrasonic system for inspecting metal and composite bonds
  - Wire testing and inspection devices capable of identifying and locating compromised and degrading electrical wire insulation, including the micro-energy spark discharge system
- Publish:
  - *Metallic Materials Properties Development Standards,* (MMPDS) – second edition
  - An operational loads monitoring report for the Boeing 747/400 airplane in overseas service
  - Lateral acceleration and landing gear loads data for large aircraft during ground operations
  - An operational loads usage report for airplanes used in the US Forest Service firefighting fleet
  - Final report on the destructive testing of flight control mechanisms
  - Assessment of Helicopter Health and Usage Monitoring System Requirements (HUMS)
  - Final report on Engineering Studies of Cleaning and Drying Process for Fluorescent Penetrant Inspection
  - Final Report on Contaminated Billet Study for titanium billets used in the manufacture of aircraft engine-rotating components

FY 2005 PROGRAM REQUEST:

Ongoing Activities

The program will continue to focus on the areas listed at the beginning of the GOALS section above. Efforts in Aging Aircraft Systems will receive a geater portion of the Aging Aircraft funding, while some structural integrity research and aircraft loads data collection will be phased-out. Tasks to develop enhanced inspection ability for flaws in engine turbine disks will continue. Airframe structural inspection research will remain constant, while application-specific projects addressing rotorcraft and commuter aircraft will receive reduced funding.

New Initiatives

There will be no new initiatives in Aging Aircraft in FY 2005

KEY FY 2005 PRODUCTS AND MILESTONES:

- Publish a handbook of FAA-accepted material properties - Metallic Materials Properties Development and Standardization. The databook is an essential reference for both aircraft design engineers and FAA certification engineers.
- Complete development of second-generation (115Volt/3-phase and 28Volt DC) arc-fault circuit breakers. The production-ready circuit breaker will reduce the possibility electrically ignited fires on aircraft.
- Publish capability report on emerging inspection technologies including remote field eddy-current and thermosonic technologies. These new technologies will enable the development of cost-effective Instructions for Continued Airworthiness (ICAs) for aircraft subject to the threat of widespread fatigue damage.

- Publish operational loads data for the Airbus A-340 and Boeing 777. The data from these reports allow aircraft manufacturers and the FAA to assess the validity of design assumptions and take preemptive action if usage and loads are more severe that the original design.
- Complete destructive testing large fuselage sections taken from a retired Boeing 727. The results of this task will help to formulate policy regarding the use and interpretation of the teardown data in applications for continued airworthiness certification.
- Publish final results of the FAA Aircraft Wire Degradation Study. This study will enable the FAA to set policy regarding the nature and frequency of aircraft wire maintenance.
- Publish a report including data and assessment of commercial HUMS applications for rotorcraft certification.

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2003)	$297,085
FY 2004 Enacted	20,498
FY 2005 Request	18,351
Out-Year Planning Levels (FY 2006-2009)	76,588
Total	$412,522

Budget Authority ($000)	FY 2001 Enacted	FY 2002 Enacted	FY 2003 Enacted	FY 2004 Enacted	FY 2005 Request
Contracts:					
Aging Aircraft	29,250	27,351	25,000	15,633	13,205
Personnel Costs	3,451	4,041	4,100	4,478	4,609
Other In-house Costs	610	608	308	387	537
Total	**33,311**	**32,000**	**29,408**	**20,498**	**18,351**

OMB Circular A-11, Conduct of Research and Development ($000)	FY 2001 Enacted	FY 2002 Enacted	FY 2003 Enacted	FY 2004 Enacted	FY 2005 Request
Basic	0	0	0	0	0
Applied	33,311	32,000	29,408	20,498	18,351
Development (includes prototypes)	0	0	0	0	0
Total	**33,311**	**32,000**	**29,408**	**20,498**	**18,351**

Aging Aircraft Product and Activities	FY 2005 Request ($000)	Program Schedule					
		FY 2004	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009
065-110 Aging Aircraft							
Structural Response Simulation and Modeling	**$895**						
Continue Support for Mil-Handbook 5 (Standard Reference)		◆	◇	◇	◇	◇	◇
Inspection Systems Research and Development	**$3,789**						
Develop Crack Detection Technologies Including pulsed Eddy Current for DC-10 Crown Splice		◆	◇	◇			
Develop Corrosion and Disbond Inspection Systems		◆	◇	◇	◇		
Perform Validation of Inspection Technologies		◆	◇	◇	◇	◇	
Conduct Visual and Fluorescent Penetrant Inspection Research		◆	◇	◇	◇		
Develop Enhanced Aircraft Repair Techniques		◆	◇	◇			
Airborne Data Monitoring Systems	**$538**						
Publish Reports on Large Transports and Commuter Loads Surveys		◆	◇	◇	◇		
Structural Integrity of Commuter Aircraft	**$474**						
Conduct Teardown of Two High-Time Commuter Aircraft		◆	◇				
Evaluate the Airworthiness of Commuter Aircraft and Provide Information for Policy Guidance.		◆	◇	◇	◇	◇	
Rotorcraft Structural Integrity and Safety	**$2,263**						
Develop Rotorcraft Damage Tolerance Methodologies		◆	◇	◇	◇		
Continued Airworthiness of Aircraft Engines	**$1,404**						
Develop Enhanced Production Inspection Systems Including Multizone and Forging Inspection Systems		◆	◇	◇			
Assess and Verify Inspection Systems Performance		◆	◇	◇	◇		
Conduct Propeller Damage Tolerance Evaluation			◇	◇	◇	◇	
Aging Mechanical Systems	**$579**						
Publish Report on Destructive Testing of Flight Control		◆	◇				
Conduct Risk Assessment for Aging Mechanical Systems		◆	◇	◇	◇	◇	
Aging Electrical Systems	**$3,263**						
Conduct Wire Degradation Assessment		◆	◇	◇	◇		
Develop Wire Testing Equipment		◆	◇	◇			
Develop Advanced Circuit Protection Devices Including Second Generation Arc-Fault Circuit		◆	◇	◇	◇		
Conduct Risk Assessment for Aging and Modified Wire		◆	◇	◇	◇	◇	
Personnel and Other In-House Costs	**$5,146**						
Total Budget Authority	**$18,351**	**$20,498**	**$18,351**	**$18,653**	**$18,956**	**$19,258**	**$19,721**

◆ - Activities Accomplished ◇ - Activities Planned

NOTE: OUT YEAR NUMBERS ARE FOR PLANNING PURPOSES ONLY. ACTUAL FUNDING NEEDS WILL BE DETERMINED THROUGH THE ANNUAL BUDGET PROCESS.

AIR TRAFFIC CONTROL / AIRWAY FACILITIES HUMAN FACTORS

Goal:

Intended Outcomes: The Air Traffic Control/ Airway Facilities Human Factors (ATC/AF) Program contributes to achievement of the FAA's strategic goal for aviation safety.

The program works to improve the ATC contribution to system safety by:

- Developing:
  - The human factors elements that enable the delivery of air traffic services and enhanced operational capabilities for the National Airspace Systems (NASs) of the future
  - Better methods to investigate, report, analyze, and mitigate ATC operational errors and AF incidents
- Improving:
  - Human-system integration in the acquisition and design of ATC automation systems
  - Techniques for forecasting hiring requirements and selecting applicants for Air Traffic (AT) and AF positions

Agency Outputs: The ATC/AF Program prepares guidelines and standards to improve the effective integration of aviation technologies. These outputs are shaped by the program's research on human performance and other human-system integration issues associated with the acquisition, design, operation, and maintenance of ATC systems.

Improvements in how errors are investigated and reported have fostered effective safety interventions. The study of the relationship between shift work schedules and fatigue, for example, has identified techniques for mitigating degradations in controller and AF specialist performance. Tests and criteria for the selection of operational personnel hold promise to improve applicant selection efficiency and validity, and to reduce costs associated with attrition and training failures.

Customer/Stakeholder Involvement: The ATC/AF Program results from continued coordination between its Air Traffic and Airway Facilities customer base and both the FAA Human Factors Research and Engineering Division (AAR-100) and the Air Traffic System Requirements Service (ARS). Research projects are sponsored by organizations in the air traffic community with operational and developmental responsibility.

In its research activities, the ATC/AF program receives recommendations and guidance from many sources, including:

- The Operational Evolution Plan (OEP)

  This FAA document identifies many human factors R&D issues regarding the future of the NAS.
- The Research, Engineering, and Development Advisory Committee (REDAC)

  This congressionally mandated committee and its Human Factors Subcommittee review and comment on FAA R&D activities.
- The 1995 joint *National Plan for Civil Aviation Human Factors: An Initiative for Research and Application* classifies the efforts described in the remainder of this ATC/AF Program description.

  The plan's work categories include:
  - *Information Management and Display* – design optimal AT/AF displays to reduce information overload
  - *Human-Centered Automation* – keep the operator informed, prevent the degradation of operator skills, and protect the system against automation failure
  - *Human Performance Assessment* – assess and improve human performance, and prevent human error
  - *Selection and Training* – assess how to hire the best potential operators and improve their training

Accomplishments: The ATC/AF Program has performed or influenced research resulting in the following :

Information Management and Display

- Improved the Human Factors Design Standard (HFDS) and guidelines for automation and advanced technologies
- Assessed the risk of user interface design inconsistencies among terminal radar baseline systems, their anticipated product improvements, and anticipated NAS subsystems
- Identified inconsistencies in display symbology and aural tones in monitor and control legacy and acquisition systems
- Developed recommendations for the Standard Terminal Automation Replacement System (STARS) radar display and maintenance control workstations

Human-Centered Automation

- Analyzed how controllers have used paper flight progress strips to support a transition to Free Flight decision support automation
- Identified human factors, operational, and functional issues with en route decision support and data link capabilities collocated in controller workstations
- Developed recommendations for improved controller performance and team communications in use of a conflict probe; completed a complex human-in-the-loop simulation

Human Performance Assessment

- Completed initial field beta testing and validation of JANUS, a new methodology for reporting and analyzing causal factors associated with ATC operational errors
- Completed surveys and biomedical studies on a congressionally mandated fatigue study; distributed a CD educating controllers on countermeasures to fatigue resulting from shift work
- Studied the impact of distributed air/ground separation responsibility on air traffic controller performance
- Modeled and simulated the impact of airspace restructuring on controller performance

Selection and Training

- Incorporated human factors information regarding communications, attention, and memory in a training aid to help controllers and pilots prevent runway incursions
- Developed a prototype biographical assessment tool for screening job applicants
- Concurrently validated a new computerized Air Traffic Selection and Training (AT-SAT) test battery for ATC
- Developed the prototype Statistical Attrition and Retirements Model (SCRAM) model for projecting retirements and attrition from AT/AF critical occupations from historical data

R&D Partnerships Research is coordinated with NASA in the areas of technology readiness levels, distributed air/ground separation responsibility, decision support automation, and controller task load measurement through the Inter-agency Integrated Product Team, which also provides a framework for coordination with MITRE. University grants are addressing tower controller use of paper flight strips, human factors with advanced surveillance technology, and collaborative decision making in Air Traffic Management (ATM).

Internationally, collaborative research with EUROCONTROL and the Icelandic Civil Aviation Administration addresses human error in the design and operation of ATC systems and assessment of human factors in advanced oceanic technologies and procedures.

MAJOR ACTIVITIES AND ANTICIPATED FY 2004 ACCOMPLISHMENTS:

Information Management and Display

- Develop display concepts for operations with the use of enhanced weather products such as storm movement and wind shear
- Assess human system integration (HSI) inconsistencies and other human factors risks in integrating enhanced capabilities with traffic flow management systems

Human-centered Automation

- Perform a controller simulation to assess interoperability issues with decision support and data link capabilities collocated in en route controller workstations
- Evaluate controller information requirements for using flight progress strips in control towers
- Analyze the design of centralized maintenance procedures to find ways to mitigate human error and improve coordination with Air Traffic operations

Human Performance Assessment

- Conduct:
  - Field beta testing of the abilities of JANUS to identify causes of operational errors and assess mitigation strategies
  - FAA-wide Employee Attitude Survey to assess and compare Model Work Environment practices
- Start to assess the impact of airspace characteristics and supervisory practices on the incidence of operational errors

Selection and Training

- Develop a parallel form to the Air Traffic-Selection and Training (AT-SAT) test battery
- Continue longitudinal validation of screening and testing tools used to select job applicants
- Complete a selection-oriented baseline job/task analysis for AF field maintenance positions to support development of a new AF selection system
- Extend the SCRAM functionality to a workforce stock-and-flow model for estimating future hiring requirements

FY 2005 PROGRAM REQUEST

The proposed program supports ATS with research to address human performance issues in the acquisition, design, operation, and maintenance of ATC systems over the next several years. Research projects will provide timely information to answer critical human factors questions.

Ongoing Activities:

The ATC/AF Program will continue to participate in the development of advanced controller and maintainer workstations to enable the human element of the AT and AF concept of operations for 2015.

The program will continue its work in human-centered automation by: assessing how decision support tools affect controller performance, roles, and responsibilities; and assessing information requirements and coordinated decision making in a centralized maintenance environment.

Program researchers will also continue to: assess improvements to the JANUS technique for the mitigation and reduction of human and system errors related to air traffic operations; assess human factors improvements to tower team operations for improving runway safety; recommend best practices through an organizational assessment addressing the Model Work Environment; validate task load and performance measures obtained before and after implementation of new controller automation tools; and, validate shift scheduling principles for effectively managing controller fatigue through a field operational test.

Research will also continue to validate ATS selection processes and assess ATS management training shortfalls that limit succession planning.

New Initiatives

Human-centered Automation

Assess human factors impacts of the AT strategic concept for an advanced standard automation platform using controller-in-the-loop simulation.

Human Performance Assessment

Evaluate an intranet-based prototype system to manage and integrate operational error reports for analysis.

KEY FY 2005 PRODUCTS AND MILESTONES:

Information Management and Display

- Develop controller information and display requirements to meet future FAA service plans
- Identify detailed HSI inconsistencies and other human factors risks that can be mitigated to improve the capabilities of oceanic and offshore ATC legacy systems
- Recommend flight progress data display techniques to meet tower controller information needs

Human-Centered Automation

- Assess the cumulative impact of incrementally integrating decision aids prescribed in AT future concepts on controller performance, situation awareness, and workload

Human Performance Assessment

- Develop:
  - A web-based prototype knowledge management system to integrate and analyze causal factors data from assessments of operational errors and runway incursions
  - Targeted management and training interventions that can mitigate human errors that cause operational errors
- Develop recommendations to mitigate human factors impacts from off-normal maintenance operations
- Report on lessons learned, organizational issues, and successful practices in developing a Model Work Environment from the FAA-wide Employee Attitude Survey

Selection and Training

- Assess specialist and technician training strategies and equipment to identify shortfalls in use of new monitor and control systems and technologies
- Develop technical enhancements and continue longitudinal validation of screening and testing tools for selection of applicants into ATS positions

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2003)	$124,657
FY 2004 Enacted	8,846
FY 2005 Request	9,467
Out-Year Planning Levels (FY 2006-2009)	40,098
Total	$183,068

Budget Authority ($000)	**FY 2001 Enacted**	**FY 2002 Enacted**	**FY 2003 Enacted**	**FY 2004 Enacted**	**FY 2005 Request**
Contracts:					
Air Traffic Control/Airway Facilities Human Factors	2,277	2,756	1,742	2,747	2,832
Personnel Costs	3,984	4,071	4,002	4,445	4,765
Other In-house Costs	1,721	1,673	1,646	1,654	1,870
Total	**7,982**	**8,500**	**7,390**	**8,846**	**9,467**

OMB Circular A-11, Conduct of Research and Development ($000)	**FY 2001 Enacted**	**FY 2002 Enacted**	**FY 2003 Enacted**	**FY 2004 Enacted**	**FY 2005 Request**
Basic	0	0	0	0	0
Applied	7,982	8,500	7,390	8,846	9,467
Development (includes prototypes)	0	0	0	0	0
Total	**7,982**	**8,500**	**7,390**	**8,846**	**9,467**

Air Traffic Control/Airway Facilities Human Factors Product and Activities	FY 2005 Request ($000)	Program Schedule					
		FY 2004	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009
082-110 Air Traffic Control/Airway Facilities Human Factors							
Information Management and Display	**$623**						
Develop Human Factors Design Standards		◆	◇	◇	◇	◇	◇
Integrate Human-System Interface		◆	◇	◇			
Tower Controller Information Requirements		◆	◇	◇			
AF Information Display and Management		◆	◇	◇	◇	◇	◇
Human Centered Automation	**$1,019**						
Assess Incremental Decision Support Tool Interoperability		◆	◇	◇	◇		
Assess AT Strategic Concepts Simulation		◆	◇	◇	◇	◇	◇
Situational Awareness in Centralized Monitor and Control		◆	◇	◇	◇		
Human Performance Assessment	**$850**						
Examine Causal Factors Related to Operational Errors		◆	◇	◇	◇	◇	◇
Runway Safety Analysis and Educational Guidance		◆	◇	◇			
Airway Facilities Work Flows and Communications		◆	◇	◇	◇		
Controller Shift Work, Work Schedules, and Fatigue		◆	◇				
POWER Task Load and Performance Assessment		◆	◇	◇			
Team Processes in Centralized Monitor and Control Systems		◆	◇	◇			
FAA-Wide Employee Attitude and Organizational Assessment		◆	◇	◇	◇	◇	◇
Selection and Training	**$340**						
AT Management Succession Planning and Training		◆	◇	◇	◇		
Applicant Evaluation System Longitudinal Validation		◆	◇	◇	◇	◇	◇
Prototype Workforce Analysis Tool Development and Analysis		◆	◇	◇			
Personnel and Other In-House Costs	**$6,635**						
Total Budget Authority	**$9,467**	**$8,846**	**$9,467**	**$9,684**	**$9,900**	**$10,119**	**$10,395**

◆ - Activities Accomplished ◇ - Activities Planned

NOTE: OUT YEAR NUMBERS ARE FOR PLANNING PURPOSES ONLY. ACTUAL FUNDING NEEDS WILL BE DETERMINED THROUGH THE ANNUAL BUDGET PROCESS.

AIRCRAFT CATASTROPHIC FAILURE PREVENTION RESEARCH

Goal:

GOALS:

Intended Outcomes: The Aircraft Catastrophic Failure Prevention Research Program contributes to achievement of the FAA's strategic goal in the area of aviation safety 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 uses historical accident data and National Transportation Safety Board (NTSB) recommendations to examine and investigate:

- Turbine engine uncontainment events, including mitigation and modeling of uncontainment and aircraft vulnerability to uncontainment (AC20-128, phase II), and
- Propulsion malfunction indications research in response to Aerospace Industries Association (AIA) recommendations and proposed solutions.

Agency Outputs: With technical input from the Aircraft Catastrophic Failure Prevention Program, the FAA establishes certification criteria for aircraft and supports revisions to the regulations to allow new technologies to be certified. The Agency also publishes Advisory Circulars (ACs) to outline acceptable means for meeting these rules. The program's objective is to ensure safe aircraft operation in the public domain.

Customer/Stakeholder Involvement: The Aircraft Catastrophic Failure Prevention Program complies with Public Law 100-591 (the Aviation Safety Act) and Public Law 101-508 (the Omnibus Reconciliation Act), which together established the aircraft catastrophic failure prevention program.

The program collaborates with a broad cross section of the aviation community, including the following, to ensure a balanced, responsive Aircraft Catastrophic Failure Prevention Program:

- The Subcommittee on Aircraft Safety (SAS) of the FAA Research, Engineering and Development Advisory Committee (REDAC) – subcommittee representatives from industry, academia, and other government agencies review the activities of the Aircraft Catastrophic Failure Prevention Program annually
- Technical Community Representative Groups (TCRGs) – representatives from FAA headquarters and the directorates apply formal guidelines to ensure that the program's R&D projects support new rulemaking and comply with existing rules
- The Aviation Rulemaking Advisory Committee (ARAC) – this committee and its subcommittees help to ensure the effectiveness of the agency's rulemaking by identifying R&D requirements and priorities, providing guidance for the update of documents such as AC20-128, and encouraging industry's full participation in implementing new rules
- FAA-sponsored workshops on turbine engine uncontainment characterization, modeling, and mitigation – this ongoing forum brings industry and government (civil and military) experts together to review progress and recommend future action
- Partnerships with industry, through an ARAC working group, to develop a toolkit for modeling engine uncontainment events
- Partnerships with industry and academia under the Center of Excellence for Airworthiness Assurance to perform technology transition of armor technologies for engine containment and engine rotor burst protection
- The Aerospace Industries Association - Transport Committee – with participation of the FAA and industry - this committee has examined propulsion system malfunctions, identified inappropriate crew

response, and recommended development of specific regulations and advisory materials to correct safety hazards

- Preliminary AIA efforts on propulsion issues with implications for follow-on ARAC work on FAR 25.1305

Accomplishments: Results of Aircraft Catastrophic Failure Prevention Program research are provided to certification officials to form the technical basis for rule changes as well as new or modified ACs. Results are also provided to airframe and engine manufacturers and designers. Program accomplishments include:

Engine Uncontainment Research

- Delivered the Uncontained Engine Debris Damage Assessment Model version 2.02 (UEDDAM) for evaluation of uncontained engine debris hazards to aircraft for ARAC evaluation and comment
- Conducted a training workshop for DOD and ARAC on UEDDAM
- Continued a cooperative evaluation of vulnerability models with the U.S. Air Force and commercial airframe manufacturers
- Completed a collaborative effort with NASA, the U.S. Navy, and the U.S. Air Force to perform the first full-scale engine disk crack detection demonstration. A crack was propagated .025 inches during 4,470 cycles on a running engine
- Completed a mitigation test for uncontained engine failure damage to pressurized fuel lines
- Continued armor material failure modeling to improve accuracy of simulations for engine debris impact
- Performed full-scale tests of advanced armor design concepts
- Completed University California (UC) Berkeley Center of Excellence for Airworthiness Assurance (AACE) Grant on "Lightweight Ballistic Protection of Flight-Critical Components on Commercial Aircraft – Phase I" Test data developed under the program was used to improve analytical modeling of fabric shielding
- Completed Arizona State University AACE Grant on "Explicit Finite Element Analysis Modeling of Multi-Layer Composite Fabric for Gas Turbine Engine Containment Systems". A significant database of small and full-scale test data was developed to understand the interaction of multiple layers in containment systems
- Documented status of ARAC 25.903(d) work (UEDDAM and armor material work) for future restart under ARAC

Propulsion Malfunction

- Completed phase I work on Indications of Propulsion System Malfunctions. Reviewed 80 in-service events and provided in-depth analysis and recommendations for propulsion indication improvement.

R&D Partnerships: Through interagency agreements, grants, and contracts, program activities are closely coordinated with governmental, academic, and commercial experts to leverage the full advantage of existing knowledge and technologies. Significant program benefits are realized from the following agreements:

- Interagency agreement with Naval Air Warfare Center Weapons Division (NAWCWD), China Lake – with Boeing, modifies tools for analyzing the vulnerability of the military's turbine engines to uncontainment events for use with commercial transport aircraft
- AACE Grant with Arizona State University (ASU) – with Honeywell Engines and SRI International, develops "An Explicit Finite Element Model of Multi-layer Composite Fabric for Gas Turbine Engine Containment Systems"
- Interagency Agreement with NASA Glenn for cooperation on turbine engine uncontainment – NASA provides test support to the AACE Grant with ASU for Engine Containment

- AACE Grant with UC Berkeley – with Boeing and SRI International, develops "Lightweight Ballistic Protection of Flight-Critical Components on Commercial Aircraft"
- NAVAIR, U.S. Air Force, and NASA Glenn partnership – develops engine disk crack detection technologies

MAJOR ACTIVITIES AND ANTICIPATED FY 2004 ACCOMPLISHMENTS:

Engine Uncontainment Research

- Complete technical assessment of detection technologies on TF41 fan disk crack detection program
- Develop a calibrated design tool to model engine uncontainment debris impact on thick plate shielding of 2024-T3 aluminum aircraft material
- Conduct Finite Element Model training for FAA certification engineers
- Release an engine containment generic model to industry to provide guidance on fabric containment modeling
- Release improved aluminum 2024-T3 material model for incorporation into the LSDYNA model
- Continue NASA/FAA sponsored quality control program for modeling aircraft problems in LSDYNA

Propulsion Malfunction

- Develop expanded phase II definitions and recommendations for the three top engine malfunction incidents (surge, asymmetric thrust and engine failure) as identified in phase 1. Primary focus in phase II is the propulsion system requirements for identification on the malfunction.

FY 2005 PROGRAM REQUEST:

Ongoing Activities

All research on uncontained engine failures will be suspended.

The program will develop engine malfunction materials to better define a variety of propulsion malfunctions, and develop demonstration system.

New Initiatives

No new initiatives are planned in FY 2005.

KEY FY 2005 PRODUCTS AND MILESTONES:

Propulsion Malfunction

- Deliver draft report of Phase II Propulsion Malfunction Indications research
- Continue*:*
  - Researching propulsion malfunction indications and monitoring (phase II)
  - Developing demonstration system for improved propulsion malfunction indications.
- Recommend incorporation of improvements to minimum engine malfunction cockpit indications based on research findings

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2003)	$27,189
FY 2004 Enacted	758
FY 2005 Request	1,116
Out-Year Planning Levels (FY 2006-2009)	4,644
Total	$33,707

Budget Authority ($000)	**FY 2001 Enacted**	**FY 2002 Enacted**	**FY 2003 Enacted**	**FY 2004 Enacted**	**FY 2005 Request**
Contracts:					
Aircraft Catastrophic Failure Prevention Research	2,131	2,101	1,319	259	842
Personnel Costs	610	621	463	468	241
Other In-house Costs	35	72	27	31	33
Total	**2,776**	**2,794**	**1,809**	**758**	**1,116**

OMB Circular A-11, Conduct of Research and Development ($000)	**FY 2001 Enacted**	**FY 2002 Enacted**	**FY 2003 Enacted**	**FY 2004 Enacted**	**FY 2005 Request**
Basic	0	0	0	0	0
Applied	2,776	2,794	1,809	758	1,116
Development (includes prototypes)	0	0	0	0	0
Total	**2,776**	**2,794**	**1,809**	**758**	**1,116**

Aircraft Catastrophic Failure Prevention Research Product and Activities	FY 2005 Request ($000)	Program Schedule					
		FY 2004	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009
066-110 Aircraft Catastrophic Failure Prevention Research							
Engine Uncontainment Research	**$0**						
Complete Engine Disk Crack Detection Test Reports		◆					
Release an Engine Containment Generic Model to Industry to Provide Guidance on Fabric Containment Modeling		◆					
Release Improved Aluminum 2024-T3 Material Model for Incorporation into the LSDYNA Model		◆					
Conduct Finite Element Model Training for FAA Certification Engineers		◆					
Complete UEDDAM Vulnerability Code with Advanced Material Penetration Equations				◇			
Complete Containment Modeling Development for Metal/Multi-layer Fabric Structure					◇		
Develop Prototype Engine Crack Detection System						◇	
Develop Dry Bay Mitigation Recommendations							◇
Propulsion Malfunction	**$842**						
Develop Recommendations for Propulsion Malfunction Indications Phase II		◆					
Deliver Draft Report of Phase II Propulsion Malfunction Indications Research			◇				
Demonstrate Advanced Monitoring Capabilities				◇			
Develop Recommendations for Propulsion Monitoring System					◇		
Conduct Propulsion Monitoring Flight Test							◇
Personnel and Other In-House Costs	**$274**						
Total Budget Authority	**$1,116**	**$758**	**$1,116**	**$1,133**	**$1,149**	**$1,167**	**$1,195**

◆ - Activities Accomplished ◇ - Activities Planned

NOTE: OUT YEAR NUMBERS ARE FOR PLANNING PURPOSES ONLY. ACTUAL FUNDING NEEDS WILL BE DETERMINED THROUGH THE ANNUAL BUDGET PROCESS.

AIRPORTS TECHNOLOGY — SAFETY

Goal:

Intended Outcomes: The FAA intends to improve airport safety by conducting research to improve airport lighting and marking, reduce wildlife hazards, improve airport fire and rescue capability, and reduce surface accidents. The FAA will also develop and maintain standards in airport system areas to:

- Reduce aircraft accidents due to incursions, particularly in low-visibility conditions
- Reduce aircraft accidents due to slipperiness caused by ice and snow on runways
- Improve post-crash rescue and firefighting capabilities
- Reduce the negative impact of wildlife on airport safety

Agency Outputs: Federal law requires the FAA to develop standards and guidance material for airport design, construction, and maintenance. The Agency uses the airport advisory circular (AC) system as its principal means of to fulfill its obligation to communicate with a user community consisting of U.S. airport planners, designers, operators, and equipment manufacturers.

Achieving the overall FAA goal of reducing accidents requires improvement in airport safety as well as aircraft safety. Outputs of the program include guidance regarding: new technology for improving airport lighting and marking to help reduce surface accidents and runway incursions; improvements in aircraft rescue and fire fighting to address double decked aircraft carrying up to 800 passengers; and new techniques to modify the habitats of increasing numbers of wildlife on or near airports.

The Airport Improvement Program (AIP) provides current technical information to support and update ACs covering design of airport safety areas, visual aids, rescue and firefighting, ice and snow control, and wildlife control. The FAA and its regional offices then enforce these standards and guidance materials as part of administering the AIP.

Customer/Stakeholder: AIP grants contribute about half of the approximately $2 billion spent each year to provide operationally safe and reliable airport pavements. Projects funded under the AIP grants must conform to the FAA ACs or designated standards. The remaining costs are borne by state and local governments.

Accomplishments: The Airport Technology research program has provided products to enhance the safety of airport operations in the United States and around the world. Research results are published as FAA ACs and made available to users worldwide. Recent program accomplishments include:

- Produced a manual on wildlife control methods for airports and translated it into Spanish and French
- Installed soft-ground arresting systems to stop aircraft overruns at a major international airport – on May 8, 1999, the arrestor bed installed at John F. Kennedy International Airport, New York, safely stopped a Saab 340 aircraft carrying 27 passengers and 3 crew members, from possibly plunging off the end of the runway into Thurston Bay
- Developed improved pavement marking for enhancing visibility, durability, and skid resistance
- Developed a enhanced vision system to help the drivers of firefighting vehicles to navigate in rain, snow, and fog
- Developed specification for a 55-foot elevated boom and aircraft cabin skin-penetration system
- Completed a study on stability of heavy rescue vehicle and anti-rollover systems
- Completed data collection for taxiway centerline deviation study at John F. Kennedy International Airport, and began data collection at a second major airport

R&D Partnerships:

- FAA-U.S. Air Force, Tyndall Air Force Base *
- FAA-USDA, National Wildlife Research Center, Sandusky, Ohio *
- FAA-Agencies of Canadian Government (for pavement technology and winter operations safety) **

- FAA-NASA (for joint runway traction research) *
- FAA-Port Authorities of New York and New Jersey (for design and construction of aircraft arrestor bed) *
- FAA-industry (to test and develop infrared deicing facilities and soft-ground arrestor materials) **

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* Inter-agency agreement or Memorandum of Agreement (MOA)

** Cost Sharing

Through these partnerships, research results are published in scientific journals, presented at technical conferences, and discussed at workshops.

MAJOR ACTIVITIES AND ANTICIPATED FY 2004 ACCOMPLISHMENTS:

- Complete Ground-Truthing Tests for Prototype Bird Detection Radar at DFW – March 2004
- Issue Final Report on Runway and Taxiway Retro-Reflective Markers – March 2004
- Issue Final Report on LED Light Strip for use in Enhancing Paint Markings – April 2004
- Issue Final Report on LED Application for Taxiway Edge Lights – July 2004
- Issue Final Report on Installation Criteria for Taxiway Centerline Lights – July 2004

FY 2005 PROGRAM REQUEST:

The Airport Technology FY 2004 research program is a collaborative effort among many government organizations, universities, and industry associations. The requested program funding provides the contract support necessary for an integrated, effective research program that delivers the standards and guidelines for maintaining and enhancing airport infrastructure.

KEY FY 2005 PRODUCTS AND MILESTONES:

- Update U.S. Air Force System with Civilian Bird Strikes Data
- Produce Interim Report on DUST Program-Basic RADAR
- Complete:
  - Technical Note on the radio frequency identification (RFID) system in-service evaluation
  - Technical Note on the waterborne paint and bead evaluation
  - Construction of two-level passenger fuselage mockup for aircraft rescue fire fighting (ARFF) testing
- Publish:
  - Report on Acquisition/Reporting of Runway Surface Friction Values
  - Advisory circular on Non-Chemical Methods for Deicing Aircraft

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2003)	$14,457
FY 2004 Enacted	2,450
FY 2005 Request	9,667
Out-Year Planning Levels (FY 2006-2009)	55,900
Total	$82,474

Budget Authority ($000)	FY 2001 Enacted	FY 2002 Enacted	FY 2003 Enacted	FY 2004 Enacted	FY 2005 Request
Contracts:					
Airport - Safety	6,068	2,450	7,600	2,600	13,767
Personnel Costs	0	0	0	0	0
Other In-house Costs	0	0	0	0	0
Total	**6,068**	**2,450**	**7,600**	**2,600**	**13,767**

OMB Circular A-11, Conduct of Research and Development ($000)	FY 2001 Enacted	FY 2002 Enacted	FY 2003 Enacted	FY 2004 Enacted	FY 2005 Request
Basic	0	0	0	0	0
Applied	0	0	0	0	0
Development (includes prototypes)	6,068	2,450	7,600	2,600	13,767
Total	**6,068**	**2,450**	**7,600**	**2,600**	**13,767**

The FY Airports 2004 request for funds is in the AIP portion of the FAA budget request.

Airports Technology - Safety Product and Activities	FY 2005 Request ($000)	Program Schedule					
		FY 2004	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009
Airport Technology – Safety Goal							
Airport Technology - Safety	**$3,500**						
Complete Testing of Proposed Heliport/Vertiport Lighting Standards		◆	◇	◇	◇	◇	◇
Complete Design Criteria for Interior Intervention Vehicle		◆	◇	◇	◇	◇	◇
Complete Design and Construction of Prototype Next Generation Elevated Waterway with Aircraft Skin Penetrating Device		◆	◇	◇	◇		
Evaluate Long-Term Performance of Bird Detection Radar at large Commercial Airport		◆	◇	◇	◇		
Develop GIS-Based Bird Strike Risk Assessment Procedures at Large Commercial Airport		◆	◇	◇			
Issue Final Report on Taxiway Spacing for New Large Aircraft (NLA)		◆	◇				
Total Budget Authority	**$3,500**	**$3,585**	**$3,500**	**$13,767**	**$13,905**	**$14,044**	**$14,184**

◆ - Activities Accomplished ◇ - Activities Planned

NOTE: OUT YEAR NUMBERS ARE FOR PLANNING PURPOSES ONLY. ACTUAL FUNDING NEEDS WILL BE DETERMINED THROUGH THE ANNUAL BUDGET PROCESS.

ATMOSPHERIC HAZARDS / DIGITAL SYSTEMS SAFETY

Goal:

[This program was formerly titled "Flight Safety/Atmospheric Hazards Research"]

Intended Outcomes: The Atmospheric Hazards/Digital System Safety Research Program contributes to the achievement of the FAA's strategic goal in the area of aviation safety.

The program develops and validates technologies, tools, methodologies, and procedures intended to:

- Detect and remove frozen contamination from aircraft at takeoff
- Develop data and technology to determine safe takeoff times and procedures in conditions of freezing precipitation
- Develop icing simulation capabilities, including super cooled large droplet conditions (SLDs)
- Characterize the aircraft icing environment, including SLD and mixed-phase conditions
- Develop technology and data packages to support certification requirements and advisory material to ensure that aircraft meet performance, stability, and control safety standards during or after in-flight operation in icing conditions
- Ensure the safe operation of emerging, highly complex software-based digital flight controls and avionics systems for flight-essential and flight-critical applications
- Protect aircraft electrical and electronic systems against the damaging effects of lightning, cosmic radiation, wireless devices on board aircraft, degradation of wiring systems and all forms of High Intensity Radiated Fields (HIRFs)

Agency Outputs: The FAA establishes rules for the operation of software, digital flight controls, and avionics systems on aircraft that encounter icing conditions and electromagnetic hazards.

The agency provides Advisory Circulars (ACs) and various forms of technical information to the FAA's certification and airworthiness specialists, its inspectors, and the aircraft and avionics industry on acceptable means for meeting the rules.

The Atmospheric Hazards/Digital System Safety Research Program acts – alone and with other U.S. and international agencies – to further the development and use of technologies for detecting frozen contamination and predicting anti-icing fluid failure and for ensuring safe operations during and after flight in atmospheric icing conditions.

Customer/Stakeholder Involvement: The Atmospheric Hazards/Digital System Safety Research Program collaborates with a broad segment of the aviation community to improve aircraft certification, inspection, and maintenance. Highlights of this involvement include:

- Improvements in the highly integrated avionics, ground-based systems, complex software, and certification to meet the emerging requirements of Free Flight
- The Subcommittee on Aircraft Safety (SAS) of the FAA Research, Engineering and Development Advisory Committee (REDAC) – subcommittee representatives from industry, academia, and other government agencies review the activities of the Flight Safety/Atmospheric Hazards program annually
- Technical Community Representative Groups (TCRGs) – representatives from FAA headquarters and the directorates apply formal guidelines to ensure that the program's R&D projects support new rulemaking and comply with existing rules
- Aviation Rulemaking Advisory Committee (ARAC) Electromagnetic Effects Harmonization Working Group (EEHWG)

- ARAC Ice Protection Harmonization Working Group (IPHWG) – including Super-cooled Large Droplets in the icing environment and ice detectors as a means to warn flight crews of ice accumulation on critical surfaces
- Society of Automotive Engineers (SAE) Aircraft Lightning Protection (AE-2) Committee – developing AC's, test standards, and related users manuals to improve flight safety
- SAE G-12 Aircraft Ground Deicing Committee – updating holdover time guidelines, and establishing standards for de/anti-icing methodologies, deicing fluids, and ground ice detection
- RTCA SC-202 (Radio Technical Commission for Aeronautics-Special Committee 202) to determine the risk of using cell phones on board aircraft

Accomplishments: Since 1998, the Atmospheric Hazards/Digital System Safety Research Program has:

- Issued several AC's, l technical bulletins, and a third iteration of the Aircraft Icing Handbook
- Held international conferences on aircraft ground deicing, aircraft in-flight icing, and mixed-phase and glaciated icing conditions
- Issued the holdover time guidelines followed by many of the world's airlines in their use of aircraft anti-icing fluids
- Published in-service electromagnetic hazards advisory material on lightning strike characterization; a HIRF Rule, drafted through the EEHWG, is currently awaiting FAA approval
- Completed research on the effects of aging on the continued protection integrity of aircraft due to degradation of wiring and connectors
- Participated in activities of the international Certification Authorities Software Team (CAST) and object-oriented technology in aviation (OOTiA) efforts
- Investigated standards, testing methods, and certification criteria for systems using commercial off-the-shelf (COTS) real-time operating systems. Results were not favorable.

R&D Partnerships: The program has established the following cooperative relationships:

- ARAC, EEHWG international certification authority/industry forum – pertains to HIRF environment, User's Guide for AC 20-1317
- ARAC, IPHWG – for maintenance of data on and analysis of SLD conditions in the atmosphere
- SAE–AE2 – pertains to "Lightning Protection of Aircraft, Lightning Environment, Waveforms and Testing Standard, Aircraft Zoning Standard," and User's Manual for AC 20-136
- RTCA Special Committee-135 – pertains to "Environmental Conditions and Test Procedures for Airborne Equipment"
- Langley Research Center – based on a multiyear FAA/NASA interagency agreement for the assessment of software-based digital flight controls and avionics systems and electromagnetic hazards research
- Sandia Corporation, Army Directorate for Applied Technology, Test and Simulation, and ORION International Technologies, Incorporated – based on a letter of agreement to leverage HIRF certification research
- CAST – this group of international certification software specialists collaborates and makes recommendations to authorities on the resolution of software problems
- Aerospace Vehicle Systems Institute (AVSI) – cooperative industry and government venture for investigation of aircraft semiconductor wear out and cosmic radiation effects on avionics systems
- NASA Glenn Research Center – includes various cooperative efforts on aircraft icing activities
- Transport Canada – based on an international agreement on research on aircraft ground deicing issues
- Meteorological Service of Canada – based on an international memorandum of cooperation for research on in-flight icing conditions

- U.S. Air Force/McKinley Environmental Laboratory – based on an interagency agreement for the development of a new in-flight icing test capability
- RTCA SC-202 – FAA mandated committee to assess the risks associated with the use of cell phones aboard aircraft

MAJOR ACTIVITIES AND ANTICIPATED FY 2004 ACCOMPLISHMENTS:

Aircraft Icing

- Evaluate time of effectiveness and aerodynamic performance of environmentally friendly and other modern fluids
- Report on the development of new test standards and procedures for Type II, Type III and Type IV anti-icing fluids
- Report on Global Aircraft Icing Characterization
- Continue investigation of atmospheric icing environment aloft
- Report on icing simulation improvement for SLD conditions
- Report on acquisition of atmospheric icing data from operational aircraft

Software and Digital Systems Safety.

- Summarize the state-of-the-industry practices for the verification of object-oriented technology in aviation, (Phase – 1)
- Investigate the deficiencies of Advanced Guidance and Control Systems that can have a negative impact on safety (Subtask 1)
- Identify safety issues and acceptance criteria for component integration of real-time operating systems into integrated modular avionics systems (Phase 1)
- In Real-Time Scheduling Analysis (RTSA) explore industry approaches to scheduling real-time tasks and develop a scheduling algorithm and temporal procedure for modeling real-time tasks
- For Ethernet as an aviation databus, study deterministic operations of Ethernet equipment and provided evaluation criteria for certification of Ethernet databuses
- Complete interim reports on software development and verification tools, which identify assessment criteria for evaluating software development tools and develop a framework for developing tests to evaluate structural coverage tools

Electromagnetic Hazards to Aircraft Systems

Complete work in progress on:

- Publication of report on the lightning strike characterization study intended to define the aircraft lightning environment
- Publication of report on emissions from newer generation cell phones and their effects upon aircraft navigation equipment
- Publication of report on protection integrity study investigating wiring, connector and insulation effectiveness over the life of an aircraft
- AVSI risk assessment study investigating neutron particle effects (single event effects) on flight critical systems
- Recommendations of RTCA – SC 202 addressing risk of newer generation cell phones

FY 2005 PROGRAM REQUEST:

Ongoing Activities

Laboratory methods for determinaton of fluid holdover times will be refined. Research in support of development of SLD engineering tools will continue. Research into atmospheric environments of special interest to aircraft icing will

continue. Development of an enhanced inflight icing simulation capability at McKinley Environmental Laboratory will continue.

Research will also continue on software and hardware for component integration. Work will continue the investigation in OOT, which will identify language and tool-specific issues concerning the confirmation of data and control coupling. Investigations into flight safety and certification issues identified by CAST AVSI and RTCA subcommittee efforts will continue.

The program will continue to research emissions from wireless devices and newer generation cell phones and the effects on aircraft navigation equipment, effects of lightning on aircraft structures and systems, issues affecting the continued protection integrity of aircraft; assessment methods for HIRF attenuation data, and neutron particle effects on flight-critical systems.

New Initiatives

Research to assess possible takeoff performance safety risks associated with ground ice detector's detection thresholds and the acceptability of using ground ice detectors to demonstrate compliance with FAA requirements.

New software and digital system safety research will begin on databus evaluation criteria for airworthiness of newly proposed databuses and local area networks (LANs) in aircraft and the protection of sensitive information on these LANs.

Research into new methods of defining the lightning environment including thunderstorm measurements. Newer methods will be used to analyze the risk of current and future Single Event Effects (SEEs) on avionics systems, and develop FAA regulation criteria for SEE design. Research into newer generation cell phones and wireless devices will be studied along with analyzing the PED risks and their effects on aircraft navigational equipment, and for the development of supporting advisory and regulatory criteria.

KEY FY 2005 PRODUCTS AND MILESTONES:

Aircraft Icing

- Report on Modeling /Simulation Improvement of SLD icing conditions
- Determination/substantiation of time of effectiveness and aerodynamic performance of modern de/anti-icing fluids
- Completion of tunnel testing of characteristic features and aerodynamic effects of runback icing for thermal ice protection systems

Electromagnetic Hazards to Aircraft Systems

- Report on:
  - Emissions from newer generation cell phones and the effects on aircraft navigation equipment
  - Aircraft continued protection integrity due to degradation of wiring, connectors and insulation
  - Single event effects risk assessment

Software and Digital Systems Safety

- Analyze aspects of Component Integration (Phase 2) that are most susceptible to failures and study techniques which reduce vulnerabilities
- OOT (Phase 2): Complete the identification of language and tool-specific issues concerning the confirmation of data and control coupling
- Complete the definition of tool use process and related team efficiency for software development tools and development of the evaluation criteria for verification tools
- Evaluate Advanced Guidance and Control Systems (Subtask 2) by documenting design objectives and characteristics of a functionally integrated flight guidance and control system

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2003)	$70,910
FY 2004 Enacted	4,568
FY 2005 Request	4,119
Out-Year Planning Levels (FY 2006-2009)	17,336
Total	$96,933

Budget Authority ($000)	**FY 2001 Enacted**	**FY 2002 Enacted**	**FY 2003 Enacted**	**FY 2004 Enacted**	**FY 2005 Request**
Contracts:					
Flight Safety	167	165	748	1,306	447
Atmospheric Hazards	2,490	4,722	3,816	1,408	1,890
Personnel Costs	1,349	1,388	1,417	1,707	1,621
Other In-house Costs	94	145	106	147	161
Total	**4,100**	**6,420**	**6,087**	**4,568**	**4,119**

OMB Circular A-11, Conduct of Research and Development ($000)	**FY 2001 Enacted**	**FY 2002 Enacted**	**FY 2003 Enacted**	**FY 2004 Enacted**	**FY 2005 Request**
Basic	0	0	0	0	0
Applied	4,100	6,420	6,087	4,568	4,119
Development (includes prototypes)	0	0	0	0	0
Total	**4,100**	**6,420**	**6,087**	**4,568**	**4,119**

Atmospheric Hazards and Digital Systems Safety Research Product and Activities	FY 2005 Request ($000)	Program Schedule					
		FY 2004	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009
064-110 Flight Safety							
Software and Digital Systems Safety	**$447**						
Publish Report on COTS Component Integration		◆	◇	◇			
Evaluate Object Oriented Technology in Aviation, Phases 1, 2, and 3		◆	◇	◇			
Publish Report on Real-Time Scheduling Analysis		◆					
Publish Reports on Research of Software Development & Verification Tools		◆	◇				
Publish Reports on Ethernet as an Aviation Data bus		◆					
Evaluate Advanced Guidance & Control Systems		◆	◇	◇	◇	◇	◇
Evaluate Safety Engineering in Software				◇	◇	◇	
Evaluate Tool Qualification of Complex Electronic Hardware				◇	◇	◇	
Evaluate Internet Aviation Data Transfer				◇	◇		
064-111 Atmospheric Hazards							
Aircraft Icing	**$1,574**						
Continue Investigation of Atmospheric Icing Environment Aloft		◆					
Evaluate Time of Effectiveness & Aerodynamic Performance of Modern Fluids		◆	◇	◇			
Report on Acquisition of Atmospheric Icing Data From Operational Aircraft		◆					
Report on Global Atmospheric Icing Environment		◆					
Report on New Test Standards and Procedures for Type II and IV Anti-Icing Fluids		◆	◇				
Report on Icing Simulation Improvement for SLD Conditions		◆	◇				
Test Icing Capability for In-flight Conditions at McKinley Environmental Laboratory					◇		
Report on Investigation and Assessment of Ice Detection					◇		◇
Report on Airplane Takeoff Operations and Performance in Icing Conditions				◇		◇	
Electromagnetic Hazards to Aircraft Systems	**$316**						
Publish Reports on Characterization of Aircraft Lightning		◆	◇	◇	◇		
Report on Risk Assessment on Emissions from Cell Phones		◆	◇	◇	◇		
Publish Protection Integrity Reports		◆	◇	◇	◇	◇	◇
Evaluate Single Event Effects		◆	◇	◇	◇	◇	◇
Investigate Cell Phone Risk Assessment				◇	◇	◇	
Personnel and Other In-House Costs	**$1,782**						
Total Budget Authority	**$4,119**	**$4,568**	**$4,119**	**$4,202**	**$4,284**	**$4,368**	**$4,482**

◆ - Activities Accomplished ◇ - Activities Planned

NOTE: OUT YEAR NUMBERS ARE FOR PLANNING PURPOSES ONLY. ACTUAL FUNDING NEEDS WILL BE DETERMINED THROUGH THE ANNUAL BUDGET PROCESS.

AVIATION SAFETY RISK ANALYSIS

Goal:

GOALS:

Intended Outcomes: The Aviation Safety Risk Analysis (ASRA) Program contributes to the achievement of the FAA's strategic goal in the area of aviation safety through the development of risk management methodologies, prototype tools, technical information, procedures, and practices. Consistent with these responsibilities, the ASRA Program collaborates with industry to ensure that risk management decision support tools, including safety critical performance measures and risk indicators, are properly defined, developed, tested, and evaluated prior to implementation and ensure changes to the regulations, advisory material and procedures are smoothly implemented.

Agency Outputs: The outputs of the Risk Management Decision Support project will make the aviation oversight processes (certification, surveillance, investigation, and certification management) more effective, efficient, systematic, and targeted to risk by reengineering the business processes and the introduction of new risk management tools. The Aircraft Maintenance – Maintainability and Reliability, and Safety Analysis Methodology projects will support the development/modification of rules and advisory material. The Runway Capacity project will provide guidance material to identify a range of landing distances needed by aircraft to safely conduct land and hold short operations under normal approach procedures.

Customer/Stakeholder Involvement: The ASRA program has encouraged broad industry and government participation across all projects:

- The System Approach for Safety Oversight (SASO) is a Flight Standards Service program that has as its primary goal the application of a systems approach, cooperative problem solving, and proactive risk management principles to operations affecting aviation safety
- The Subcommittee on Aircraft Safety (SAS) of the FAA Research, Engineering and Development Advisory Committee (REDAC) recommended that SASO, including ASRA research tasks, work closely with the air carriers Directors of Safety. The subcommittee representatives from industry, academia, and other government agencies review the activities of the ASRA Program annually
- Technical Community Representative Groups (TCRGs) – representatives from FAA headquarters and the directorates apply formal guidelines to ensure that the program's R&D projects support new rulemaking and comply with existing rules
- The Certification Process Study Response Team, consisting of representatives from both FAA and industry, provides guidance regarding safety information requirements with respect to oversight processes related to aircraft certification and certification maintenance
- The ASRA program and the Helicopter Association International worked to develop the Maintenance Malfunction Information Reporting System (MMIR), a risk analysis software tool to improve the collection, storage, and transfer of service difficulty reports and part warranty information
- The ASRA program and industry are developing system engineering models of air carrier operations, repair stations and training centers

Accomplishments: The program is focused on incorporating system safety principles into its research efforts to support the reengineering of the oversight system. Research results are provided to Aircraft Certification and Flight Standards personnel for incorporation into regulations and advisory material. Recent program accomplishments include:

- Continuing Analysis and Surveillance System Models that were incorporated into an Advisory Circular and guidance material
- The inclusion of additional software changes to the MMIR that provides the helicopter industry with trends related to helicopter parts to be used to determine the maintenance requirements for helicopters

- System Engineering Models and associated regulations of air carrier operations, repair station operations, and training simulators that will be used to reengineer the oversight processes
- The SASO Final Requirements Document that was used to establish the baselined needs for the SASO program

R&D Partnerships: The ASRA Program partners with industry, academia, and other government agencies including:

- The Safety Management Focus Group composed of directors of safety from various major and regional carriers to review and provide input to the Risk Management Decision Support project
- The Netherlands Civil Aviation Authority to jointly conduct research on aviation system safety initiatives via a Memorandum of Cooperation
- The Helicopter Association International to cooperatively develop and enhance the Web-based system that now accepts data from the industry for safety analysis
- NASA to annually co-sponsor the Workshop on Risk Analysis and Safety Performance Measurement
- The University of Maryland with cost sharing on a grant to develop an integrated hazards framework
- Wichita State University with cost sharing on a grant to develop techniques that will evaluate and improve the usability and reliability of aviation technical manuals

MAJOR ACTIVITIES AND ANTICIPATED FY 2004 ACCOMPLISHMENTS:

Risk Management Decision Support

- Start to:
  - Develop a methodology to identify the information requirements required to support a decision support system
  - Meet with the Safety Management Focus Group to review and provide input to the project
- Continue to:
  - Develop systems engineering models of FAA-certificated entities, e.g. airlines, repair stations, aviation schools, etc. within the air transportation system
  - Develop risk/hazard/accident models and tools derived from FAA and industry accepted system safety models of FARs related to safety oversight
  - Design next generation safety critical performance measures and risk indicators based on system engineering and system safety models
  - Conduct a workshop with industry and NASA to discuss aviation risk analysis and safety performance measurement methodologies and tools
- Complete:
  - Preliminary development of a methodology to assess the state of health/illness of an air carrier from the perspective of safety
  - Development of a methodology to measure regulatory effectiveness
  - A preliminary conceptual design of an oversight evalution system

Aircraft Maintenance - Maintainability and Reliability

- Start to:
  - Develop tool calibration program for repair stations
- Continue to:
  - Develop techniques to evaluate and improve the usability and reliability of aviation technical manuals

- Complete:
  - A web-based information system prototype to facilitate collection and dissemination of aircraft maintenance related data
  - Guidance and training requirements for repair stations certification according to the new revision Title XIV Code of Federal Regulations (CFR) Part 145.163
  - The Safety Through Accurate Technical Statistics (STATS) software module and integrated it into the web-based MMIR system that tracks helicopter flight hours and flight profiles
  - Toolbox kit to assist in the process of developing and validating aviation technical manuals

Safety Analysis Methodology

- Start to:
  - Validate methodology to determine an appropriate certification credit level for design features intended to reduce the effect of system errors
- Continue analysis or review of:
  - Airworthiness information needed to identify unsafe conditions and assess their relative impact on continued airworthiness
- Operational information needed to set the standard probability values of encountering the subject conditions as addressed in Advisory Circular 25.1309-1B, Appendix 4
  - FAA-maintained certification and continued airworthiness data; start to develop methods for sorting and evaluating data sets to identify technical areas posing fleet-wide safety risks

Runway Capacity Analysis

- Start to:
  - Develop a systematic method to collect operational flight data and surface surveillance radar data for aircraft landing performance analysis
  - Identify a range of landing distances needed by aircraft that currently comprise the U.S. fleet to safely conduct land and hold short operations (LAHSO) under specified approach procedures
  - Develop tools to model the safety hazards of Rejected Landing Procedures associated with LAHSO and to identify possible training solutions

FY 2005 PROGRAM REQUEST:

Ongoing Activities

Research will continue to focus on the areas listed in the GOALS section above. Government, industry, and academia aviation safety subject matter experts will be invited to participate in the research efforts. This cooperation will ensure that risk management decision support tools, including safety critical performance measures and risk indicators, are properly defined, developed, tested, and evaluated prior to implementation. The participation of these subject matter experts will also ensure the smooth tranistion of new regualtions and advisory materials. The program will also investigate, test, and recommend improvements, including standardization, to the quality (and quantity) of data used in risk analysis. It will also complete studies to identify and verify flight standards and aircraft certification safety information requirements.

New Initiatives

No new major initiatives are planned in FY 2005.

KEY FY 2005 PRODUCTS AND MILESTONES:

Risk Management Decision Support

- Start to:

  - Develop the conceptual design of a decision support sytem
- Continue to:
  - Meet with the Safety Management Focus Group to review and provide input to the project
  - Develop a methodology using an integrated framework for the identification, classification, and assessment of hazards
  - Develop a methodology to design performance measures and risk indicators based on system engineering models and an integrated hazard framework
  - Develop a methodology to identify the information requirements required to support a decision support system
  - Conduct a workshop with industry and NASA to discuss aviation risk analysis and safety performance measurement methodologies and tools
- Complete:
  - The validatation of a methodology to measure regulatory effectivenss
  - The development of systems engineering models of FAA-certificated entities (or FAR parts) within the air transportation system

Aircraft Maintenance - Maintainability and Reliability

- Start to:
  - Develop technical materials to support the policy development for maintenance program for US registered aircraft under Title 14 CFR Part 129.14
- Continue to:
  - Develop training materials for both FAA and industry personnel in the use and understanding of CASS
  - Develop tool calibration program for aircraft maintenance
- Complete:
  - The development of techniques to evaluate and improve the usability and reliability of aviation technical manuals

Safety Analysis Methodology

- Continue to:
  - Analyze the airworthiness information needed to identify unsafe conditions and assess their relative impact on continued airworthiness
  - Develop methods for sorting and evaluating certification and continued airworthiness data in ways that identify technical problem areas that pose a fleet-wide safety risk
- Complete:
  - The validation of the methodology that would provide an appropriate level of certification credit for design features intended to reduce the effects of system errors
  - Analysis of the operational information to set the standard probability values of encountering the subject conditions as addressed in Advisory Circular 25.1309-1B, Appendix 4

Runway Capacity Analysis:

- Start to:
  - Develop a program plan to expand the use of operations on intersecting runways

- Develop air traffic and flight procedures for operating intersecting runways

- Continue to:
  - Develop a systematic method to collect operational flight data and surface surveillance radar data for aircraft landing performance analysis
  - Identify a range of landing distances needed by aircraft that currently comprise the U.S. fleet to safely conduct land and hold short operations under specified approach procedures
  - Develop tools to model the safety hazards of Rejected Landing Procedures associated with LAHSO and to identify possible training solutions

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2003)	$42,801
FY 2004 Enacted	7,851
FY 2005 Request	8,640
Out-Year Planning Levels (FY 2006-2009)	36,035
Total	$95,327

Budget Authority ($000)	**FY 2001 Enacted**	**FY 2002 Enacted**	**FY 2003 Enacted**	**FY 2004 Enacted**	**FY 2005 Request**
Contracts:					
Aviation Safety Risk Analysis	5,150	4,377	5,124	6,194	6,329
Personnel Costs	1,414	1,253	1,317	1,528	2,091
Other In-house Costs	78	154	98	129	220
Total	**6,642**	**5,784**	**6,539**	**7,851**	**8,640**

OMB Circular A-11, Conduct of Research and Development ($000)	**FY 2001 Enacted**	**FY 2002 Enacted**	**FY 2003 Enacted**	**FY 2004 Enacted**	**FY 2005 Request**
Basic	0	0	0	0	0
Applied	6,642	5,784	6,539	7,851	8,640
Development (includes prototypes)	0	0	0	0	0
Total	**6,642**	**5,784**	**6,539**	**7,851**	**8,640**

Aviation Safety Risk Analysis Product and Activities	FY 2005 Request ($000)	Program Schedule					
		FY 2004	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009
060-110 Aviation Safety Risk Analysis							
Risk Management Decision Support	**$3,122**						
Conduct Meeting with Management Focus Group		◆	◇	◇	◇	◇	◇
Complete Development of System Engineering Models of FAA Certified Entities		◆	◇				
Develop Methodology to Develop an Integrated Framework for the Identification, Classification, and Assessment of Hazards		◆	◇	◇	◇		
Develop Methodology to Design Performance Measures and Risk Indicators Based on System Engineering Models and Integrated Hazards Framework		◆	◇	◇	◇		
Develop Methodology to Identify Information Requirements Necessary for Decision Support System		◆	◇	◇	◇	◇	
Develop Oversight Evaluation Tool to Determine Effectiveness and Efficiency of the Oversight System		◆	◇	◇			
Develop a Conceptual Design of Decision Support System			◇	◇	◇		
Conduct Workshops with Industry To Discuss Aviation Risk Analysis and Safety Performance Measurement Methodologies		◆	◇	◇	◇	◇	◇
Aircraft Maintenance – Maintainability & Reliability	**$842**						
Develop Technical Materials to Support Policy Development Regarding Maintenance Program for US-Registered Aircraft Under Title CFR 14 Part 129.14		◆	◇	◇	◇		
Develop Safety Through Accurate Technical Statistics (STATS) Software Module and Integrate It into MMIR		◆					
Develop Web-Based Information System for Aircraft Maintenance		◆					
Complete Guidance and Training requirements for Repair Station Certification According to Revised Part 145.163		◆					
Develop Tool Calibration Standards for Aircraft Maintenance		◆	◇	◇			
Develop Techniques to Evaluate and Improve Usability and Reliability of Aviation Technical Manuals		◆	◇				
Identify Methods, Techniques, etc. to Improve Certification and Maintenance Processes Currently in Place Throughout the Airplane's Service Life				◇	◇	◇	
Safety Analysis Methodology	**$600**						
Continue the Analysis of Airworthiness Information to Identify Unsafe Conditions and Assess their Relative Impact on Continued Airworthiness		◆	◇	◇	◇	◇	◇
Continue Analysis of Operational Information to Establish Standard Probability of Value of Encountering Subject Conditions as Addressed in Advisory Circular 25.1309-1B, Appendix 4		◆	◇				
Complete Validation of Methodology to Determine Appropriate Credit Level for Design Features Intended to Reduce the Effect of System Errors		◆	◇				
Continue Development of Methods for Sorting and Evaluating Certification and Continuous Airworthiness Data to Identify Technical Problems Posing a Fleet-Wide Safety Risk		◆	◇	◇	◇	◇	◇
Runway Capacity Analysis	**$1,765**						
Identify Range of Landing Distances needed by Aircraft That Currently Comprise the U.S. Fleet to Safely Conduct Land Hold Short Operations under Specified Approach Procedures		◆	◇	◇	◇		
Develop Tools to Model the Safety Hazards of Rejected Landing Procedures Associated with LAHSO & to Identify Possible Training Solutions		◆	◇	◇	◇		
Develop Program Plan to Expand the Use of Operations on Intersecting Runways			◇	◇	◇		
Develop Sir Traffic and Flight Procedures for Conducting Operations on Intersecting Runways			◇	◇	◇		
Personnel and Other In-House Costs	**$2,311**						
Total Budget Authority	**$8,640**	**$7,851**	**$8,640**	**$8,779**	**$8,920**	**$9,060**	**$9,276**

◆ - Activities Accomplished ◇ - Activities Planned

NOTE: OUT YEAR NUMBERS ARE FOR PLANNING PURPOSES ONLY. ACTUAL FUNDING NEEDS WILL BE DETERMINED THROUGH THE ANNUAL BUDGET PROCESS.

COMMERCIAL SPACE TRANSPORTATION SAFETY

Goal:

Intended Outcomes:

Non-traditional Flight Safety Systems and Integrated Vehicle Health Monitoring

The commercial launch industry anticipates the need for non-traditional flight safety systems and integrated vehicle health monitoring (IVHM) systems to be used during RLV launch and reentry activities to enhance flight safety capability and reduce operational costs. Flight safety systems (FSSs) are those systems that minimize the threat to public safety posed by a malfunctioning vehicle. Non-traditional versions of these systems will include fully autonomous systems and semi-autonomous systems that interface with pilots and/or the range. IVHM systems are onboard systems that will detect, report, and isolate malfunctioning units and sub-systems of a vehicle to ensure safety and mission success. The utility of these safety systems could be crucial to the development of an RLV capable of maintaining a consistent level of safety at a variety of ranges and spaceports.

Initial research of these systems was conducted during fiscal year 2003, resulting in a report describing the current and intended designs and uses of these systems across the aerospace industry. Follow-on work has been scheduled for fiscal year 2004 to further analyze unresolved issues and ongoing projects. Specific attention will be given to ongoing autonomous FSS research, including Phase 3 of NASA's Autonomous FSS program. To that end, the major outcome of this program will be a report that details the status of these technologies and suggests approaches and guidelines for their regulation.

Medical and Equipment Criteria for Human Spaceflight

The FAA is now researching the basis of standards for carrying humans aboard commercial space transportation vehicles. Intended outcomes from this program include developing: 1) Medical criteria for human survival during commercial space transportation operations; and 2) Minimum requirements for environmental control and life support systems on manned commercial space transportation vehicles.

Development and Calibration of a Launch and Reentry Vehicle Hazard Model

The FAA intends to improve public safety regarding commercial space launch vehicle by investigating improvements to methods of analyzing debris survivability. The goal of this task is the development of a tabular handbook that would allow our customers—launch and reentry vehicle developers—to perform a first-hand estimation of casualty expectation for the reentry phase of their mission. AST will focus on the aero-thermal demise of the reentry debris analysis process in developing this handbook.

Inspection Technique for Thermally-Protected Commercial Space Vehicle

The FAA intends to improve public safety regarding space launch vehicles by investigating improvements to the techniques and methods associated with the inspection of space launch vehicles that utilize thermal protection systems (TPSs). Thermal protection systems are used to protect critical aerospace structures exposed to severe heat environments. Given the criticality the TPS function with respect to ensure public safety, FAA will embark on research geared toward new non-destructive evaluation (NDE) methods for use with TPS.

Development of Launch and Reentry Vehicle Debris Database

This task seeks to enhance public safety and agency efficiency through the development of improved methods for public risk assessments. Specifically, the FAA also is working to facilitate improved public safety evaluations for launch and re-entry vehicles by studying the debris recovered from Columbia. The FAA will develop a database with detailed information of individual fragments recovered from Columbia.

Examination of Launch Area Expected Casualty Methods

This task seeks to enhance public safety and agency efficiency through the development of improved methods for public risk assessments. The FAA is now researching methods currently employed by DoD and the launch industry to

estimate public risk due to potential launch vehicle debris impacts in the vicinity of the launch point. This task will identify any important differences that may influence the maximum probable loss values set by AST.

Radio Frequency (RF) Blackout During Reentry

Radio Frequency blackout is caused by the high electron concentration in the plasma around the reentering reusable launch vehicle (RLV), which absorbs or attenuates the electromagnetic communication wave. Several alleviation techniques may be considered to arrive at some safe operational procedures; these include high power antennas, high frequency range (~10-100 GHz) operation, generation of local magnetic fields to create a spectral window through which RF waves can propagate or flow field modification techniques.

This study will seek to understand the phenomena and presently known methodologies for mitigation to develop recommendations that might be useful for: 1) Applications to RLV entering civilian commercial space and operating under the Space and Air Traffic Management System (SATMS); and 2) Identification of frequency bands that might be amenable to continuous communication in the presence of plasma fields.

Agency Outputs:

Non-traditional Flight Safety Systems and Integrated Vehicle Health Monitoring

The FAA ensures public safety associated with RLV launch and reentry activities through the development of regulations that identify the requirements for safe RLV operations. This research program provides the resources to address the concerns regarding public safety issues associated with non-traditional flight safety systems and IVHM systems. This research could develop and frame the criteria and/or methodology that can be applied to RLV concepts utilizing these systems to provide a method for determining their safety on a case-by-case basis.

Medical and Equipment Criteria for Human Spaceflight

In accordance with the Commercial Space Act of 1998, the FAA developed regulations for licensing RLV missions and the conduct of commercial space reentry activities. Other than when the crew is part of the flight safety system, these regulations, however, do not specifically address the safety of humans aboard commercial space transportation vehicles. Commercial operators have proposed design and operational concepts that include the carriage of crew and passengers. These concepts are being researched, and results will provide inputs to future rulemaking or provide guidance on an interim basis.

Development and Calibration of a Launch and Reentry Vehicle Hazard Model

The FAA ensures public safety associated with commercial launch vehicle activities by developing safety standards and acceptable methods of verification. This research program will help identify public safety issues associated the AST-licensed launch and reentry activities, and the public safety issues associated with the mitigation of risk posed by debris to people on the ground.

Inspection Technique for Thermally-Protected Commercial Space Vehicle

This research program provides the technical support needed to develop requirements or guidelines for inspecting components of space vehicles that are protected by TPS.

Development of Launch and Reentry Vehicle Debris Database

This research develops an important benchmark of real world data that will enhance the safety of the licensed launch and reentry operations by facilitating more realistic public risk assessments. The database will be made available for official use only. Based on this database and other information, AST can develop guidelines for developing credible launch and re-entry debris models.

Examination of Launch Area Expected Casualty Methods

AST is responsible for ensuring that the public is protected during a FAA licensed launch or reentry activity. A critical component of any launch license application is the public risk assessment. Currently various methods are in use by federal ranges and launch industry contractors. This task will produce a side-by-side comparison of current methods based on consistent input data. The report generated by this effort will help launch license applicants and AST

understand the influence of various modeling assumptions and methods on their public risk assessments. This task will enhance the efficiency of AST's review and approval of safety critical processes for expendable and reusable launch vehicle operations. This task will facilitate improvements in the methodology AST uses to set the maximum probable loss values used to determine launch insurance requirements.

Radio Frequency Blackout During Reentry

Complete a study detailing: 1) Understanding of methods to mitigate communications outages during reentry and enable controller communications for operation within NAS; 2) Recommended techniques for reduced RF reception errors on reentry craft for GPS and other RF navigation signals; 3) Recommended methods for uninterrupted communications through plasma field and the requisite frequency bands; and 4) Documented results of the foregoing investigations.

Customer/Stakeholder Involvement:

Non-traditional Flight Safety Systems and Integrated Vehicle Health Monitoring

This research initiative is the product of a suggestion for study by the FAA Commercial Space Transportation Advisory Committee (COMSTAC) Reusable Launch Vehicle Working Group (RLVWG). The results of this research will be presented to the RLVWG for comment and suggestions for further investigation. The resulting guidelines will be prepared with the intent of providing the industry with a less burdensome but equally effective approach to the regulation of the launch and reentry of vehicles utilizing these systems.

Medical and Equipment Criteria for Human Spaceflight

This program will help to fill the current need for federal regulations that specifically address the safety of humans aboard commercial space transportation vehicles.

Development and Calibration of a Launch and Reentry Vehicle Hazard Model

The outcomes of this task will benefit both government regulators and the commercial space launch and reentry industry by reducing the effort required to comply with FAA regulations.

Inspection Technique for Thermally-Protected Commercial Space Vehicle

The report generated in effort could be shared with NASA and DoD. The Reusable Launch Vehicle industry and the public will be well served with the guidelines generated from this R&D project.

Development of Launch and Reentry Vehicle Debris Database

NASA and the USAF are also providing funds to support this effort. The ultimate goal of this research is the development of guidelines for launch and re-entry debris models that are consistent with the best available data. The launch industry and the public will be well served by such guidelines.

Examination of Launch Area Expected Casualty Methods

The USAF is collaborating on this project to provide input data (such as vehicle probability of failure, and population characteristic descriptions) that are consistent with their public risk assessments. The report generated by this effort will help launch license applicants and AST understand the influence of various modeling assumptions and methods on their public risk assessments. The ultimate goal of this research is the development of guidelines for public risk assessment based on the best available methods and data. The launch industry and the public will be well served by such guidelines.

Radio Frequency Blackout During Reentry

The stakeholders of this work are the prospective and nascent RLV industry, and the ultimate beneficiaries of this work are: 1) the RLV industry, for a reliable means of communication during the reentry and ascent phases of the flight under SATMS; 2) The FAA in providing a safe means for the Controllers in communicating with the reentering craft; and 3) The safety of the occupants in the RLVs and the general public by ensuring a safe mode of operation during a high speed reentry.

Accomplishments:

Non-traditional Flight Safety Systems and Integrated Vehicle Health Monitoring

During fiscal year 2003, the FAA produced a report containing: 1) Descriptions of existing and proposed designs of these systems, 2)Identification of technologies that will enable regulatory approval of these systems, and 3) Draft plan of verification for these systems.

Medical and Equipment Criteria for Human Spaceflight

The FAA has produced draft documents on: 1) The Role of the FAA Office of Aerospace Medicine in Support of Manned Commercial Space Transportation; 2) Proposed Medical Certification Standards for Commercial Aerospace Crews; 3) Recommended Guidelines for Medical Screening of Commercial Space Passengers; and 4) Draft guidelines pertaining to the cabin environment.

Development and Calibration of a Launch and Reentry Vehicle Hazard Model

The initial documentation of the proposed methodology for calculating the casualty expectation for reentry over populated areas has been submitted to AST. A sample of the tabular parameters (i.e. casualty area, expected casualty, probability of impact, etc.) of the lookup tables that are slated for the final handbook has also been submitted to AST.

Inspection Technique for Thermally-Protected Commercial Space Vehicle

Aerospace Corporation provided a white paper discussing various inspection methods for inspecting TPS. The Aerospace Corporation Paper identified three NDE techniques, Narrow Band Eddy, Capacitance, and Ultrasonic inspection, that potentially promise to provide adequate and accurate inspection of the structure beneath the TPS. As a result of the Aerospace Corporation's white paper, the project was redefined to provide limitations of these existing inspection techniques.

Development of Launch and Reentry Vehicle Debris Database

Examination of Launch Area Expected Casualty Methods

Radio Frequency Blackout During Reentry

FY2004 is the first year of funding for these projects.

R&D Partnerships:

Non-traditional Flight Safety Systems and Integrated Vehicle Health Monitoring

Various tasks associated with this research may be accomplished in conjunction with ongoing NASA, Department of Defense (DoD), and U.S. Air Force efforts in this field.

Medical and Equipment Criteria for Human Spaceflight

The FAA and NASA are developing an MOA to expand their working relationship for developing minimum launch vehicle and human flight safety requirements. The FAA plans to brief the COMSTAC's RLV Working Group on the findings from this R&D project.

Development and Calibration of a Launch and Reentry Vehicle Hazard Model

The FAA will work closely with subcontractors to accomplish the objective of the debris hazard modeling research task. The outcome of the research could provide benefits to other U.S. space agencies (i.e., NASA, DoD, etc.).

Inspection Technique for Thermally-Protected Commercial Space Vehicle

The FAA is working with Aerospace Corporation which is associated in this effort closely with DoD and NASA.

Development of Launch and Reentry Vehicle Debris Database

The FAA will work closely with subcontractors to accomplish the objective of the task. An interagency effort is underway involving NASA and the USAF. The outcome of the research will benefits other U.S. space agencies including NASA and DoD.

Examination of Launch Area Expected Casualty Methods

The FAA will work closely with subcontractors and the USAF to accomplish the objective of the task. The outcome of the research will benefits other U.S. space agencies including NASA and DoD.

Radio Frequency Blackout During Reentry

Identified candidate organizations with accomplishments in the area of RF Blackout and plasma physics phenomenology. Established cooperative research partnership with Air Force Research Laboratory (AFRL), Hanscom AFB, MA.

MAJOR ACTIVITIES AND ANTICIPATED FY 2004 ACCOMPLISHMENTS:

Non-traditional Flight Safety Systems and Integrated Vehicle Health Monitoring

Create regulatory approaches and guidelines that can lend to the development of standards for public safety for non-traditional flight safety systems and IVHM systems.

Medical and Equipment Criteria for Human Spaceflight

Report on the interim research findings.

Development and Calibration of a Launch and Reentry Vehicle Hazard Model

The development of a tabular handbook an applicant can utilize as an acceptable method of performing a first-hand conservative estimation of their expected casualty. The goal is to provide our customers with a less costly method of performing a debris survivability analysis during reentry.

Inspection Technique for Thermally-Protected Commercial Space Vehicle

Provide a report identifying basic issues concerning the inspection of components protected by TPS, and describe the inherent strengths and limitations of the various techniques as they relate to the projected needs of future RLV systems. Additionally the report will outline the current state of developmental inspection methods that offer strong potential for future application to RLV inspection and which may be relevant to the future needs of RLV systems.

Development of Launch and Reentry Vehicle Debris Database

Establish the requirements for a database of individual fragments recovered from Columbia relevant to public safety assessments. Organize an inter-agency working group and establish a process for development of a database with detailed information about individual fragments recovered from Columbia. Collect data on Columbia debris relevant to public safety assessments.

Examination of Launch Area Expected Casualty Methods

Report (draft) interim research findings.

Radio Frequency Blackout During Reentry

Acceptance letter for partnering on this research effort received from AFRL. A statement of work developed and a summary and final report to AST.

FY 2005 PROGRAM REQUEST:

All Projects

Authorized commercial space transportation research is currently included in the Operations budget.

KEY FY 2005 PRODUCTS AND MILESTONES:

Non-traditional Flight Safety Systems and Integrated Vehicle Health Monitoring

Follow-on tasks in FY 2005 may be proposed if unresolved issues involving these systems are identified during FY 2004 efforts.

Development of Launch and Reentry Vehicle Debris Database

- Develop and disseminate for official use a database with detailed information about individual fragments recovered from Columbia
- Analyze Columbia debris database and assess the potential for of un-recovered fragments to pose a public hazard

Examination of Launch Area Expected Casualty Methods

- Report on project research findings
- Publish updated guidelines on expected casualty analysis as necessary

Radio Frequency Blackout During Reentry

Continue the advancement of public safety of RLVs through the development of reliable tracking, surveillance and communications for RLVs and other crafts operating in transitional space regime and NAS.

APPROPRIATION SUMMARY

	Amount ($000
Appropriated (FY 1982-2003)	$0
FY 2004 Enacted	0
FY 2005 Request	0
Out-Year Planning Levels (FY 2006-2009)	0
Total	$0

Budget Authority ($000)	FY 2001 Enacted	FY 2002 Enacted	FY 2003 Enacted	FY 2004 Enacted	FY 2005 Request
Contracts:					
Commercial Space Transportation Safety	0	0	0	0	0
Personnel Costs	0	0	0	0	0
Other In-house Costs	0	0	0	0	0
Total	**0**	**0**	**0**	**0**	**0**

OMB Circular A-11, Conduct of Research and Development ($000)	FY 2001 Enacted	FY 2002 Enacted	FY 2003 Enacted	FY 2004 Enacted	FY 2005 Request
Basic	0	0	0	0	0
Applied	0	0	0	0	0
Development (includes prototypes)	0	0	0	0	0
Total	**0**	**0**	**0**	**0**	**0**

Notes:

- Commercial Space Transportaion Safety funding is included in the Operations Appropriation.

- Programs and projects are not separately budgeted in Operations Appropriation.

- Out year funding is under review.

Commercial Space Transportation Safety Product and Activities	FY 2005 Request ($000)	Program Schedule					
		FY 2004	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009
Commercial Space Transportation Safety							
Non-Traditional Flight Safety and Integrated Vehicle Health Monitoring	*						
Create Regulatory Approaches and Guidelines to Develop Public Safety Standards		◆	◇				
Inspection Techniques for Thermally Protected Commercial Space Vehicles	*						
Report on Limitation of Currently Existing Non-Destructive Inspection Techniques		◆					
Report on Inspection Techniques for Future Development							
Develop and Calibrate a Launch and Reentry Vehicle Hazard Model	*						
Program Management Plan							
Tabular Handbook – for Performing a First-Hand Conservative Estimation of Their Expected Casualty		◆					
Assess Medical and Equipment Criteria for Human Space Flight	*						
Program Management Plan							
Develop Report on Research Findings		◆					
Development of a Launch and Reentry Vehicle Debris Database	*						
Program Management Plan							
Establish Data Requirements for Database		◆					
Provide Interested Parties Best Available Data Collected to Date for Official Use Only		◆	◇				
Examination of Launch Area Expected Casualty Methods	*						
Program Management Plan							
Develop Draft Interim Report on Research Findings		◆					
Develop a Report on the Research Findings		◆	◇				
Radio Frequency Blackout During Reentry	*						
Obtain Acceptance Letter for Partnership with AFRL		◆					
Provide Statement of Work		◆					
Provide Quarterly Report		◆					
Provide Final Briefing and report		◆					
Total Budget Authority	*	*	*	*	*	*	*

◆ - Activities Accomplished ◇ - Activities Planned

NOTES: OUT YEAR NUMBERS ARE FOR PLANNING PURPOSES ONLY. ACTUAL FUNDING NEEDS WILL BE DETERMINED THROUGH THE ANNUAL BUDGET PROCESS.
IN THE FACILITIES AND EQUIPMENT APPROPRIATIONS, PERSONNEL AND OTHER COSTS ARE BUDGETED IN ACTIVITY 6, NOT THE PROGRAM BUDGET LINE ITEM.

* Funding requests for all years are under review.

FIRE RESEARCH AND SAFETY

Goal:

Intended Outcomes: The Fire Research and Safety Program contributes to achievement of the FAA's strategic goal in the area of aviation safety by developing technologies, procedures, test methods, and criteria to prevent accidents caused by hidden in-flight fires and fuel tank explosions and to improve survivability during a post-crash fire.

The program focuses on near-term improvements in aircraft fuel tank explosion protection, fire detection and suppression systems, and interior materials fire test methods and criteria, as well as long range research to develop the enabling technology for ultra-fire resistant cabin materials.

Agency Outputs: The FAA establishes rules for aircraft fire safety affecting material selection, design criteria, and operational procedures. New test methods, reports, and journal publications produced by the fire research and safety program provide the major source of technical information used in developing these regulations and offer advice on how to comply with them. New materials and formulations and government owned patents provide industry with new safety products developed through long term research.

Customer/Stakeholder Involvement: The Fire Research and Safety Program has worked with the following industry and government groups:

- The Aircraft Safety Subcommittee of the FAA Research, Engineering and Development Advisory Committee (REDAC) – subcommittee representatives from industry, academia, and other government agencies annually review the activities of the Fire Research and Safety Program
- Technical Community Representative Groups (TCRBs) – representatives from FAA headquarters and the directorates apply formal guidelines to ensure that the program's R&D projects support new rulemaking and comply with existing rules
- The Aviation Rulemaking Advisory Committee (ARAC), the Boeing Company and Airbus Industries – focused on fuel tank inerting
- Aircraft manufacturers (U.S. and foreign), airlines, foreign airworthiness authorities, chemical companies, material suppliers and aircraft fire safety equipment manufacturers – focused on interior material fire tests and improvement of fire detection and suppression systems
- National Transportation Safety Board (NTSB) – focused on in-flight fire incidents, on-site accident investigations, and related testing

Accomplishments: The FAA operates the world's most extensive aircraft fire test facilities. FAA certification engineers receive training in these facilities each year and, at the request of the NTSB, program personnel participate in major fire accident and incident investigations. The Fire Research and Safety Program annually publishes approximately two-dozen reports and papers.

Outstanding program accomplishments include:

- Designed, built and demonstrated an on-board inerting system to prevent fuel tank explosions, persuading Boeing to seek FAA certification of this system for 737 and 747 aircraft
- Determined the minimum concentration of oxygen required to inert a fuel tank to prevent explosions
- Conducted the first-ever ground based fuel tank inerting flight tests in a joint program with Boeing
- Developed improved fire test criteria for thermal acoustic insulation including in-flight fire resistance and post-crash fire burn-through resistance, mandated by FAA in 2003
- Completed and published tests, resulting in an FAA airworthiness directive, requiring the removal of metallized Mylar insulation in over 700 aircraft because of its vulnerability to ignition by an electrical arc
- Completed and published cargo fire hazard tests, resulting in the retrofit of 3400 transport aircraft with fire detection and suppression systems

- Developed and published minimum performance standards for halon replacement fire extinguishing agents in cargo compartments, lavatories and hand-held extinguishers
- Published upgraded Aircraft Material Fire tests Handbook
- Transferred Microscale Combustion Calorimeter technology to DOW Chemical Company in first-ever licensing of FAA/DOT patented technology
- Developed and patented a hand-held extinguisher nozzle that discharges carbon dioxide as dry ice, increasing the agent effectiveness

R&D Partnerships: The following are representative of ongoing Fire Research and Safety Program involvement with its R&D partners:

- FAA-sponsored international systems fire protection working group – R&D involves fuel tank protection, fire/smoke detectors and halon replacement
- FAA-sponsored international aircraft materials fire test working group – R&D involves standardization to minimize lab-to-lab variation in results
- Integrated FAA and NASA program – R&D involves research on gas generation systems for fuel tank protection and emergency oxygen, advanced fire/smoke detectors and ultra fire resistant materials
- Inter-agency working group on fire and materials – promotes technology exchange among U.S. Government agencies and prevents unwarranted duplication of work
- Inter-agency agreement with the National Institute of Standards and Technology (NIST) – develops fire retardant mechanisms and rapid screening tools for flammability
- Memorandum of cooperation with the British Civil Aviation Administration (CAA) – R&D involves a variety of fire safety research efforts
- Letters of cooperation (individually) with Canadian, Japanese, and European aviation authorities
- Grant programs with educational institutions and consortia
- Arrangements with Fortune 100 companies to share development costs for new fire resistant materials (e.g., the FAA has licensed a program-patented heat release calorimeter to Dow Chemical Co.)

MAJOR ACTIVITIES AND ANTICIPATED FY 2004 ACCOMPLISHMENTS:

Fire Resistant Materials

- Develop and demonstrate a thermoset resin for composite materials used in cabin sidewalls, ceiling and stowage bins with an order of magnitude reduction in heat release rate
- Develop and publish in a referred journal the relationship between the heat release rate and ignition resistance (small flame) of plastics

Fire Safety Improvements

- Conduct flight tests with NASA on FAA-developed inerting systems for preventing fuel tank explosions
- Measure fuel vapor concentrations during FAA/NASA 747 flight tests for comparison with predictive models
- Develop improved fire test criteria for electrical wiring. This continues the plan to upgrade all hidden material fire test criteria that was initiated with thermal acoustic insulation
- Design, test and evaluate methods of accessing hidden fires above the cabin ceiling ("attic" space) and extinguishing the fires with hand-held extinguishers
- Complete tests to determine the quantities of replacement extinguishing agents (CF3I and HFC-125) for equivalent effectiveness to currently used halon in engine nacelle fire extinguishing systems
- Initiate testing to determine the impact of the planned Boeing 7E7 composite fuselage and wings on in-flight and postcrash fire safety

FY 2005 PROGRAM REQUEST:

Ongoing Activities

Development and testing will continue on an on-board fuel tank inerting system. The goal is to identify a simple and light, but highly effective and reliable, inerting system that will have minimum impact on the airplane. FAA will test an advanced inerting system being developed by NASA in FAA's ground based 737 test aircraft. Also, design criteria for an inerting system will be developed to guide other designs under development and in support of potential rulemaking.

Work will continue on the development and validation of a fuel tank flammability model that is an important tool for assessing the risk of aircraft fuel tank explosions.

Further improvements and design criteria will be identified to safeguard against hidden fires in accessible areas. The recent development of improved fire test criteria for electrical wiring, will be standardized. Tests will be conducted by different laboratories to ensure reproducible results. Also, guidance material will be developed to minimize the liklihood of contaminants that made hidden materials much more flammable. Finally, recommendations will be made for the most cost effective approach for fighting hidden in-flight fires, with hand-held extinguishers and for areas requiring a fixed fire detection and extinguishing system.

Work will continue on assessing the potential fire safety concerns related to the planned composite fuselage/wings for the new highly efficient Boeing 7E7 transport airplane. The impact of a composite aircraft with regard to providing an equivalent level of safety (as current aircraft) during an in-flight fire and postcrash fire burnthrough will be determined and appropriate recommendations will be made.

Research will continue to develop the enabling technologies for ultra-fire resistant aircraft interior materials. A thermoplastic will be demonstrated for use in passenger service units, seat trays and other molded parts, with an order of magnitude reduction in heat release rate compared to current material requirements. Also, previously demonstrated low heat release thermoset resins will be fabricated into small coupons and tested for in-service requirements, such as mechanical strength, and physical and chemical properties.

New Initiatives

No new initiatives are planned in FY 2005.

KEY FY 2005 PRODUCTS AND MILESTONES:

Fire Safety Improvements

- Develop design criteria for a fuel tank inerting system
- Evaluate advanced fuel tank inerting system developed by NASA in FAA's ground-based 737 test aircraft
- Complete standardization of improved fire test methods for electrical wiring
- Develop guidance material to minimize contamination in hidden areas that make materials more flammable
- Recommend the most cost effective methods for fighting hidden in-flight-cabin fires
- Determine the impact of the new Boeing 7E7 composite aircraft on in-flight and postcrash fire safety

Fire Resistant Materials

- Develop and demonstrate thermoplastic for use in making passenger service units, seat trays and other molded cabin components with an order of magnitude reduction in heat release rate
- Fabricate and test samples of low heat release thermoset resin composites for mechanical strength, and physical and chemical properties

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2003)	$112,009
FY 2004 Enacted	9,668
FY 2005 Request	5,578
Out-Year Planning Levels (FY 2006-2009)	23,673
Total	$150,928

Budget Authority ($000)	**FY 2001 Enacted**	**FY 2002 Enacted**	**FY 2003 Enacted**	**FY 2004 Enacted**	**FY 2005 Request**
Contracts:					
Fire Research and Safety	1,671	2,340	2,903	6,311	2,316
Personnel Costs	2,856	2,621	2,796	3,043	2,890
Other In-house Costs	213	281	252	314	372
Total	**4,740**	**5,242**	**5,951**	**9,668**	**5,578**

OMB Circular A-11, Conduct of Research and Development ($000)	**FY 2001 Enacted**	**FY 2002 Enacted**	**FY 2003 Enacted**	**FY 2004 Enacted**	**FY 2005 Request**
Basic	0	0	0	0	0
Applied	4,740	5,242	5,951	9,668	5,578
Development (includes prototypes)	0	0	0	0	0
Total	**4,740**	**5,242**	**5,951**	**9,668**	**5,578**

Fire Research and Safety Product and Activities	FY 2005 Request ($000)	Program Schedule					
		FY 2004	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009
061-110 Fire Research & Safety							
Fire Resistant Materials	**$1,053**						
Demonstrate Resins, Thermoplastic, Elastomer and Fiber with Order of Magnitude Reduction in Heat Release		◆	◇	◇	◇		
Complete Property Tests of Ultra-Fire Resistant Resins, Thermoplastic, Elastomer, and Fiber Specimens			◇	◇	◇	◇	
Develop and Publish Journal Report on Relationship Between Heat Release Rate and Ignition Resistance (Small Flame) of Plastics		◆					
Fire Safety Improvement	**$1,263**						
Measure Fuel Vapor Concentrations During FAA/NASA 747 Flight Tests for Comparison with Predictive Models		◆					
Conduct Flight Tests on Fuel Tank Inerting System		◆					
Recommend Design Criteria for Fuel Tank Protection System			◇				
Evaluate Advanced Fuel Tank Inerting System Developed by NASA in FAA's Ground-Based 737 Test Aircraft			◇				
Conduct Flight Tests on Advanced Fuel Tank Inerting System					◇		
Develop and Standardize Improved Fire Test Criteria for All Hidden Materials			◇				
Recommend Firefighting Methods for All Hidden Areas			◇				
Develop Hidden Fire Safety Requirements				◇			
Assess Fire Safety Impact on 7E7 Composite Fuselage			◇				
Develop 7E7 Composite Fuselage Fire Safety Requirements/Guidelines					◇		
Characterize Cabin & Fuselage Fires in VLTA				◇			
Define VLTA Fire Protection Methodology							◇
Improve Oxygen System Design Guidelines/Requirements						◇	
Examine Aircraft Vulnerability to Hydraulic Fluid Fires							◇
Personnel and Other In-House Costs	**$3,262**						
Total Budget Authority	**$5,578**	**$9,668**	**$5,578**	**$5,711**	**$5,843**	**$5,977**	**$6,142**

◆ - Activities Accomplished ◇ - Activities Planned

NOTE: OUT YEAR NUMBERS ARE FOR PLANNING PURPOSES ONLY. ACTUAL FUNDING NEEDS WILL BE DETERMINED THROUGH THE ANNUAL BUDGET PROCESS.

FLIGHTDECK / MAINTENANCE SYSTEM INTEGRATION HUMAN FACTORS

Goal:

Intended Outcomes: The Flightdeck/Maintenance/System Integration Human Factors Program contributes to achievement of the FAA's strategic goal in the area of aviation safety by:

- Developing more effective methods for aircrew, inspector, and maintenance technician training
- Enhancing the understanding and application of error management strategies in flight and maintenance operations
- Increasing human factors considerations in certifying new aircraft and in equipment design and modification
- Improving aircrew, inspector, and maintenance technician task performance

Agency Outputs: The Human Factors Research and Engineering Division provides the research foundation for FAA guidelines, handbooks, advisory circulars, rules, and regulations that help to ensure the safety and efficiency of aircraft operations. The division also develops human performance information which the agency provides to the aviation industry for use in designing and operating aircraft and training personnel.

The 1995 *National Plan for Civil Aviation Human Factors: An Initiative for Research and Application* provides a technical frameword for the research program. Research categories and associated emphases include:

- Information Management and Display – improving design of computer-human interfaces to reduce information overload and resulting errors
- Human-Centered Automation – improving and maintaining the operator's situational awareness, and providing corrective mechanisms to compensate for operator skills degradation or automation failure
- Human Performance Assessment – assessing cognitive and contextual factors in order to improve operator performance and reduce errors
- Selection and Training – applying program-generated knowledge of human factors to improve selection and training of aviation system personnel

Customer/Stakeholder Involvement: The Human Factors Research Program complies with Public Law 100-591. The program works directly with colleagues in the FAA, government, and industry to support the following R&D programs and initiatives:

- NASA's Aviation Safety Program
- FAA's Voluntary Safety Program Office initiatives including Advanced Qualification Program (AQP), Flight Operations Quality Assurance (FOQA), and Aviation Safety Action Program (ASAP)
- The FAA/Industry Safer Skies initiative – analyzes U.S. and global data to find the root causes of accidents and proposes the means to prevent their occurrence

Accomplishments: The program's output of scientific and technical human performance information includes:

Information Management and Display

- Developed a manual that addresses appropriate human factors considerations in designing flight deck operating documents that was adopted for use by International Civil Aviation Organization (ICAO)
- Produced human factors design and evaluation considerations for aviation applications such as electronic flight bags and head-up displays in air transports

Human-Centered Automation

- Completed job aids and checklists ensuring human factors considerations in the certification of technologies such as flight deck displays and global positioning system receivers
- Developed initial performance models for automation usage in air carrier cockpits

Human Performance Assessment

- Provided guidance to reduce the likelihood of loss of control following a loss of vacuum or failure of vacuum-powered attitude indicators
- Demonstrated that simplified English improves non-native English speaker aircraft maintenance technicians' comprehension for aircraft maintenance work cards
- Completed initial mapping of flight data parameters onto AQP qualification standards

Selection and Training

- Developed standards and implemented a distance learning aviation maintenance technician and aviation maintenance technician-transport (AMTT/AMT-T) training curriculum
- Developed and validated a proceduralized pilot crew resource management (CRM) training and assessment system
- Improved line operations safety audit (LOSA) methodology adopted by ICAO to help air carriers to identify human-centered safety vulnerabilities

R&D Partnerships: The Flightdeck/Maintenance/System Integration Human Factors Program collaborates with industry and other government programs through the following partnering vehicles and forums for information exchange:

- Joint Safety Analysis Teams (JSATs) and Joint Safety Implementation Teams (JSITs) within the Safer Skies Agenda – coordinated with NASA and industry, these efforts stress human factors issues in developing intervention strategies for the reduction of air carrier and general aviation accidents
- DOD Human Factors Engineering Technical Advisory Group – FAA participates in this group to promote a joint vision for automation and related technical areas
- Domestic and international aviation maintenance partnerships with industry – the emphasis is on achieving research results that can be applied to real-world problems
- Society of Automotive Engineers G-10 subcommittees – the FAA participates on all of the Society's subcommittees involving human factors to adapt their findings to aviation standards, guidelines, etc.
- Twenty-one FAA grants to universities support research on air carrier training, flight deck automation, aviation accident analysis, general aviation, and aviation maintenance technician and inspector training

MAJOR ACTIVITIES AND ANTICIPATED FY 2004 ACCOMPLISHMENTS:

Information Management and Display

- Identify an inexpensive, reliable field methodology to make general aviation night vision goggles compatible with cockpit lighting
- Identify human factors issues in instrument procedures design
- Determine whether digitizing maintenance data (manuals, work cards, inspection information, and/or procedures for sign off) affects maintenance performance

Human-centered Automation

- Expand human factors Certification Job Aid for FAR Part 25 flight decks
- Develop certification guidelines for integrated technology in general aviation cockpits

Human Performance Assessment

- Develop and demonstrate Precision Visual Flight Rules (PVFR) routes that use the global positioning system to enhance helicopter pilots' ability to navigate more efficiently in the National Airspace System (NAS)

- Complete analysis on Part 145 operators language related error patterns, and measure the effectiveness of recovery/mitigation strategies in improving written comprehension of maintenance related documentation
- Expand analyses to isolate precursors of general aviation pilot error

Selection and Training

- Enhance Rapidly Reconfigurable Line Oriented Evaluations (RRLOEs) scenario generation software and expanded collection of air carrier user data
- Develop methodologies for integrating ASAP, FOQA and AQP data
- Expand methodologies to link performance data to curriculum modification procedures in AQP programs
- Develop training guidelines for error management in air carrier cockpits

FY 2005 PROGRAM REQUEST:

The program will continue to focus on providing technical information and advice to improve aircrew, inspector, maintenance technician, and aviation system performance. The emphasis will remain on developing guidelines, tools, and training to enhance error capturing and mitigation capabilities in the flight deck and maintenance environments, and on developing human factors tools to ensure that human performance considerations are adequately addressed in the design and certification of flightdecks and equipment.

Ongoing Activities

Information Management and Display

- Develop human factors guidance for instrument procedures design
- Develop human factors guidance for multiple weather sources on a multi-function display
- Develop certification guidelines for integrated technology in general aviation cockpits

Human-Centered Automation

- Develop certification guidelines for integrated technology in general aviation cockpits
- Provide expanded guidance addressing training for automated cockpits
- Develop the human factors Certification Job Aid for FAR Part 25 flightdecks

Human Performance Assessment

- Provide guidance for pilots' visual detection, recognition and identification of objects at different distances during low-visibility flight conditions
- Refine air carrier flight and simulator data analysis tools
- Continue developing guidance on the possible effects of language barriers upon maintenance deficiencies
- Develop intervention matrix for predicting the effectiveness of selected interventions in reducing human errors in aviation accidents

Selection and Training

- Develop advanced analysis methods linking FOQA and simulator data
- Provide guidance on simulator motion requirements for recurrent pilot training
- Assess expansion of realistic radio communications in simulator training
- Standardize and codify essential Line Operations Safety Audit (LOSA) elements and training guidelines for cockpit error management in support of transferring LOSA technology to ICAO air carriers

- Complete guidance on an industry-wide benchmark for general aviation inspection training including a prototype training system on appropriate media.

New Initiatives

No new initiatives are planned in FY 2005.

KEY FY 2005 PRODUCTS AND MILESTONES:

Information Management and Display

Complete the development of:

- Guidance on implementation of ASAP for aircraft maintenance
- Initial human factors guidelines for instrument procedure design
- Guidelines regarding multiple weather sources on a multi-function display

Human-centered Automation

- Complete development of Certification Job Aid for FAR Part 25 flightdecks
- Provide certification guidelines for integrated technology in general aviation cockpits

Human Performance Assessment

- Complete guidance for acceptable vision standards and procedures to be used by nondestructive inspection and testing (NDI/NDT) and visual inspection personnel relative to aircraft and aircraft components
- Complete Web-based appliction to allow users to understand relationships between theHuman Factors Analysis and Classification System (HFACS) taxonomy and National Transportation Safety Board accident data

Selection and Training

- Provide ASAP enhancements for reporting factors contributing to aviation incidents
- Complete guidance on new air carrier CRM training post 9/11
- Provide guidance on training air carrier flight crews for unexpected events
- Expand software enhancements to Rapidly Reconfigurable Line Oriented Evaluations scenario generation tools; collect air carrier user data
- Expand the development of:
  - LOSA cockpit threat and error management methodology
  - Knowledge assessment software tool and mental models for operating automated aircraft

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2003)	$167,721
FY 2004 Enacted	8,344
FY 2005 Request	8,294
Out-Year Planning Levels (FY 2006-2009)	34,751
Total	$219,110

Budget Authority ($000)	**FY 2001 Enacted**	**FY 2002 Enacted**	**FY 2003 Enacted**	**FY 2004 Enacted**	**FY 2005 Request**
Contracts:					
Flightdeck/Maintenance/System Integration Human Factors	7,016	6,617	6,330	4,647	4,751
Personnel Costs	2,283	2,398	2,582	2,856	2,664
Other In-house Costs	779	891	845	841	879
Total	**10,078**	**9,906**	**9,757**	**8,344**	**8,294**

OMB Circular A-11, Conduct of Research and Development ($000)	**FY 2001 Enacted**	**FY 2002 Enacted**	**FY 2003 Enacted**	**FY 2004 Enacted**	**FY 2005 Request**
Basic	0	0	0	0	0
Applied	10,078	9,906	9,757	8,344	8,294
Development (includes prototypes)	0	0	0	0	0
Total	**10,078**	**9,906**	**9,757**	**8,344**	**8,294**

Flightdeck/Maintenance/System Integration Human Factors Product and Activities	FY 2005 Request ($000)	Program Schedule					
		FY 2004	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009
081-110 Flightdeck/Maintenance/System Integration Human Factors							
Selection and Training	**$1,900**						
Develop Automation Reconfigurable Event Sets		◆	◇	◇			
Provide Guidance for Simulator Motion Requirements		◆	◇	◇			
Develop/Distribute Advanced Data Analysis Methods Linking FOQA and Simulator Data		◆	◇	◇			
Develop Training Guidelines for Flightdeck Error Management		◆	◇	◇	◇	◇	◇
Develop Guidance on Information Required to Revise FAR 61.141 that Specifies Credit Hours for which FTDs and PCATDs May Be Used in Lieu of Actual Flight		◆	◇	◇	◇		
Initiate Development of Guidance on Use of Advanced Technology for Inspection Training and Reducing Errors in General Aviation Maintenance		◆	◇	◇			
Human Performance Assessment	**$380**						
Provide Expanded APMS Methodologies and Analysis Capabilities		◆	◇				
Provide Guidance on Effectiveness of Realistic Radio Communications in Line-oriented Evaluations		◆	◇				
Continue Examination on Acceptable Vision Standards and Procedures for Personnel Involved in NDT/NDI and Visual Inspection of Aircraft and Aircraft Components		◆	◇				
Demonstrate Precision Visual Flight Rules (PVFR) Routes That Use Global Positioning System		◆	◇				
Human Centered Automation	**$1,378**						
Provide Industry and FAA Guidance Addressing Training for Automated Cockpits		◆	◇				
Complete Certification Job Aid for FAR Part 23/25 Flight-decks and other FAR Parts (e.g., 23, 27, 29) as Determined by FAA Sponsor		◆	◇				
Develop Certification Guidelines for Integrated Technology in General Aviation Cockpits		◆	◇	◇	◇	◇	◇
Information Management and Display	**$1,093**						
Develop Guidelines for Instrument Procedures Design		◆	◇	◇	◇	◇	◇
Develop Guidelines for the Display of Weather on Multi-Function Displays		◆	◇				
Provide Guidance on the Effects of Digitizing Maintenance Data upon Maintenance Performance		◆	◇	◇			
Identify factors that Can Maximize the Likelihood of Successful Implementation of ASAP for Aircraft Maintenance Programs		◆	◇	◇			
Personnel and Other In-House Costs	**$3,543**						
Total Budget Authority	**$8,294**	**$8,344**	**$8,294**	**$8,445**	**$8,595**	**$8,747**	**$8,964**

◆ - Activities Accomplished ◇ - Activities Planned

NOTE: OUT YEAR NUMBERS ARE FOR PLANNING PURPOSES ONLY. ACTUAL FUNDING NEEDS WILL BE DETERMINED THROUGH THE ANNUAL BUDGET PROCESS.

GENERAL AVIATION AND VERTICAL FLIGHT TECHNOLOGY (GA&VF)

Goals:

Intended Outcomes: The General Aviation and Vertical Flight (GA&VF) Technology Program directly supports goals and programs delineated in FAA's *Flight Plan 2004-2008*, the Aviation Safety Action Plan, the RTCA Free Flight Action Plan, the Operation Evolution Plan, Terminal Area Operations Advisory Committee requirements, and the ongoing NAS architecture development effort. The program emphasizes direct needs of light general aviation airplanes, helicopters and tiltrotor aircraft.

The program contributes to achieving three strategic goals and associated objectives of *Flight Plan 2004-2008*. It supports the strategic goal of *Increased Safety,* with application to general aviation, by providing visual flight rules (VFR) pilots with instrument flight rules (IFR)-like environments and conducting research to increase the situational awareness of the pilots of small general aviation (GA) aircraft. It also supports the strategic goal of *Greater Capacity* through initiatives that increase GA access to high-demand metropolitan areas by adding new routes, and by improving landing and departure capabilities for helicopters during bad weather. And it supports the strategic goal of *International Leadership* through its recommendations to incorporate standards and procedures developed by the GA&VF Technology Program into ICAO Standards and Practices.

The applied research and development activities of the GA&VF Technology Program support GA requirements for communications, navigation, and surveillance (CNS) services, and improved avionics technologies. Program products are integral to NAS modernization. Advanced CNS technology not only provides for precise navigation of aircraft and aircraft position determination for air traffic management (ATM), but it also enables these services at locations that are currently unavailable to GA users. New and improved standards and regulations associated with this program help to improve the safety, cost-effectiveness, and efficiency of air traffic services, and by so doing they safely expand the capacity of the NAS.

The GA&VF Technology Program supports research and development across all GA operations. Its research areas align with the most critical components for GA participation in NAS-terminal and en route operations: landing facilities, airmen and controller training, and low-cost avionics. The program also supports the development of procedures and standards that enable simultaneous non-interfering (SNI) operations between fixed-wing and vertical flight aircraft.

The programs new terminal instrument procedures (TERPS) criteria for GA and vertical flight aircraft are based on specific aircraft and avionics performance characteristics within the context of new CNS capabilities. This approach promises to make better aviation services safely and efficiently available in new locations. For example, low-altitude CNS research is helping to evaluate the future low-altitude en route infrastructure needed for Free Flight.

Agency Outputs: The GA&VF Technology Program helps generate design criteria, provides technical data for advisory circulars and training documents, and supports collaborative technology integration with the current and future NAS. The program also provides technical and management expertise to establish successful partnerships with industry.

Efforts that rely upon GA&VF Technology Program products and services include:

Terminal Airspace Infrastructure – Criteria and design parameters for instrument approaches to hospital, corporate, and business district heliports. These results support TERPS criteria, aircraft and avionics certification standards, IFR operations, emergency medical service (EMS) procedures and training guidance, as well as minimum aviation system performance standards, minimum operational performance standards, and technical standard orders.

Low Altitude Air Routes – Procedures and test protocols designed in an operational environment to work with global positioning system (GPS) navigation, new surveillance capabilities, and terrain-avoidance technology developed by other projects. These results help to integrate newer, safer, and more efficient rotorcraft routings into the NAS, and can be useful to other GA aircraft operating at low altitudes.

Avionics and Cockpit Technology – Avionics, auxiliary equipment, procedures, and related testing to enable the safe, efficient integration of GA and vertical flight aircraft into the NAS. These results support the introduction of GPS-based navigation, landing and surveillance systems, and related work under the Free Flight initiative, and the Safer Skies initiative.

Low Altitude CNS Infrastructure – Route system guidelines, cockpit display guidelines, noise abatement procedures, and terminal and en route system integration plans for low altitude CNS operations.

Homeland Security – Feasibility assessments of concepts and procedures related to GA aircraft operations, related avionics and security equipment requirements.

Customer/Stakeholder Involvement:

Customers Include:

- Helicopter Association International
- Aircraft Owners and Pilots Association
- National Association of State Aviation Officials
- Association of Aeronautical Medical Services
- National Emergency Medical Services Pilots Association
- Airborne Law Enforcement Association

Stakeholders include:

- American Helicopter Society
- National Business Aircraft Association
- Experimental Aircraft Association
- General Aviation Manufacturers Association
- Small Aircraft Manufacturers Association

Accomplishments:

- Evaluated current technology to support precision IFR approaches to heliports and vertiports
- Developed vertical flight satellite navigation (SATNAV) road map
- Developed operations concept plan to provide enhanced weather data and flight information services to helicopter operations in the Gulf of Mexico as part of the next generation CNS technology
- Developed strategic plan and operations concept for vertical flight operations using advanced technology
- Established criteria to publish mountain pass waypoints on VFR charts
- Completed initial phases of testing and data collection to support helicopter instrument landing system (ILS) approaches to lower minimum weather conditions
- Reported on procedures for providing enhanced services for time-critical (e.g., law enforcement or EMS) VFR vertical flight operations
- Amended the Aeronautical Information Manual to provide guidance on special practices and techniques for helicopters in off-shore environments
- Reported on maximum safe descent angle for helicopters during the visual segment of an instrument approach to a heliport
- Reported on current and developing heliport lighting and marking technologies
- Conducted tests and collected data on human factors affecting how precision VFR (PVFR) routes are flown

R&D Partnerships: The GA&VF Technology Program collaborates with the Centers of Excellence for General Aviation for research initiatives and with industrial partners on projects involving various types of aircraft and pilot experience levels. Experts from aviation industries review test specifications with program personnel, and companies provide qualified pilots to participate in experiments. This spirit of cooperation helps the program to develop standards and criteria that accurately reflect industry's performance capabilities.

MAJOR ACTIVITIES AND ANTICIPATED FY 2004 ACCOMPLISHMENTS:

- Complete simulation, testing and analysis of helicopter ILS approaches for safe use in lower than the present minimal weather conditions
- Report on human factors issues affecting how PVFR routes are flown
- Report on simulation study to identify SNI routes and assess benefits of reduced SNI route widths in the New York terminal area
- Initiate design of SNI routes and procedures in the New York terminal area
- Report on helicopter performance and instrumentation required for heliport instrument approaches
- Establish Industry/FAA partnership for SNI demonstration in the northeast corridor
- Initiate testing and data collection for heliport steep approaches and departures
- Report on operation and inspection standards for use with a non-radar flight locating system as required by CFR Part 135.79
- Research new lighting concepts and technology for IFR and VFR operations at heliports

FY 2005 PROGRAM REQUEST:

The requested funding will allow the program to continue to focus on the areas listed in the GOALS section of this narrative. Specific R&D areas will include SNI operations in the terminal area, precision approaches to heliports, heliport lighting, and reduction of controlled flight into terrain (CFIT) for light general aviation aircraft and vertical flight aircraft.

KEY FY 2005 PRODUCTS AND MILESTONES:

- Initiate testing and demonstration of vertical flight and light general aviation SNI routes in the northeast corridor
- Develop PVFR route criteria, associated advisory circular material, and FAA information for Air Traffic and Flight Standards handbooks
- Design reduced-width SNI routes in the northeast corridor based on optimized C/N/S capabilities and the results of simulation
- Develop heliport IFR steep angle approach, missed approach, and departure standards for helicopters
- Initiate design of complex helicopter and tiltrotor approaches and departures
- Demonstrate new lighting technologies for IFR and VFR operations at a test heliport
- Complete information for advisory circular and Flight Standards Inspector Handbook information for GPS CFIT and enhanced vision technology

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2003)	$6,295
FY 2004 Enacted	1,392
FY 2005 Request	1,500
Out-Year Planning Levels (FY 2006-2009)	7,500
Total	$16,687

Budget Authority ($000)	FY 2001 Enacted	FY 2002 Enacted	FY 2003 Enacted	FY 2004 Enacted	FY 2005 Request
Contracts:					
General Aviation and Vertical Flight Technology Program	900	1,000	993	1,392	1,500
Personnel Costs	0	0	0	0	0
Other In-house Costs	0	0	0	0	0
Total	**900**	**1,000**	**993**	**1,392**	**1,500**

OMB Circular A-11, Conduct of Research and Development ($000)	FY 2001 Enacted	FY 2002 Enacted	FY 2003 Enacted	FY 2004 Enacted	FY 2005 Request
Basic	0	0	0	0	0
Applied	0	0	0	0	0
Development (includes prototypes)	900	1,000	993	1,392	1,500
Total	**900**	**1,000**	**993**	**1,392**	**1,500**

General Aviation and Vertical Flight Technology Program Product and Activities	FY 2005 Request ($000)	Program Schedule					
		FY 2004	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009
General Aviation and Vertical Flight Technology Program							
Simultaneous Non Interfering Operations	**$700**						
Precision VFR Route Testing and Analysis		◆	◇				
Northeast Corridor (NEC) Using Existing Standards		◆	◇	◇			
Establish FAA/Industry Partnership for NEC Demonstration		◆			◇		
NEC Simulation/Modeling for Separation Standards Reduction		◆	◇				
NEC Simulation/Modeling for WAAS/LAAS Standards			◇	◇			
NEC Demonstration with WAAS/LAAS Standards					◇	◇	◇
Recommendation for WAAS/LAAS SNI National Development					◇		
Instrument Operations at Heliports/Vertiports	**$700**						
Copter ILS Lighting Simulation, Test and Evaluation		◆					
Heliport IFR/VFR Lighting Research, Design, Test and Demonstration		◆	◇	◇	◇		
Helicopter Performance/Instrumentation for Heliport Approaches		◆					
Helicopter/Tiltrotor criteria for Steep Angle Approaches		◆	◇	◇	◇		
Helicopter/Tiltrotor criteria for Complex Approaches			◇	◇	◇	◇	◇
Advanced Technology and Procedures Applications	**$100**						
Non Radar Surveillance for CFR Part 135.79 Flight Locating		◆					
Surveillance Options for Light GA Aircraft Pilot Guidance				◇	◇		
Enhanced Vision for Light GA Aircraft Pilot and Inspector Guidance			◇	◇	◇		
Copter CFIT GPWS/TAWS Pilot and Inspector Guidance		◆	◇				
Copter/Light GA Synthetic Displays Pilot and Inspector Guidance			◇	◇	◇	◇	
Improve Weather Distribution in the Gulf of Mexico					◇	◇	
Homeland Security							
Analyze Options for GAVF Support of Homeland Security				◇	◇	◇	◇
Total Budget Authority	**$1,500**	**$1,400**	**$1,500**	**$1,500**	**$2,000**	**$2,000**	**$2,000**

◆ - Activities Accomplished ◇ - Activities Planned

NOTES: OUT YEAR NUMBERS ARE FOR PLANNING PURPOSES ONLY. ACTUAL FUNDING NEEDS WILL BE DETERMINED THROUGH THE ANNUAL BUDGET PROCESS.
IN THE FACILITIES AND EQUIPMENT APPROPRIATIONS, PERSONNEL AND OTHER COSTS ARE BUDGETED IN ACTIVITY 6, NOT THE PROGRAM BUDGET LINE ITEM.

NAS SAFETY ASSESSMENTS

GOALS:

Intended Outcomes: FAA research and development associated with air traffic safety focuses on developing and implementing an ICAO compliant safety management system (SMS). The SMS will incorporate the principles of safety risk management (SRM) to enhance the safety of the FAA's Air Traffic System.

Implementation of the SRM will provide the following benefits to the NAS:

- Consistent, well defined system safety methodology and terminology across programs
- Application of safety risk management to all safety-significant changes in the NAS
- Guidance and training for new safety engineers to improve overall quality and technical accuracy of safety analyses
- Expanded collection, consolidation, and analysis of safety data to enhance safety reporting and assessments
- Definition and communication of remaining risk to guide decision makers

Agency Outputs: The NAS Modernization Program's overall System Safety Management Plan and each individual acquisition program's Integrated Safety Plan support one another. Together they impose the system engineering discipline needed to manage the program's life cycle safely, as required by FAA orders and Acquisition Management System (AMS) policy.

The following products will directly result from SRM activities:

- Agency-wide SMS processes to assess risk and to monitor effectiveness of risk-mitigation strategies
- A safety risk-management program within the Office of the Associate Administrator for Research and Acquisition (ARA) for selected new system acquisitions (through FY 2008)
- 15% reduction, prior to FY 2003, in the number of the most serious air traffic control operational errors (Categories A and B) – no more than 563 occurrences
- Development of the Integrated Safety Engineering Environment (ISEE) tool
- Development of the Hazard Tracking and Risk Resolution (HTRR) tool

Partnerships:

FAA and EUROCONTROL are developing future concepts of operations that will increase capacity with no reduction in safety. Due to the our common goal to reduce the aviation accident rate, and given the limited resources available, there is a need for communicating and combining research efforts from all sides on focused activities in order to contribute to a global understanding of safety and risks, and to develop potential improvements for future ATM. Three areas of collaboration proposed are coordinating safety R&D, understanding system safety, and assessing and improving safety.

MAJOR ACTIVITIES AND ANTICIPATED FY 2004 ACCOMPLISHMENTS:

- Develop an SMS program approach that that initially focuses on implementing targeted NAS changes
- Modify the FAA System Safety Management Program (SSMP) and the Acquisition Management System (AMS)
- Implement ground-based SRM processes
- Initiate SMS based training to support the development of safety skill sets
- Initiate development of the FAA/EUROCONTROL System Safety Techniques Toolbox

- Integrate established methodologies into the ISEE tool. At a minimum include:
  - Operational Safety Analysis
  - Comparative Safety Analysis
  - Preliminary Hazard Analysis
  - System Hazard Analysis
  - Sub-system Hazard Analysis
  - Operations and Support Hazard Analysis
  - Fault Tree Analysis
  - Failure Modes and Effect Analysis
- Continue developing the HTS HTRR tool in support of NAS Modernization projects.

FY 2005 PROGRAM REQUEST:

The requested funding will allow the program to implement:

- Effective and efficient Safety Management System in accordance with International Civil Aviation Organization (ICAO) Annex 11
- Computer-based capability that will form an integral part of the FAA's Intellectual Capital Investment Planning (ICIP) training initiative

KEY FY 2005 PRODUCTS AND MILESTONES:

- Incorporate an on-line capability to provide safety training on each component or module into the ISEE tool
- Complete development of the ISEE tool

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2003)	$0
FY 2004 Enacted	994
FY 2005 Request	1,000
Out-Year Planning Levels (FY 2006-2009)	3,200
Total	$5,194

Budget Authority ($000)	FY 2001 Enacted	FY 2002 Enacted	FY 2003 Enacted	FY 2004 Enacted	FY 2005 Request
Contracts:					
NAS Safety Assesment	0	0	0	994	1,000
Personnel Costs	0	0	0	0	0
Other In-house Costs	0	0	0	0	0
Total	**0**	**0**	**0**	**994**	**1,000**

OMB Circular A-11, Conduct of Research and Development ($000)	FY 2001 Enacted	FY 2002 Enacted	FY 2003 Enacted	FY 2004 Enacted	FY 2005 Request
Basic	0	0	0	0	0
Applied	0	0	0	0	0
Development (includes prototypes)	0	0	0	994	1,000
Total	**0**	**0**	**0**	**994**	**1,000**

NAS Safety Assessment Product and Activities	FY 2005 Request ($000)	Program Schedule					
		FY 2004	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009
NAS Safety Assessment							
Integrated Safety Engineering Environment (ISEE)	**$900**						
Incorporate Ground-Based Safety Analysis Descriptions		◆	◇	◇	◇	◇	◇
Incorporate Airborne-Based Safety Analysis Descriptions		◆	◇	◇	◇	◇	◇
Develop Computer-Based Training Capability		◆	◇	◇	◇	◇	◇
Maintain ISEE Tool		◆	◇	◇	◇	◇	◇
Safety Tools	**$100**						
Integrated Safety Engineering Environment (ISEE)							
Incorporate Ground-Based Safety Analysis Descriptions		◆	◇	◇	◇	◇	◇
Incorporate Airborne-Based Safety Analysis Descriptions		◆	◇	◇	◇	◇	◇
Develop a Computer-Based Training Capability		◆	◇	◇	◇	◇	◇
Maintain ISEE Tool		◆	◇	◇	◇	◇	◇
Hazard Tracking and Risk Resolution							
Achieve a Fully-Oriented System		◆	◇	◇	◇	◇	◇
Capture Incident Data and Convert to Hazards		◆	◇	◇	◇	◇	◇
Align HTTR with SMS Requirements		◆	◇	◇	◇	◇	◇
Total Budget Authority	**$1,000**	**$1,000**	**$1,000**	**$1,000**	**$1,000**	**$1,200**	**$1,200**

◆ - Activities Accomplished ◇ - Activities Planned

NOTES OUT YEAR NUMBERS ARE FOR PLANNING PURPOSES ONLY. ACTUAL FUNDING NEEDS WILL BE DETERMINED THROUGH THE ANNUAL BUDGET PROCESS.
IN THE FACILITIES AND EQUIPMENT APPROPRIATIONS, PERSONNEL AND OTHER COSTS ARE BUDGETED IN ACTIVITY 6, NOT THE PROGRAM BUDGET LINE ITEM.

PROPULSION AND FUEL SYSTEMS

Goal:

Intended Outcomes: The Propulsion and Fuel Systems Program contributes to achievement of the FAA's strategic goal in the area of aviation safety by enhancing the airworthiness, reliability, and performance of civil turbine and piston engines, propellers, fuels, and fuel management systems.

The program develops and validates technologies, tools, methodologies, and materials intended to:

- Transition safely to a new high octane unleaded aviation gasoline that can ensure the continued reliability and safety of general aviation operations
- Improve the structural integrity and durability of rotating turbine engine parts throughout their service life
- Improve design and life management standards for turbine engine rotors
- Improve the melt process standards for premium quality aerospace alloys used in the manufacture of turbine rotor components
- Evaluate other factors and defects that can shorten the fatigue life of turbine rotor disks
- Evaluate any safety impact for the use of compression ignition (diesel) engines for general aviation use
- Determine the impact of Jet A fuel in very low temperature operations

Agency Outputs: The FAA issues certification and advisory standards, and it endorses the specifications and practices recommended by recognized technical societies in order to maintain the airworthiness of aircraft engines, fuels, and airframe fuel management systems. The agency also publishes information in the public domain and sponsors technology workshops, demonstrations, and other means of training and technology transfer. The Propulsion and Fuel Systems Program provides the resources and oversight to deliver the propulsion, fuel, and fuel transfer system technologies needed to implement these agency outputs.

Customer/Stakeholder Involvement: The Propulsion and Fuel Systems Program works with the following industry and government groups:

- The Subcommittee on Aircraft Safety of the FAA Research, Engineering and Development Advisory Committee (REDAC) – subcommittee representatives from industry, academia, and other government agencies review the activities of the Propulsion and Fuel Systems Program annually
- Technical Community Representative Groups (TCRGs) – representatives from FAA headquarters and the directorates apply formal guidelines to ensure that the program's R&D projects support new rulemaking and comply with existing rules
- The Coordinating Research Council (CRC) Unleaded Aviation Gasoline Development Group
- The Aerospace Industries Association (AIA) working subcommittees; Materials & Structures, Rotor Integrity, Rotor Manufacturing and Jet Engine Titanium Quality
- The National Transportation Safety Board (NTSB), particularly with regard to recommendations A-90-89 and A-90-90
- CRC ad hoc group on the effect of red dye contamination of Jet A fuel

Accomplishments:

- Sponsored five joint FAA/Air Force/Navy/NASA workshops on the application of probabilistic design methodology to gas turbine rotating components; published proceedings
- Demonstrated the integrated probabilistic rotor design and life management code (Design Assessment for Reliability with Inspection - DARWIN™) for titanium alloys to provide commercial aircraft

turbine engine manufacturers an approved certification tool to augment the current "safe life" management approach

- Conducted a DARWIN™ Code FAA/Industry training workshop
- Demonstrated and delivered the DEFORM™ defect deformation micro code for analysis of titanium alloy defects during the turbine disk forging process
- Proved that the fleet octane requirement is the single most critical parameter for development of high-octane unleaded aviation gasoline
- Established matrix components for developing candidate fuel formulations
- Tested motor octane and engine endurance associated with candidate fuel formulations
- Defined detonation detection procedures for use by the American Society for Testing and Materials (ASTM D6424) on potential unleaded replacement fuels
- Determined and issued final fleet octane requirements (greater than 100 octane) for unleaded fuel replacement in high performance piston engines
- Published final report on in-service Jet A fuel sample analysis volatility survey
- Reported results of titanium melting enhancements
- Validated a DEFORM™ forging microcode for tracking subsurface anomalies
- Demonstrated a DARWIN™ code version for surface anomalies
- Demonstrated the feasibility of safety net unleaded fuel
- Completed vacuum fatigue crack growth tests on nickel rotor disk super alloys
- Demonstrated portable industrial process monitor for vacuum arc remelting
- Drafted report documenting the impact of red dye contamination in Jet A fuel for continuous engine operation

R&D Partnerships:

- Southwest Research Institute (SwRI) – Turbine Rotor Material Design (TRMD) cooperative grant teaming Pratt and Whitney, General Electric, Honeywell, and Rolls Royce in R&D to provide a probabilistic-based rotor integrity life, risk management certification tool (DARWIN™)
- FAA TRMD cooperative research activities with FAA Engine Titanium Consortium (see budget item A11e, Aging Aircraft)
- SwRI research to determine the acceptable level of fuel dye contamination allowable for the safe, continuous operation of turbine engines; the Defense Energy Support Center, Internal Revenue Service, Air Transport Association, American Petroleum Institute, General Electric Aircraft Engines, Pratt & Whitney, Rolls Royce, Honeywell and Boeing also contributed funding to this effort
- Specialty Metals Processing Consortium (SMPC) – based at Sandia National Laboratory, this consortium includes the Sandia Liquid Metals Processing Laboratory, Allvac, Oremet Titanium Co., RMI Titanium Co., Timet Co., General Electric Aircraft Engines, and Pratt & Whitney
- CRC Unleaded Aviation Gasoline Development Group – includes Texaco, ExxonMobil, Phillips Petroleum, Chevron, British Petroleum, Cessna, Raytheon (Beech), Teledyne Continental, and Textron Lycoming; this group facilitates two-way transfer of technology between government and industry to benefit all participants
- The Cessna Aircraft Company – partnered R&D has demonstrated the feasibility of a temporary (safety net) unleaded 100 octane general aviation fuel
- The FAA Center of Excellence for Airworthiness Assurance (AACE) – this partnering within the FAA leverages monetary and intellectual contributions of university researchers; an AACE-initiated academic partnership with the University of Dayton Research Institute has investigated the performance of Jet A fuel in very low temperature flight operations

- The FAA Center of Excellence for General Aviation in conjunction with direct grants with the University of North Dakota, South Dakota State University and Baylor University – these relationships have produced feasibility studies for the use of ethanol fuel blends as a possible unleaded piston fuel replacement for 100 octane low lead avgas

MAJOR ACTIVITIES AND ANTICIPATED FY 2004 ACCOMPLISHMENTS:

- Demonstrate a temporary safety net, high octane, unleaded piston fuel
- Expand research on blended fuels containing ethanol for general aviation piston engines
- Complete the rotor disk nickel super-alloy anomaly database for use with the DARWIN™ life assessment code
- Continue research, test, and evaluation of compression ignition (diesel) engines for general aviation use
- Continue laboratory characterization and engine ground testing of industry-supplied candidate unleaded fuels
- Draft report documenting an investigation of turbine Jet A fuel operating at very low temperatures (near freeze point)

FY 2005 PROGRAM REQUEST:

Ongoing Activities

Advancement of the probabilistically based turbine engine rotor design and life risk assessment code (DARWIN™) will continue. This code is an FAA approved means to support a damage tolerant based certification enhancement to the current safe life design approach.

The program will continue research on industry-provided lead free fuel formulation candidates including petrochemical and ethanol based fuels to replace the low lead aviation gasoline currently in use. In-house testing will continue to evaluate industry-supplied formulations.

Research will continue into criteria for use in commercial manufacturing standards for premium quality rotor grade materials. This research will concentrate on required rotor disk alloy material melt process improvements.

Research into the metallurgical, cold dwell time load factors that can shorten fatigue life in titanium rotor disk alloys will be continued.

New Initiatives

No new initiatives are planned in FY 2005.

KEY FY 2005 PRODUCTS AND MILESTONES:

- Continue developing advanced melt process controllers for premium quality aerospace alloys
- Continue advancements to the probabilistic rotor design code (DARWIN™) for nickel super alloys that contain multiple anomalies
- Continue developing an understanding of the relationship between cold dwell fatigue and the microstructure of titanium as well as the fatigue life debit
- Complete draft report on dwell time fatigue in titanium alloys
- Continue evaluating unleaded candidate fuels to replace 100 octane low lead avgas

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2003)	$70,319
FY 2004 Enacted	6,607
FY 2005 Request	3,672
Out-Year Planning Levels (FY 2006-2009)	15,321
Total	$95,919

Budget Authority ($000)	**FY 2001 Enacted**	**FY 2002 Enacted**	**FY 2003 Enacted**	**FY 2004 Enacted**	**FY 2005 Request**
Contracts:					
Propulsion Systems Research	6,994	7,344	6,046	5,461	2,646
Personnel Costs	1,114	1,079	1,224	1,052	922
Other In-house Costs	74	145	87	94	104
Total	**8,182**	**8,568**	**7,357**	**6,607**	**3,672**

OMB Circular A-11, Conduct of Research and Development ($000)	**FY 2001 Enacted**	**FY 2002 Enacted**	**FY 2003 Enacted**	**FY 2004 Enacted**	**FY 2005 Request**
Basic	0	0	0	0	0
Applied	8,182	8,568	7,357	6,607	3,672
Development (includes prototypes)	0	0	0	0	0
Total	**8,182**	**8,568**	**7,357**	**6,607**	**3,672**

Propulsion and Fuel Systems Product and Activities	FY 2005 Request ($000)	Program Schedule					
		FY 2004	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009
063-110 Propulsion and Fuel Systems Research							
Turbine Engine Research	**$1,854**						
Advance the Probabilistic Rotor Design Code (DARWIN™) for Nickel Super-Alloys That Contain Multiple Anomalies			◇				
Complete Draft Report on Dwell Time Fatigue in Titanium Alloys			◇				
Demonstrate Advanced Melt Process Controllers for Aerospace Alloys			◇		◇		
Provide Disk Nickel Super-Alloy Database for Use in the DARWIN™ Code		◆					
Unleaded Fuels and Fuel System Safety Research	**$792**						
Continue Lab Characterization and Engine Ground Testing of Candidate Unleaded Fuels		◆	◇	◇	◇	◇	◇
Complete Endurance Demonstration of Safety Net Unleaded Fuel		◆					
Evaluate Ethanol Based Piston Fuel		◆					
Complete Draft Report Documenting the Investigations for Very Cold Jet A fuel Operations		◆					
Continue Investigations to Evaluate the use of Compression Ignition Engines for General Aviation Use		◆					
Continue Evaluating Unleaded Candidate Fuels to Replace 100 Octane Low-Lead Gasoline		◆					
Personnel and Other In-House Costs	**$1,026**						
Total Budget Authority	**$3,672**	**$6,607**	**$3,672**	**$3,731**	**$3,792**	**$3,853**	**$3,945**

◆ - Activities Accomplished ◇ - Activities Planned

NOTE: OUT YEAR NUMBERS ARE FOR PLANNING PURPOSES ONLY. ACTUAL FUNDING NEEDS WILL BE DETERMINED THROUGH THE ANNUAL BUDGET PROCESS.

RUNWAY INCURSION REDUCTION

Goal:

Intended Outcomes: The FAA has undertaken the Runway Incursion Reduction Program (RIRP) to minimize the chance of injury, death and damage, or loss of property caused by runway accidents or incidents within the civil aviation system. The program selects and evaluates runway incursion reduction technologies to validate their technical performance and operational suitability. Based on these evaluations, a business case for program implementation is developed to support Agency investment decisions. Current program initiatives are aimed at evaluating pilot situational awareness tools.

The Program directly contributes to achieving Objective 4, "reduce the risk of runway incursions," of the FAA's *Flight Plan 2004 –2008* strategic goal of *Increased Safety*.

Agency Outputs:

- Qualifying criteria and specifications for low-cost airport surface detection equipment and the integration of (any) related surface visual guidance products, and
- Non-technology solutions, such as improved airport markings/signage, education, training, and advisory circulars.

Customer/Stakeholder Involvement: Runway incursion reduction is second on the National Transportation Safety Board's "Most Wanted List" of safety improvements. Reducing runway incursion incidents remains a top FAA priority as reflected in Safety Objective 4 of the agency strategic plan.

Accomplishments:

- Completed simulation studies to establish a baseline design for a runway status lights (RWSL) airfield lighting system
- Completed RWSL system initial shadow operations tests at Dallas Fort Worth International Airport (DFW)
- Completed evaluation of the Laser Enhanced Holding Position Marking System
- Installed a ground marker system prototype at Concord (CCR), California

R&D Partnerships:

The RIRP Program collaborates with other researchers in the aviation community through:

- A Memorandum of Agreement with the DFW Airport Authority to operate facility's multilateration surface surveillance test bed to evaluate runway safety applications
- An R&D project agreement with MIT Lincoln Laboratory to develop an automated system of RWSL
- A general working agreement with the Volpe National Transportation Systems Center to research and develop surface technology projects

MAJOR ACTIVITIES AND ANTICIPATED FY 2004 ACCOMPLISHMENTS:

- Secure approval of the construction permit for RWSL airfield lighting equipment at DFW
- Complete the RWSL shadow operations retest at DFW
- Install and integrate the RWSL prototype at DFW.
- Complete the initial phase of ground marker system evaluation at CCR
- Evaluate enhanced airport lighting configurations at North Las Vegas Airport

FY 2005 PROGRAM REQUEST:

The requested funding will allow the program to:

- Develop a business case for RWSL
- Conduct the operational validation of the ground marker pilot advisory system
- Develop a final approach runway occupancy signal (FAROS)
- Conduct education, training, and awareness programs

KEY FY 2005 PRODUCTS AND MILESTONES

- Continue research on potential technology solutions for small – to – medium-sized airports
- Continue developing performance standards/requirements for selected runway incursion reduction technologies
- Complete evaluation and business case development for RWSL
- Complete operational assessment of the enhanced lighting configuration
- Develop system specifications for approved projects

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2003)	$29,024
FY 2004 Enacted	8,152
FY 2005 Request	9,100
Out-Year Planning Levels (FY 2006-2009)	20,000
Total	$66,276

Budget Authority ($000)	FY 2001 Enacted	FY 2002 Enacted	FY 2003 Enacted	FY 2004 Enacted	FY 2005 Request
Contracts:					
Runway Incursion Reduction	11,500	5,700	6,656	8,152	9,100
Personnel Costs	0	0	0	0	0
Other In-house Costs	0	0	0	0	0
Total	**11,500**	**5,700**	**6,656**	**8,152**	**9,100**

A-11, Conduct of	FY 2001 Enacted	FY 2002 Enacted	FY 2003 Enacted	FY 2004 Enacted	FY 2005 Request
Basic	0	0	0	0	0
Applied	0	0	0	0	0
Development (includes prototypes)	11,500	5,700	6,656	8,152	9,100
Total	**11,500**	**5,700**	**6,656**	**8,152**	**9,100**

Runway Incursion Reduction Product and Activities	FY 2005 Request ($000)	Program Schedule					
		FY 2004	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009
Runway Incursion Reduction							
Business Case/Investment Analysis Approved Activities	**$1,000**		◇	◇	◇	◇	◇
Dallas-Ft. Worth (DFW) Test Bed							
Upgrade of Test Bed		◆	◇				
Runway Status Lights (RWSL)	**$1,200**						
Surveillance Modifications		◆					
Conduct Shadow Operations 2 Tests		◆					
Install RWSL Prototype at DFW		◆					
Conduct Operational Evaluations			◇				
Resolve OpEval Issues			◇				
JRC ½ Preparation		◆	◇				
Airfield Lighting Contract*				◇			
Limited Deployment Site 1**				◇			
Limited Deployment Site 2***					◇		
System Enhancements						◇	◇
Enhanced Lighting	**$900**						
Evaluate Enhanced Lighting Configurations			◇				
System Specifications (e.g., E-Spec, AC, etc)				◇			
Addressable Marker Board (AMB)	**$100**						
Field Demonstration			◇				
System Specifications (e.g., E-Spec, AC, etc)				◇			
Ground Marker	**$1,800**						
Operational Evaluation		◆					
System Follow-Up Actions to FY 2004 Evaluation			◇				
System Specifications (e. g., E-Spec, AC, etc)				◇			
Final Approach Runway Occupancy System (FAROS)/Flashing PAPI	**$2,600**						
Operational Assessment			◇				
System Specifications (e. g., E-Spec, AC, etc)				◇			
Vehicle Tracking System (VTS)	**$600**						
Conditional Evaluation of Concepts			◇				
VTS Requirements/Architecture				◇			
Total Budget Authority	**$9,100**	**$8,200**	**$9,100**	**$5,000**	**$5,000**	**$5,000**	**$5,000**

◆ - Activities Accomplished ◇ - Activities Planned

*Assume Positive JRC Decisions **Supports Flight Plan Objective 4 ***CIP Increase Required

Notes: OUT YEAR NUMBERS ARE FOR PLANNING PURPOSES ONLY. ACTUAL NEEDS WILL BE DETERMINED THROUGH THE ANNUAL BUDGET PROCESS.
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SAFE FLIGHT 21 – ALASKA CAPSTONE

Goal:

Intended Outcomes: Capstone is a joint government/industry initiative designed to prototype, demonstrate, validate and implement the capabilities of advanced surveillance systems and air traffic procedures associated with "free flight" in a real-world environment. The initiative's first priority is to improve aviation-system safety in Alaska through the introduction of new Communications, Navigation, and Surveillance (CNS) technologies. Capstone enabling technologies are Automatic Dependent Surveillance-Broadcast (ADS-B), Flight Information Services-Broadcast (FIS-B), and Traffic Information Service-Broadcast (TIS-B).

The Capstone initiative is a visible program providing tangible benefits that include: weather, terrain, and traffic information; flight following and locating capabilities; global positioning system (GPS) en route instrument flight rules (IFR) infrastructure and non-precision instrument approaches; and training for pilots with Capstone avionics equipment. The program is building an infrastructure that is consistent with NAS modernization plans while it identifies the transition path for procedure development and technology implementation and provides near-term safety benefits.

The Capstone initiative directly contributes to achieving Objective 3, "reduce accidents in Alaska," of the FAA's *Flight Plan 2004 –2008* strategic goal of *Increased Safety*. It will expand through a three-phased approach from Bethel and Southeast Alaska to the entire state. By FY 2008, Capstone and related initiatives are expected to reduce accidents involving general aviation and Part 135 operators by 20% throughout Alaska.

Agency Outputs: The Capstone Program is essential to risk mitigation in the evolutionary process of bringing emerging technologies into the NAS. Its objectives will be achieved as follows:

- Evaluating the Universal Access Transceiver link
- Conducting operational tests of:
  - FIS-B, weather, wind-shear, Notices to Airmen, and Pilot Reports
  - Cost-effective Controlled Flight into Terrain avoidance through graphical position display
  - Surveillance using ADS-B in non-radar airspace
  - Multilateration for runway safety and terminal surveillance
  - Improved navigation through the use of GPS and WAAS
  - TIS-B

Customer/Stakeholder Involvement: The Safe Flight 21 – Alaska Capstone Program grew from the FAA's Safer Skies initiative. The program is strongly endorsed by the Alaska Industry Council, the Aircraft Owners and Pilots Association, the Airline Pilots Association, the Alaska Aviation Safety Foundation, the Alaska Airmen's Association, the Department of Defense, the State of Alaska Department of Transportation and Public Facilities, the Air Traffic Control Association, the Cargo Airline Association, the MITRE Corporation, U.S. airlines, and the Alaska Capstone Program Office.

Accomplishments:

The following has been accomplished in Alaska under the Safe Flight 21 – Capstone Program:

- Installed Ground Based Transceivers in the Bethel area to provide critical information to controllers, dispatchers, and pilots
- Installed Certified Capstone avionics in over 190 commercial aircraft operating in the Bethel area
- Began installing avionics in aircraft in Southeast Alaska
- Installed and commissioned thirteen automated weather observation systems with weather cameras in the Bethel area and one in Southeast Alaska
- Published 19 first-time GPS approaches for 10 airports

- Trained over 100 pilots and associated personnel on Capstone avionics through the University of Alaska
- Initiated use of the world's first GPS/WAAS receiver as the sole means for *en route* navigation in Alaska

R&D Partnerships: The Capstone program is based on the principle that government and industry must share in developing and implementing new communications, navigation, and surveillance technologies as the nation enters the free flight era.

The FAA works closely with the aviation industry in supporting Safe Flight 21 – Alaska Capstone. This partnership allows the community to share the funding of avionics and ground systems and to build on ongoing industry initiatives. Safe Flight 21 will build on Alaska Capstone activities by:

- Identifying and resolving ADS-B technology issues
- Developing ADS-B operational concepts
- Focusing data collection activities to answer as many operational and avionics certification issues as practical
- Focusing on cockpit human factors issues
- Exploring the use of TIS-B and FIS-B data link messages to receive traffic, weather, and other information in the cockpit
- Developing an integrated cockpit display of terrain, traffic, and weather information
- Ensuring that organizations representing controllers and commercial and general aviation pilots are included in Alaska Capstone planning and in the evaluation of operational enhancements and data link alternatives

MAJOR ACTIVITIES AND ANTICIPATED FY 2004 ACCOMPLISHMENTS:

In FY 2004, the FAA expects to complete the following activities in support of Capstone in Alaska:

- Commission additional Ground Based Transceivers in the Bethel area for Air Traffic Surveillance Upgrade avionics and Ground Based Transceivers to meet recently approved industry standards
- Begin installing primary flight displays and navigation displays and ADS-B avionics in up to 200 aircraft Southeast Alaska Capstone-participating aircraft
- Expand use of RNAV Arrival/Departure Procedures in Southeast Alaska
- Commission two communications sites
- Install and commission Ground Based Transceivers in the Southeast area
- Procure and install second-generation Ground Based Transceivers in Southeast Alaska
- Test surveillance of mixed-equipped (transponder and ADS-B) aircraft via multilateration in the Juneau area
- Develop and demonstrate a prototype satellite communications system to complement the Capstone Ground Based Transceivers
- Complete a strategic plan for expanding Capstone statewide

FY 2005 PROGRAM REQUEST:

The requested funding will provide:

- Ongoing test and evaluation, procedures development, certification tasks, and simulation activities for the activities described above in Southeast Alaska
- Initial expansion of Capstone ground infrastructure for Alaska statewide

KEY FY 2005 PRODUCTS AND MILESTONES:

Key FY 2005 products and milestones involve activities related to the implementation of ADS-B applications in Alaska that prove beneficial in achieving these program outcomes:

- Install ADS-B avionics and Ground Based Transceivers in Southeast Alaska
- Provide Approach Control services for aircraft in the Bethel area
- Provide enhanced low level surveillance and air traffic situational awareness for the Juneau Control Tower

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2003)	$68,971
FY 2004 Enacted	20,975
FY 2005 Request	29,000
Out-Year Planning Levels (FY 2006-2009)	31,100
Total	$150,046

Budget Authority ($000)	FY 2001 Enacted	FY 2002 Enacted	FY 2003 Enacted	FY 2004 Enacted	FY 2005 Request
Contracts:					
Safe Flight 21 - Alaska Capstone	12,200	20,000	19,771	20,975	29,000
Personnel Costs	0	0	0	0	0
Other In-house Costs	0	0	0	0	0
Total	**12,200**	**20,000**	**19,771**	**20,975**	**29,000**

OMB Circular A-11, Conduct of Research and Development ($000)	FY 2001 Enacted	FY 2002 Enacted	FY 2003 Enacted	FY 2004 Enacted	FY 2005 Request
Basic	0	0	0	0	0
Applied	0	0	0	0	0
Development (includes prototypes)	12,200	20,000	19,771	20,975	29,000
Total	**12,200**	**20,000**	**19,771**	**20,975**	**29,000**

Safe Flight 21 – Alaska Capstone Product and Activities	FY 2005 Request ($000)	Program Schedule					
		FY 2004	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009
Safe Flight 21 – Alaska Capstone							
Optional Enhancements	**$29,900**						
Commission Additional Ground Based Transceivers in the Bethel area for Air Traffic Surveillance		◆	◇	◇	◇		
Upgrade Avionics and Ground Based Transceivers to Meet Recently Approved Industry Standards		◆	◇	◇	◇		
Install Primary Flight Displays and navigation Displays and ADS-B Avionics in up to 200 Aircraft Southeast Alaska Capstone Participating Aircraft		◆	◇	◇	◇		
Expand Use of RNAV Arrival/Departure Procedures in Southeast Alaska		◆	◇	◇	◇		
Commission Two Communications Sites		◆	◇	◇	◇		
Install and Commission Ground Based Transceivers in the Southeast Area		◆	◇	◇	◇		
Test Surveillance of Mixed-Equipped (Transponder and ADS-B) Aircraft Via Multilateration in the Juneau Area		◆	◇	◇	◇		
Develop and Demonstrate a Prototype Satellite Communications System that will Complement Capstone Ground Based Transceivers		◆	◇	◇	◇		
Complete a Strategic Plan for Expanding Capstone Statewide		◆	◇	◇	◇		
Continue Test and Evaluation, Procedures Development, Certification Tasks, and Simulation Activities for the Activities Initiated in 2004 in Southeast Alaska			◇				
Begin Expansion of Capstone Ground Infrastructure for Alaska Statewide			◇				
Total Budget Authority	**$29,000**	**$21,100**	**$29,000**	**$14,500**	**$16,600**	**$0**	**$0**

◆ - Activities Accomplished ◇ - Activities Planned

NOTES: OUT YEAR NUMBERS ARE FOR PLANNING PURPOSES ONLY. ACTUAL FUNDING NEEDS WILL BE DETERMINED THROUGH THE ANNUAL BUDGET PROCESS.
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SAFER SKIES

GOALS:

Intended Outcomes: The FAA, other government agencies, and industry launched Safer Skies in April of 1998 in direct response to a White House Commission on Safety and Security goal of sharply reducing fatal aviation accidents within ten years.

Agency Outputs: The implementation of the Safer Skies initiative is resulting in the development of guidance materials and/or revisions to Advisory Circulars (ACs), Aeronautical Information Manuals, Handbook Bulletins for Air Transportation, and Notices to Airmen.

Customer/Stakeholder Involvement:

The FAA, NASA, and the Department of Defense are working jointly with industry participants to analyze causes of accidents and to develop and implement new intervention technologies and strategies to prevent or reduce the leading causes of aviation accidents.

The Commercial Aviation Safety Team (CAST) provides the leadership for identifying causes of accidents and intervening to reduce the commercial accident rate. Their focus is on reducing commercial aviation accidents attributed to uncontained engine failure, Controlled Flight into Terrain (CFIT), approach and landing, loss of control, runway incursions, and weather.

Similarly, General Aviation Joint Steering Committee researchers are committed to reducing the numbers, and increase the survivability, of general aviation accidents caused by CFIT, weather, runway incursions, pilot decision-making, and loss of control.

Other industry members include the Aerospace Industries Association, Airbus Industries, Air Transport Association, Aircraft Owners and Pilots Association, Boeing, Experimental Aircraft Association, Flight Safety Foundation, General Aviation Manufacturers Association, Helicopter Association International, National Air Carrier Association, National Air Transport Association, National Business Aviation Association, Pratt & Whitney (also representing General Electric and Rolls-Royce), and the Regional Airline Association. Employee groups include the Allied Pilots Association, Air Line Pilots Association, International Federation of Air Line Pilots, and the National Air Traffic Controllers Association.

Accomplishments:

CAST is well on its way toward implementing safety interventions for two leading causes of commercial accidents, CFIT and uncontained engine failures. CAST has approved intervention strategies affecting approach and landing accidents and is beginning the implementation phase. Government and industry CAST participants continue to develop intervention strategies for runway incursions, loss of control, and weather.

The General Aviation Joint Steering Committee has completed analyses for CFIT and weather –related accidents. Areas under analysis are pilot decision-making, loss of control, survivability, and runway incursions.

MAJOR ACTIVITIES AND ANTICIPATED FY 2004 ACCOMPLISHMENTS:

- Continue to:
  - Support the work of the Terminal Area Operations Aviation Rulemaking Committee to: evaluate critical safety issues; complete the Joint Safety Analysis Team weather activity; develop an advisory circular outlining approved requirements for the Joint Safety Implementation Team weather program; and issue handbook bulletins supporting new weather products
  - Assess existing and emerging weather-related technologies that affect commercial and GA operations
  - Develop mountain pass guidance to assist GA pilots in safety navigating and in flying both through and within specific mountain passes – five mountain passes are scheduled for completion

  - Develop ACs, guidance, and guidelines for FARs for CFIT in areas of precision-like approach implementation (PAI) programs
- Complete evaluation of Cockpit Display of Traffic Information (CDTI) Enhanced Flight Rules to provide pilots better access to traffic data through cockpit displays
- Begin the Moving Map Integration program to evaluate multifunction displays and avionics by comparing the effectiveness of various equipment packages and procedures

FY 2005 PROGRAM REQUEST:

FY 2005 funding will support implementation of Safer Skies interventions that have been identified by the FAA in collaboration with other government agencies, industry representatives, and employee groups. This request will focus primarily on accident causes related to Runway Incursion and Weather focus areas for commercial and general aviation. These funds will be used for development of criteria and standards for the use of private sector communications/spectrum in mountainous terrain and course development on airport surface movement operations and digital data link pilot usage.

KEY FY 2005 PRODUCTS AND MILESTONES:

During FY 2005 the program will:

- Produce reports on technical aspects of existing non-aeronautical spectrum communication systems and potential communication link applications as applied to specific mountainous locations
- Draft guidance for general aviation and air carrier and operating certificate holders on non-aeronautical spectrum communications
- Develop training courses for aviation safety inspectors on airport surface movement operations and pilots' use of digital data link
- Continue to develop mountain pass guidance to assist GA pilots in safety navigating and flying through and in specific mountain passes – completion of 20 mountain passes scheduled
- Complete the Moving Map Integration program where multifunction displays and various avionics packages will be evaluated comparing equipment and procedure effectiveness
- Continue to assess existing and emerging weather-related technologies that affect commercial and GA operations

APPROPRIATION SUMMARY

	Amount ($000
Appropriated (FY 1982-2003)	$1,987
FY 2004 Enacted	2,982
FY 2005 Request	3,400
Out-Year Planning Levels (FY 2006-2009)	11,300
Total	$19,669

Budget Authority ($000)	FY 2001 Enacted	FY 2002 Enacted	FY 2003 Enacted	FY 2004 Enacted	FY 2005 Request
Contracts:					
Safer Skies	0	0	1,987	2,982	3,400
Personnel Costs	0	0	0	0	0
Other In-house Costs	0	0	0	0	0
Total	**0**	**0**	**1,987**	**2,982**	**3,400**

OMB Circular A-11, Conduct of Research and Development ($000)	FY 2001 Enacted	FY 2002 Enacted	FY 2003 Enacted	FY 2004 Enacted	FY 2005 Request
Basic	0	0	0	0	0
Applied	0	0	0	0	0
Development (includes prototypes)	0	0	1,987	2,982	3,400
Total	**0**	**0**	**1,987**	**2,982**	**3,400**

Note: Out year funding is under review.

Safer Skies Product and Activities	FY 2005 Request ($000)	Program Schedule					
		FY 2004	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009
Safer Skies							
Safer Skies Implementation	**$3,400**						
Identify Operational Requirements for Mountainous and Remote Operating Area Communication Links		◆	◇	◇	◇	◇	◇
Develop Test Plans			◇	◇			
Conduct Evaluations			◇	◇	◇		
Develop Course Materials			◇		◇	◇	◇
Identify AIM and AC Guidance Appropriate for Inclusion in FAA Handbooks			◇	◇	◇	◇	◇
Develop Handbook Materials			◇	◇	◇	◇	◇
Total Budget Authority	**$3,400**	**$3,000**	**$3,400**	**$2,600**	**$2,500**	**$2,800**	**$3,000**

◆ - Activities Accomplished ◇ - Activities Planned

Notes: OUT YEAR NUMBERS ARE FOR PLANNING PURPOSES ONLY. ACTUAL NEEDS WILL BE DETERMINED THROUGH THE ANNUAL BUDGET PROCESS.
IN THE FACILITIES AND EQUIPMENT APPROPRIATIONS, PERSONNEL AND OTHER COSTS ARE BUDGETED IN ACTIVITY 6, NOT THE PROGRAM BUDGET LINE ITEM.

WEATHER PROGRAM - SAFETY

Goal:

Intended Outcomes: The Weather Program contributes to achievement of the FAA's strategic goals in the areas of aviation safety. It also contributes to efficiency and capacity goals as well.

The agency works constantly to provide weather observations, warnings, and forecasts that are more accurate, accessible, and efficient than existing services. Resulting upgrades enhance flight safety, reduce air traffic controller and pilot workload, improve flight planning, increase productivity, and enhance situational awareness.

The weather program supports the FAA's policy of focusing its research, development, and acquisition on "products that will improve the safety and efficiency of the Air Traffic System," and it also directly supports the agency's "Safer Skies", and "Flight Plan" initiatives.

In collaboration with National Weather Service (NWS) and National Aeronautic and Space Administration (NASA) programs, this R, E &D program produces weather algorithms (technology), more accurate and rapid forecasting and dissemination of forecasts (delivery), and enhanced intuitive capability for aviation decision makers. It also supports the development of aviation weather instructional material (education).

Agency Outputs: The weather program develops new and improved weather algorithms that help to solve operational problems that have always challenged aviation. National Airspace System (NAS) research platforms for the program's research include the weather and radar processor, the integrated terminal weather system and the operational and supportability implementation system. NWS platforms are also used.

The program participates in technology transfer that allows private weather service companies that support the NAS to share in the following benefits from the improved algorithms and other weather products developed by the FAA:

- Depiction of current and forecasted in-flight icing areas – enhances safety and aircraft utilization
- Interactive data assimilation, editing and forecast tools – improves aviation advisories and forecasts issued by the NWS
- Depiction of current and forecasted precipitation type and rate – enhances safety in the terminal area
- Short-term forecasts and prediction of ceiling and visibility in the national area – enhances national area safety
- In-situ and remote detection and forecast of enroute turbulence including clear air turbulence – enhances enroute safety

Customer/Stakeholder Involvement: The weather research priorities and plans are consistent with user needs. The program works in concert with the Aerospace Weather Policy and Standards Staff (ARS), and with Flight Standards (AFS).

It derives research projects and priorities from the interagency National Aviation Weather Initiatives (1999). These initiatives are strongly influenced by other NAS drivers, such as "Safer Skies," free-flight implementation, Aviation Weather Mission Need Statement (2002), Traffic Management Unit Weather Needs Document (1999), Flight Plan Safety Objectives, and NAS operational concept documents. The weather program continually revalidates these merged priorities and plans by giving briefings in public forums such as the annual National Business Aircraft Association conference and the Friends/Partners in Aviation Weather Forum.

The program is responsive to the aviation weather service user needs and requirements stated in the Aviation Safety Action Plan. Additionally, it has addressed recommendations and requirements found in several industry-produced documents and publications.

Accomplishments: Major accomplishments and associated benefits of the Weather Program include:

- Provided more accurate, higher-resolution data on upper winds, temperature, and moisture through rapid-update-cycle analyses and forecasts – enhanced safety

- Forecast freezing precipitation aloft and supported rulemaking that prevents turboprops from flying into conditions conducive to in-flight icing – enhanced safety and improved airspace efficiency, aircraft utilization, and safety, especially for commuter aircraft
- Upgraded Next-Generation Weather Radar (NEXRAD) algorithms, storm cell identification and tracking, hail detection, and mesocyclone and tornado detection (leveraged with NWS) – enhanced flight safety through better definition of location, timing, and severity of convective weather hazards
- Transferred the Weather Support to Deicing Decision Making (WSDDM) system technology to a commercial weather provider – enhanced safety by providing ground deicing decision making information to airlines, airports and cities, and resulted in significant cost savings (received the 1999 Government Technology Leadership Award)
- Enhanced the Aviation Digital Data Service (ADDS) via the implementation of a flight path tool depicting vertical cross sections of weather along user-specified flight routes – enhanced safety and system efficiency (received the 2000 Government Technology Leadership Award)
- Delivered data through four recently-operationally implemented weather products with strong potential to impact the future safety and efficiency of NAS operations; respectively, these products provide new capabilities of:
  - One-hour forecasts of convective weather
  - Current and up to twelve hour forecasts of in-flight icing conditions
  - Current and up to twelve hour forecasts of clear-air turbulence
- Awarded the FAA's 2002 Excellence in Aviation Award
- Awarded the National Weather Association's 2002 Aviation Meteorology Award
- Awarded the FAA Office of Research and Acquisitions 2003 Mission Excellence Award

R&D Partnerships: As required by the Federal Aviation Act of 1958, as amended, the FAA cooperates with the Department of Commerce in promoting and developing meteorological science, and in fostering support of research projects through the use of private and governmental research facilities. The scope of these duties is broadened by recommendations published by the Office of the Federal Coordinator for Meteorology (1999), the Weather Joint Safety Implementation Team (2000), and the FAA Aviation Weather Mission Needs Statement (2002).

The Weather Program collaborates with the FAA's Aviation Weather Policy and Standards Staff and with Flight Standards. It also leverages research activities with members of industry, academia, and other government agencies through interagency agreements, university grants, and Memorandums of Agreement (MOAs).

The program's partners include: the National Center for Atmospheric Research; NOAA laboratories; Massachusetts Institute of Technology's Lincoln Laboratory; NWS's Aviation Weather Center and Environmental Modeling Center; NASA Dryden, Langley and Glenn; the Naval Research Laboratory; UPS; universities; airlines; port authorities; and cities.

Research results are transferred to the private sector via cooperative research and development agreements with WSI, Harris, Sonalyst, Freese-Notis, Jeppesen, and Parochus.

MAJOR ACTIVITIES AND ANTICIPATED FY 2004 ACCOMPLISHMENTS:

- In-flight icing forecast product for CONUS operational use
- Acceptance by NWS Technical Advisory Committee of 3-D gridded multi-radar algorithms
- Approval by FAA of Alaska ceiling, visibility and flight category analysis products for test use
- Approval by FAA of national convective weather 2-hour forecast for experimental use
- Transition marine stratus burn-off forecast product for SFO to NWS
- Technical Review Panel assessment of a mid-level turbulence forecast product for experimental use
- Complete development of 2-4 hour freezing precipitation forecast

- Conduct quality assessment evaluations of in-flight icing, turbulence, convective weather, and ceiling and visibility products to support the aviation weather technology transfer process
- Approval by FAA of oceanic convective diagnosis and volcanic ash products for test use
- Distributed the research quality weather research & forecasting (WRF) model to users
- Conduct rapid prototyping of weather products for Traffic Management Units

FY 2005 PROGRAM REQUEST:

Ongoing Activities

- Develop algorithms for forecasts of freezing drizzle aloft
- Integrate terminal, regional, and national convective weather forecast capability; continue to develop related automated data analysis and assimilation techniques
- Develop oceanic hazard diagnostic and forecast products
- Develop ceiling and visibility now-cast products as part of northeast corridor efforts for Terminal Ceiling and Visibility (C&V) program
- Transition weather research products to operations in the NWS, the FAA, and industry automation and weather systems

New Initiatives

No new initiatives are planned in FY 2005.

KEY FY 2005 PRODUCTS AND MILESTONES:

- Inflight icing forecast product including super-cooled large droplet operational
- Acceptance by NWS Technical Advisory Committee of real-time 3-D mosaics for Corridor Integrated Weather System
- Implement Real-Time Verification System capability operationally at the Alaska Aviation Weather Unit
- Availability of Weather Research and Forecasting model with rapid refresh for experimental use
- Develop 12-hour frost forecast capability
- Approval by FAA of mid-level turbulence forecast product for experimental use
- Approval by FAA of CONUS ceiling, visibility, and flight category analysis products for experimental use
- Approval by FAA of oceanic cloud-top height product for experimental use
- Test 3-6 hour convective forecast product
- Integrate Northeast ceiling and visibility nowcast product components
- Conduct quality assessment evaluations of turbulence, national C&V, convective weather, and oceanic products to support the aviation weather technology transfer process

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2003)	$270.698
FY 2004 Enacted	23,437
FY 2005 Request	20,838
Out-Year Planning Levels (FY 2006-2009)	85,947
Total	$400,920

Budget Authority ($000)	**FY 2001 Enacted**	**FY 2002 Enacted**	**FY 2003 Enacted**	**FY 2004 Enacted**	**FY 2005 Request**
Contracts:					
Weather Program - Safety	23,960	21,706	19,249	19,073	19,415
Weather Program - Efficiency			4,176	2,981	
Personnel Costs	705	1,506	1,145	1,264	1,224
Other In-house Costs	86	456	113	119	199
Total	**24,751**	**23,668**	**24,683**	**23,437**	**20,838**

OMB Circular A-11, Conduct of Research and Development ($000)	**FY 2001 Enacted**	**FY 2002 Enacted**	**FY 2003 Enacted**	**FY 2004 Enacted**	**FY 2005 Request**
Basic	0	0	0	0	0
Applied	24,751	23,668	24,683	20,852	20,853
Development (includes prototypes)	0	0	0	0	0
Total	**24,751**	**23,668**	**24,683**	**20,852**	**20,853**

Weather Program - Safety Product and Activities	FY 2005 Request ($000)	Program Schedule					
		FY 2004	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009
041-110 Aviation Weather Analysis and Forecasting							
In-flight Icing	**$3,237**						
Forecast Product for CONUS Operational		◆					
Forecast SLD Product Operational			◇				
FAA Approval of Terminal-Scale Product for Operational Use							◇
Implement Forecast Product for Alaska into Operation						◇	
NEXRAD Algorithms	**$515**						
Obtain TAC Acceptance of Real-Time 3-D Mosaics for CIWS			◇				
3-D Mosaics for CIWS Operational					◇		
Aviation Forecast	**$1,235**						
Implement RTVS Capability Operationally at the AAWU			◇				
Implement Volcanic Ash Coordination Tool into All Volcanic Ash Advisory Centers					◇		
Model Development and Enhancement	**$2,065**						
WRF with Rapid Refresh Available for Experimental Use							
Operational implementation of WRF model at NWS					◇		
Winter Weather Research	**$679**						
Develop 12 hour frost forecast capability			◇				
Complete Development of 6-12 hr. Freezing Precip Forecast							◇
Turbulence	**$1,630**						
FAA Approval of Mid-Level Turbulence Product for Experimental Use			◆				
FAA Approval of Mid-Level Turbulence Forecasting Product for Operational Use				◇			
Complete Operational Implementation of Convectively-Induced Turbulence Product							◇
National Ceiling & Visibility	**$1,902**						
Obtain FAA Approval of Alaska C&V/flight Category Analysis Product for Test Use		◆					
Obtain FAA Approval of CONUS C&V/flight Category Product for Experimental Use			◇				
Complete Operational Implementation of C&V/flight Category Forecast Products for Alaska							◇
Convective Weather	**$4,608**						
Obtain FAA Approval of National Convective Weather 2-hour forecast for Experimental Use		◆					
Test 3-6 Hour Convective Forecast Product			◇				
Complete Operational Implementation of 3-6 Hour Convective Weather Forecast Product							◇
Terminal Ceiling and Visibility	**$1,506**						
Transition Marine Stratus Burn-Off Forecast Product at SFO To NWS for Operational Implementation		◆					
Integrate NE Ceiling/Visibility Nowcast Product			◇				
Demonstrate Winter C&V Products at DCA & IAD							◇

Weather Program - Safety Product and Activities (Cont.)	FY 2005 Request ($000)	Program Schedule					
		FY 2004	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009
Oceanic Weather	**$1,034**						
Obtain Approval of Cloud Top Height Product for Experimental Use			◇				
Obtain Approval of Oceanic Convection Diagnostic and Volcanic Ash Product for Experimental Use		◆					
Complete Operational Implementation of Convective Nowcast Product							◇
Quality Assessment	**$1,004**						
Conduct Evaluation to Support AWTT Process			◇				
Develop Verification Techniques and Conduct Evaluations for AWTT							◇
Personnel and Other In-House Costs	**$1,343**						
Total Budget Authority	**$20,838**	**$20,852**	**$20,838**	**$21,397**	**$21,652**	**$22,197**	**$22,729**

◆ - Activities Accomplished ◇ - Activities Planned

NOTE: OUT YEAR NUMBERS ARE FOR PLANNING PURPOSES ONLY. ACTUAL FUNDING NEEDS WILL BE DETERMINED THROUGH THE ANNUAL BUDGET PROCESS.

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2.2 Aviation Capacity Research and Development Goal Area Description

Mission

The unifying mission of the Aviation Capacity R&D Goal area is to support the FAA Capacity Goal, as stated in the agency's strategic plan: "*Work with local governments and airspace users to provide capacity in the United States airspace system that meets projected demand in an environmentally sound manner.*"

Figure 2.2-1 indicates the percentage of the total requested FY 2005 R&D funding that will be devoted to the support of Aviation Capacity research.

Programs within this research area develop information, tools, methods, and technologies that, when applied to the establishment or improvement of aviation standards and acceptable practices and operational systems, will help to ensure the environmentally sound and efficient management of aviation traffic while maintaining optimal safety and facilitating collaborative decision making between air traffic managers and National Airspace System (NAS) users.

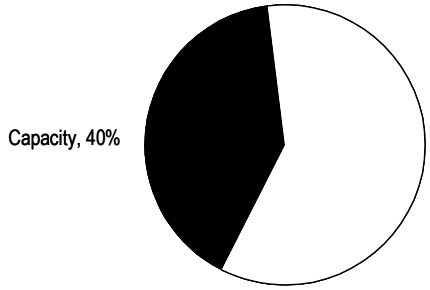

Figure 2.2-1: Percentage of Requested FY 05 R&D Funding Supporting the FAA Goal for Greater Capacity

Goal area Structure

Broad research emphases within the Aviation Capacity R&D Goal area include:

- Environment and Energy *
- Advanced Technology Development and Prototyping Program **
  - Aviation System Capacity Improvement (ASCI)
  - Separation Standards
  - Operations Concept Validation
  - NAS Requirements Development
  - Domestic Reduced Vertical Separation Minima (DRVSM)
  - Airports Technology
- Safe Flight 21 (Ohio River Valley) **
  - Automatic Dependent Surveillance – Broadcast (ADS-B)
- Center for Advanced Aviation System Development (CAASD) R&D Programs **
- National Plan for Transformation for Air Transportation *
- Wake Turbulence *

* R,E&D Budget Request
** F&E Budget Request

Through projects such as the Advanced Technology Development and Prototyping Program, Safe Flight 21, and CAASD R&D, the FAA Air Traffic Services Organization and associated Integrated Product Teams work to reduce delays and improve the predictability and flexibility of NAS systems.

Program Challenges and Strategies

A conceptual framework of R&D challenges to FAA mission goals is being prepared to reflect the requirements of *Flight Plan 2004-2008* in combination with current aviation system needs, circumstances and issues. Scheduled for presentation in the 2004 *R&D Strategic Plan,* the full framework will be consistent with the preliminary high-level mapping, shown in Figure 2.2-2, of Capacity objectives from the Flight Plan to relevant R&D Challenges.

R&D CHALLENGES DEFINED IN THE *FAA R&D STRATEGY*		CAPACITY												
FLIGHT PLAN OBJECTIVES		Increased Airport Arrival/Departure Rates	Increased En Route Capacity	Reduced Airport Weather Impacts	Reduced En Route Weather Impacts	Expanded Access and Service Availability	Future Capacity Enhancements	Improved NAS Predictability	Greater NAS Flexibility	Reduced Cost of Providing NAS Services	Reduced Cost of Airport Infrastructure	Enhanced Environmental Knowledge Base	Minimization of Noise Impacts	Minimization of Air Quality Impacts
Capacity Objectives	*Increase Airport Capacity to Meet Projected Demand*	X		X			X				X			
	Make Air Traffic Flow over Land and Sea More Efficient		X		X		X		X	X				
	Increase or Improve Airspace Capacity in the Eight Major Metropolitan Areas	X		X			X		X					
	Increase On-Time Performance of Scheduled Carriers	X	X	X	X			X	X					
	Address Environmental Issues Associated with Capacity Enhancements	X						X	X			X	X	X

Figure 2.2-2: Mapping of Capacity R&D Challenges to *Flight Plan 2004-2008* Capacity Objectives

Goal Area Outputs

Detailed outputs of all FAA Aviation Capacity R&D can be found in the individual descriptions of the component programs that follow this goal area description.

The airport advisory circular system is the FAA's principal means of communicating with airport planners, designers, operators, and equipment manufacturers. Advisory circulars (ACs) publish the standards used in the design, construction, installation, maintenance, and operation of airports and airport equipment. In all projects funded through the Airport Improvement Program (AIP), project work must meet standards set in one of these ACs.

The research outputs of the Advanced Technology Development and Prototyping Program are many and varied. As a group, the component programs develop and produce the validated technical requirements needed to move the FAA systems architecture from the planning stages to acquisition and implementation of newer, more efficient air traffic system technologies and management procedures. The products of ongoing activities, such as modeling, prototyping, simulations, demonstrations, and evaluations are common to the programs, as are the development of new and refined procedures, standards, guidance, and performance metrics.

Safe Flight 21 Program outputs that address the capacity benefits of ADS-B and other technologies and applications will continue to be developed, validated and demonstrated. The results from Safe Flight 21 program activities will

guide the FAA and the participating stakeholder community in making decisions regarding the implementation suitability and readiness of these technologies and applications.

Research into a highly integrated/secure common information network (CIN)/System-Wide Information Management (SWIM) concept and the value of network-centric operations will be explored along with the results of the Global Communications Navigation Surveillance System (GCNSS) contract activities. This information will be used to shape future NAS enhancements.

In accordance with the joint FAA/Industry Concept of Operations for the NAS, the Free Flight Program is pursuing research into capacity-enhancing decision support tools for controllers and traffic managers that build upon the capabilities already deployed by the Program. Specific outputs from this R&D will include investment decisions, together with all supporting documentation, including operational concepts, requirements, and cost/benefit analyses necessary to initiate procurement of these capabilities.

Detailed program outputs of FAA Environmental R&D can be found in the description, drawn from the FY 2005 budget submission, which follows this general goal area description.

FAA aviation environmental research produces:

- Analytic and planning computer models and impact criteria for government, industry, and the public to understand aviation's environmental impacts and the consequences of alternative courses of action
- Guidance for noise and emissions standards for the certification of new and modified airframe and engine designs
- Technical guidance on certification procedures and practices for manufacturers and modifiers in the form of technical reports, handbooks, advisory circulars, training courses, and rules

FAA/NASA Collaborative R&D (Capacity)

In 1995, the FAA and NASA formed the FAA/NASA Interagency Air Traffic Management (ATM) Integrated Product Team (IAIPT) to coordinate research into air traffic control technologies and the development of procedures for their safe and efficient use. This relationship was broadened three years later through an agreement enlisting the cooperation of the Department of Defense.

Comprised of the major stakeholders in the planning, execution, and outcome of ATM R&D programs throughout the FAA and NASA, the IAIPT is structured as follows to facilitate communications and the resolution of issues:

- Co-Leads, who formulate R&D goals and programs
- The Interagency Integrated Management Team (IAIMT), which targets R&D outputs to the needs of customers and stakeholders
- Area Work Teams (AWT), which execute research activities in these research areas:
  - *System/Cross-Cutting* — System-wide initiatives, including the initial definition of concepts and assessment methodologies and demonstrations of cross-domain system(s) integration (e.g., en route, terminal, and surface decision support systems)
  - *Traffic Flow Management* — Strategic resource allocation and flow management
  - *Surface* — Operations on an airport's surface
  - *Terminal* — Operations in airspace surrounding one or more closely spaced airports where a TRACON or a comparable military facility provides services
  - *En Route* — Operations in airspace between airports where an Air Route Traffic Control Center (ARTCC) provides services, and transition airspace between the en route and terminal environments
  - *Oceanic* — Operations in airspace over international waters where an oceanic ARTCC provides services
- A series of memoranda of understanding enabling the FAA to work with NASA and U.S. industry, and academia to identify source noise and emissions abatement technologies

- Collaboration with the Environmental Protection Agency (EPA), NASA, the Department of Defense (DoD), the Department of Energy (DOE), industry, and academia to assess the local and global impacts of aviation emissions
- Support of the Volpe National Transportation Systems Center's (VNTSC) continuing efforts to provide substantial technical assistance in aircraft noise and emissions measurement and assessment
- Participation on the Federal Interagency Committee on Aviation Noise (FICAN), a body established by the FAA and other interested federal entities to conduct public forums in different geographic regions in order to encourage debate, public input, and agreement over needs for future aviation noise abatement and resulting new research effort

The IAIPT periodically reports to the FAA Associate Administrator for Research and Acquisitions and the NASA Associate Administrator for Aerospace Technology through the FAA/NASA Coordinating Committee. Specific program direction and control comes through internal program management mechanisms in both agencies.

IAIPT research is accomplished at the following research facilities: FAA William J. Hughes Technical Center, NASA Ames Research Center, NASA Langley Research Center, MITRE CAASD, MIT Lincoln Laboratory, Volpe National Transportation Systems Center, and NASA North Texas Research Station.

International Cooperative Aviation R&D

The FAA Research and Acquisitions International Office coordinates with agencies of the U.S. and other governments to carry out cooperative international R&D activities affecting the worldwide capacity and safety of aviation. U.S. agencies participating in these activities include the Trade and Development Agency, the Aid for International Development Agency, the National Image and Mapping Agency, and the Departments of State, Defense, and Commerce. Participating overseas entities, drawn from over 30 nations, include the International Civil Aviation Organization (ICAO), both at the Headquarters and Regional levels, the European Organization for the Safety of Air navigation (EUROCONTROL), and the Asia Pacific Economic Cooperation.

The FAA also collaborates with EUROCONTROL on the SOURDINE project (Study of Optimisation procedURes for Decreasing the Impact of NoisE around airports) to identify new procedures leading to the reduction of noise in the airport vicinity and the requirements for supporting tools.

Along with representatives of other civil aviation authorities and observers from the aviation industry, the FAA represents the United States on ICAO's Committee on Aviation Environmental Protection. This committee conducts technical analyses to assess the adequacy of international aviation's environmental standards for aircraft noise and engine exhaust emissions.

Intended Outcomes

Detailed anticipated benefits and recent accomplishments of all FAA Aviation Capacity R&D can be found in the individual descriptions of the component programs that follow this goal area description.

A comprehensive R&D program for the improvement of airport and pavement design is directed toward the achievement of increases in aviation system efficiency and capacity. The program is highly regarded by the world's aviation community, and the International Civil Aviation Organization (ICAO) has formally agreed to base worldwide pavement design standards on its findings.

R&D conducted by the Advanced Technology Development and Prototyping Program provides information required for making long-term investments in integrated services, procedures and infrastructure with potential to improve the overall efficiency of Air Traffic Services.

The Safe Flight 21 Program will provide information resulting from ADS-B and other technology and application assessments to support decisions to enhance capacity and safety in the NAS.

The FAA intends to build upon and improve national and international participation of citizens and aviation agencies to minimize the global, regional, and local impact of aviation. The environmental research program will improve our understanding of aerospace environmental issues required to foster new solutions, encompassing a balance between

new technology, better operational procedures, sound land use, and operational controls leading to a quieter and cleaner NAS.

Long-Range View

A long-range commitment to improving airport technology will allow the FAA to better ensure the public that federal funds are being judiciously spent and that public investment in infrastructure is prudently managed. Operation of FAA's national pavement test facility began in June 1999 with a projected duration of ten years. The data collected from the test machine will allow smooth introduction of new heavy aircraft expected to join the fleet starting in 2006.

Aviation Capacity R&D programs maintain a long-term view of the research requirements needed to continue safe and efficient operation, maintenance, and use of the NAS, and to meet the projected capacity demands of the future. The composition of the R&D program portfolio can be expected to change over time. As some of today's technologies transition to full-scale development, other technologies with potential for improving capacity will take their place. Thus, the need for continued funding for the ATS technology development and verification will continue.

The Safe Flight 21 Program will continue to assess, validate and demonstrate ADS-B and other technology initiatives and applications that have a high probability to enhance NAS capacity and safety.

Important research into a highly integrated/secure common information network (CIN)/System-Wide Information Management (SWIM) concept and the value of network-centric operations will help shape future NAS enhancements.

The key to successful environmental planning is to identify operational mitigation options for those sectors of the aviation markets that are most likely to reach environmental critical mass. The FAA must continue to determine where best to target its research to achieve noise and emissions mitigation.

Continued aviation growth is predicated on our ability to mitigate its environmental consequences. The solution to controlling the environmental consequences of aircraft traffic growth will be achieved through an interdisciplinary approach to the development and use of new analytical tools to gain a better understanding of the interrelated effects of beneficial actions affecting noise and various types of emissions.

The proposed FY 2004 research program addresses the necessary R&D effort to support an effective long-term environmental mitigation strategy and to identify the best approaches for addressing current environmental concerns.

AIRPORTS TECHNOLOGY – CAPACITY

GOALS:

Intended Outcomes: The FAA is enhancing airport system capacity through better airport planning, airport design, and through improved pavement thickness design, construction, and maintenance.

Agency Outputs: Federal law requires the FAA to develop standards and guidance material for airport design, construction, and maintenance. The Airport Technology program provides the technical information needed to support and update these FAA outputs in a timely manner.

The airport advisory circulars (ACs) related to capacity improvements are the agency's principal means of communicating with U.S. airport planners, designers, operators, and equipment manufacturers. These ACs apply to airport geometric design, pavement thickness design, and airport planning.

The FAA and its regional offices enforce standards and guiding material when administering the Airport Improvement Program (AIP).

Customer/Stakeholder Involvement: AIP grants contribute about half of the approximately $2 billion spent each year to provide operationally safe and reliable airport pavements. Projects funded under the AIP grants must conform to the FAA ACs or designated standards. The remaining costs are borne by state and local governments.

To ensure new pavement standards will be ready to support the safe international operation of next-generation heavy aircraft, the FAA and the Boeing Company have entered into a Cooperative Research and Development Agreement. Together, these partners have built the National Airport Pavement Test Facility (NAPTF), a unique full-scale research vehicle, at the William J. Hughes Technical Center. Along with the International Civil Aviation Organization, they are using data collected at the facility in developing the pavement design standards that airports throughout the world need to accommodate the new large aircraft weighing in excess of 1,000,000 pounds.

Accomplishments: The Airport Technology research program has provided products to enhance airport capacity in the United States and around the world. Recent research results are published as FAA reports and ACs and made available to users worldwide. Some major accomplishments are:

- Built the National Airport Pavement Test Facility and dedicated it on April 12, 1999; began testing at the facility on June 4, 1999
- Used data generated at the Test Facility and issued new pavement design standard software, LEDFAA version 1.3, to allow the introduction of Boeing B-777 in the fleet mix
- Expanded the Center of Excellence (COE) Airport Technology at the University of Illinois and Northwestern University to include outreach program to prepare minority students to undertake graduate education in the area of civil engineering
- Established an airport pavement data base with field data collected at Denver International Airport and gave on-line access to international researchers

R&D Partnerships:

- FAA-U.S. Army Waterways Experiment Station*
- FAA-U.S. Air Force, Tyndall Air Force Base*
- FAA-University of Illinois/Northwestern University (COE for Airport Pavement Research)**
- FAA-Boeing Company, Cooperative Research and Development Agreement ($7 million Boeing/$21 million total for National Airport Pavement Test Machine)***

* Interagency agreement or Memorandum of Agreement

** Partnership through matching funds

*** Cost Sharing

Through these partnerships, research results are published in scientific journals, presented at technical conferences, and discussed at workshops.

MAJOR ACTIVITIES AND ANTICIPATED FY 2004 ACCOMPLISHMENTS:

- Complete reconstruction of three concrete pavement test items at the NAPTF – May 2004
- Complete traffic testing of concrete pavement test items at the NAPTF – September 2004
- Complete beta test of new airport pavement design software FEDFAA – September 2004
- Complete IPRF report on Ultra-Thin Whitetopping durability study at airports – March 2004
- Release software for computing runway smoothness using an inertial profiler with simulations to the standard outputs from other pavement roughness devices – September 2004

FY 2005 PROGRAM REQUEST:

The Airport Technology research program is a collaborative effort among many government organizations, universities, and industry associations. The requested funding will allow this group to continue developing standards and guidelines for maintaining and enhancing our national airport infrastructure.

KEY FY 2005 PRODUCTS AND MILESTONES

- Continue analyzing full-scale data from the NAPTF
- Design and fabricate modules for 8-wheel gear loading
- Publish LEDFAA Version 2
- Conduct technical workshops in pavement design using LEDFAA Version 2
- Complete beta testing of the FEDFAA pavement computer design
- Develop conceptual guidelines and computer tools for terminal building design
- Develop design standards for general aviation airports
- Publish updated failure models for airport pavement design

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2003)	$9,266
FY 2004 Enacted	3,900
FY 2005 Request	3,800
Out-Year Planning Levels (FY 2006-2009)	35,529
Total	$52,495

Budget Authority ($000)	FY 2001 Enacted	FY 2002 Enacted	FY 2003 Enacted	FY 2004 Enacted	FY 2005 Request
Contracts:					
Airport - Capacity	3,331	2,675	6,586	3,900	3,800
Personnel Costs	0	0	0	0	0
Other In-house Costs	0	0	0	0	0
Total	**3,331**	**2,675**	**6,586**	**3,900**	**3,800**

OMB Circular A-11, Conduct of Research and Development ($000)	FY 2001 Enacted	FY 2002 Enacted	FY 2003 Enacted	FY 2004 Enacted	FY 2005 Request
Basic	0	0	0	0	0
Applied	0	0	0	0	0
Development (includes prototypes)	3,331	2,675	6,586	3,900	3,800
Total	**3,331**	**2,675**	**6,586**	**3,900**	**3,800**

The FY Airports 2004 request for funds is in the AIP portion of the FAA budget request.

Airports Technology - Capacity Product and Activities	FY 2005 Request ($000)	Program Schedule					
		FY 2004	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009
Airport Technology – Capacity Goal							
Airport Technology - Capacity	**$5,000**						
Continue Testing and Analysis of Full-Scale Data from NAPTF		◆	◇	◇	◇	◇	◇
Continue Support of Pavement Center of Excellence		◆	◇	◇			
Evaluate Non-FWD Technologies		◆	◇	◇			
Support Development of MicroPaver Software		◆	◇	◇	◇	◇	
Develop Gyratory Test Method for P-401		◆	◇				
Develop Conceptual Guidelines and Computer Tools for Terminal Building Design		◆	◇	◇	◇	◇	
Develop Design Standards for General Aviation Airports		◆	◇	◇	◇		
Develop Models for Airport Funding Strategies, Passenger Surveys, and Capacity Delay		◆	◇	◇	◇		
Total Budget Authority	**$5,000**	**$10,815**	**$5,000**	**$8,750**	**$8,838**	**$8,926**	**$9,015**

◆ - Activities Accomplished ◇ - Activities Planned

NOTES: OUT YEAR NUMBERS ARE FOR PLANNING PURPOSES ONLY. ACTUAL FUNDING NEEDS WILL BE DETERMINED THROUGH THE ANNUAL BUDGET PROCESS.
IN THE FACILITIES AND EQUIPMENT APPROPRIATIONS, PERSONNEL AND OTHER COSTS ARE BUDGETED IN ACTIVITY 6, NOT THE PROGRAM BUDGET LINE ITEM.

AUTOMATIC DEPENDENT SURVEILLANCE – BROADCAST (ADS-B)

GOALS:

Intended Outcomes: This program aims to improve aviation safety and efficiency by developing system standards of ADS-B technology in terminal, en route, and oceanic airspace , as well as on the airport surface. Domestic and international standards for ADS-B are developed to facilitate avionics certification and global system interoperability. Application descriptions for ADS-B (operational concepts) are developed, in addition to functional and system requirements to support ADS-B applications.

ADS-B uses an onboard Global Navigation Satellite System (GNSS) receiver or other source of navigation data to derive position and velocity of an ADS-B-equipped aircraft or vehicle. These data and other aircraft information are broadcast directly to ground receivers as well as to nearby aircraft. ADS-B surveillance information displayed on an aircraft's onboard Cockpit Display of Traffic Information (CDTI) enhances flight crew's situational awareness and improves flight operations and efficiencies. The ground receivers can provide the information to ATM facilities and other users.

The ADS-B technology's modular design and cooperative nature offer a low-cost alternative for surveillance coverage in areas without radars such as in parts of Alaska and offshore areas. ADS-B can also enhance Air Traffic Control (ATC) surveillance in areas currently served by radars. Through accurate and rapid surveillance updates to ground automation system, ADS-B could serve as an alternative system for monitoring instrument approaches to closely spaced parallel runways.

The ADS-B standards being developed contribute to the following goals and objectives:

- FAA Strategic Goal – Increased Safety

  Objective 1 Reduce the commercial airline fatal accident rate

  Objective 2 Reduce the number of fatal accidents in general aviation

  Objective 3 Reduce accidents in Alaska

  Objective 4 Reduce the risk of runway incursions.

- FAA Strategic Goal – Increased Capacity

  Objective 1 Increase airport capacity to provide a system that meets projected demand.

- FAA Strategic Goal – International Leadership

  Objective 2 Promotes seamless operations around the globe in cooperation with bilateral, regional, and multilateral aviation partners.

Agency Outputs: Current efforts focus on developing standards for the system's avionics, application descriptions, and display (CDTI) system. Standardization efforts include RTCA minimum aviation system performance standards (MASPS) and minimum operational performance standards (MOPS). Analyses and evaluations will be conducted under this program to provide technical inputs to RTCA MASPS/MOPS on ADS-B links, airborne surveillance and separation assurance processing, and other surveillance system sources necessary to support ADS-B applications. Joint standards/documents with EUROCAE, EUROCONTROL and European states will be published to harmonize ADS-B system standards and applications. International standards such as the International Civil Aviation Organization's (ICAO) standards and recommended practices will also be developed. These standards must be developed and maintained for the purpose of facilitating global interoperability and implementation.

Customer/Stakeholder Involvement: The FAA and the user community are actively involved in the standards development activity at RTCA, specifically Special Committee 186. Some of the stakeholders include the Cargo Airline Association, Air Transport Association, Airline Pilots Association, Aircraft Owners and Pilots Association, United Airlines, Northwest Airlines, avionics manufacturers, and airframe manufacturers. EUROCAE Work Groups

and EUROCONTROL have been contributing to the harmonization of MASPS and MOPS. Additionally, ICAO panels are actively engaged in the development and updating of ADS-B SARPs.

Accomplishments: As a result of active support from this program, a number of critical ADS-B related standards have been published by RTCA:

- Universal Access Transceiver (UAT) MOPS, DO-282
- 1090 MHz ADS-B MOPS Revision A, DO-260A
- ADS-B MASPS Revision A, DO-242A
- Traffic Information Services-Broadcast (TIS-B) MASPS, DO-286
- DO-263, Application of ACM: Detection, Prevention, & Resolution
- DO-257A MOPS for the depiction of Navigation Information on Electronic Maps
- Aircraft Surveillance Application (ASA) MASPS in final draft
- Additionally, UAT SARPS has been given approval by ICAO Air Navigation Commission to proceed with development. UAT SARPs entered into the validation phase of SARPs development.

R&D Partnerships: The joint government/industry committee, RTCA SC 186, is tasked with achieving R&D consensus on system standards for ADS-B. Massachusetts Institute of Technology Lincoln Laboratory, MITRE, FAA's William J. Hughes Technical Center, and NASA are also jointly involved in the technical development and integration of ADS-B technology into the NAS. EUROCONTROL Experimental Centre is also involved with ADS-B R&D activities.

MAJOR ACTIVITIES AND ANTICIPATED FY 2004 ACCOMPLISHMENTS:

- Complete Aircraft Surveillance Application (ASA) MASPS and obtain approval from RTCA PMC
- Continue development of TIS-B Rev A
- Initiate Airborne Separation Assistance System (ASAS) MOPS
- Collaborate with EUROCONTROL/EUROCAE/RTCA on development of operational and technical requirements documents for Package I (initial) ADS-B applications
- Continue to complete validation phase of ICAO UAT SARPs
- Update ICAO SARPs on 1090 MHz ADS-B

FY 2005 PROGRAM REQUEST:

This program will continue to complete RTCA standards documents and achieve harmononization of Package I ADS-B applications with EUROCONTROL and EUROCAE. Additionally, significant progress will be made to finalize ICAO UAT SARPS. Specific FY 2005 activities will include the following:

- Complete TIS-B MASPS Rev. A
- Continue to draft ASAS MOPS
- Coordinate with EUROCONTROL/EUROCAE to draft operational and technical requirements documents for Package I applications
- Coordinate with ICAO panels to complete validation phase of UAT SARPs
- Update ICAO SARPs on 1090 MHz ADS-B

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2003)	$13,080
FY 2004 Enacted	1,988
FY 2005 Request	2,000
Out-Year Planning Levels (FY 2006-2009)	8,000
Total	$25,068

Budget Authority ($000)	FY 2001 Enacted	FY 2002 Enacted	FY 2003 Enacted	FY 2004 Enacted	FY 2005 Request
Contracts:					
ADS-B	2,600	2,800	1,490	1,988	2,000
Personnel Costs	0	0	0	0	0
Other In-house Costs	0	0	0	0	0
Total	**2,600**	**2,800**	**1,490**	**1,988**	**2,000**

OMB Circular A-11, Conduct of Research and Development ($000)	FY 2001 Enacted	FY 2002 Enacted	FY 2003 Enacted	FY 2004 Enacted	FY 2005 Request
Basic	0	0	0	0	0
Applied	0	0	0	0	0
Development (includes prototypes)	2,600	2,800	1,490	1,988	2,000
Total	**2,600**	**2,800**	**1,490**	**1,988**	**2,000**

Automatic Dependent Surveillance – Broadcast (ADS- B) Product and Activities	FY 2005 Request ($000)	Program Schedule					
		FY 2004	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009
ADS-B	***$2,000***						
RTCA Standards:							
TIS-B MASPS Rev. A		◆	◇	◇			
ASA MASPS		◆					
ASA MASPS Rev. A				◇	◇	◇	
ASAS MOPS		◆	◇	◇	◇		
EUROCONTROL/EUROCAE/RTCA Standards for Package I Operational and Technical Requirements		◆	◇	◇			
ICAO Standards on UAT SARPs		◆	◇	◇	◇		
Update ICAO Standards 1090 ADS-B		◆	◇	◇			
Update and Revise SARPs Standards						◇	◇
Total Budget Authority	**$2,000**	**$2,000**	**$2,000**	**$2,000**	**$2,000**	**$2,000**	**$2,000**

◆ - Activities Accomplished ◇ - Activities Planned

NOTES: OUT YEAR NUMBERS ARE FOR PLANNING PURPOSES ONLY. ACTUAL FUNDING NEEDS WILL BE DETERMINED THROUGH THE ANNUAL BUDGET PROCESS. IN THE FACILITIES AND EQUIPMENT APPROPRIATIONS, PERSONNEL AND OTHER COSTS ARE BUDGETED IN ACTIVITY 6, NOT THE PROGRAM BUDGET LINE ITEM.

AVIATION SYSTEM CAPACITY IMPROVEMENT (ASCI)

GOALS:

Intended Outcomes: The Office of Aviation System Capacity (ASC) has developed a series of programs that provide capacity enhancements, airport improvements, and modernized infrastructure to promote the Greater Capacity, International Leadership, and Organizational Excellence goals of the Agency. The ASC programs continue to deliver products and services that alleviate traffic congestion, system delays, and operational inefficiencies within the aviation system through the development of new runways, new technologies, and modified operational procedures that will improve the National Airspace System (NAS) operations.

The Capacity programs support the Agency's efforts to adopt a performance-based organization by doing the following:

- Implementing a performance measurement tool which translates the organizations vision/mission and strategies into a set of performance indicators that are linked to activities and initiatives
- Developing and expanding a computer-based tool that will collect, process, compute, and analyze data so users can measure and report system performance on a routine basis
- Providing timely and accurate performance metrics specifically designed to measure current FAA goals and customer needs

The Capacity Office complies with the Government Performance and Results Act (GPRA) of 1993 and an executive order controlling infrastructure investment requirements; responds to the congressional mandate to produce airport improvement plans; advances the aviation industry's high-priority initiatives for increased capacity; and implements recommendations of the Presidential Commission on Improved Airline Competitiveness.

Agency Outputs: The Capacity Office strives to deliver high-quality, cost-effective services to meet the needs of its customers and, the users of the air transportation system on a continuing basis. The Performance Data and Analysis Reporting System (PDARS) will provide a new tool for capturing real time performance data at all field facilities. The Airport design studies will continue to provide problem identification and solution sets at specific targeted airports. The Air Traffic Organization performance metrics and balanced scorecard will continue to provide a framework for assessing operational performance against Agency goals. ASC sponsors a wide range of programs designed to measure, assess, and improve aviation capacity. The following programs are critical to the refinement of the aviation system:

<u>Airport Capacity Enhancement Studies</u>

Investigate capacity and delay issues at the major airports within the NAS. Through computer simulation modeling the Agency works with airports and other aviation industry stakeholders to conduct studies that recommend improvements for the operating efficiency of the infrastructure.

<u>International Terminal Benchmarking</u>

Measures the cost and performance of air traffic terminal facilities through a series of bilateral comparisons of U.S. terminal facilities with similar facilities worldwide.

<u>Air Traffic Services (ATS) Balanced Scorecard</u>

Designs, develops, and implements a communications management tool within regional, en route, and terminal businesses for the purpose of improving the efficiency and effectiveness of strategy implementation with the ATS regional environment.

<u>Aviation Capacity Enhancement Plan</u>

Identifies new and ongoing agency initiatives to increase airport and airspace capacity. Additionally contains a compilation of useful data on operations, emplacements and airport project development plans for the top 100 U.S. airports.

Performance Data and Analysis Reporting System

Supports the development of facility level metrics and tie Agency level goals to actions at the point of service delivery and quantify specific outcomes. The system will facilitate baselining and trend monitoring of various operations such as travel times, traffic density, aircraft interval and acceptance rates.

Customer/Stakeholder Involvement: The success of the FAA is largely due to effective capacity programs lead by all facets of the FAA, their customers, and stakeholders alike. Field experts from all disciplines including: concerned airports, air carrier representatives, aviation interest groups, and FAA regional and local air traffic control collaborate on diversified airspace and airport capacity task force or projects.

The Capacity Office is an active participant in formal advisory committees, informal seminars, and individual meetings with relevant industry elements regarding the NAS infrastructure.

Accomplishments:

- Capacity Enhancement: Portland - Completed collection and verification of all data inputs and calculation of the model) and portions of Phase II (simulation of the potential improvements); Philadelphia - Completed determination of the location of the new runways and terminals
- Terminal Benchmarking: Completed the pairing of airports and received concurrence from all participants and Completed the initial collection of staffing, operational and facility cost data
- Identified and developed new En Route Balanced Scorecard financial metrics for Air Traffic and Airway Facilities management at prototype facilities. Automated the ATS Flash Report
- Published and distributed the 2002 ACE Plan
- Completed the installation of PDARS at the Jacksonville, Memphis, Atlanta, Miami and Indianapolis Centers. Developed the Area Navigation Pro capability to analyze departure and arrival flight paths in the terminal area and assess the feasibility of proposed en route flight paths.
- Prototyped En Route Balanced Scorecard tool at Indianapolis, Memphis, and Atlanta Air Route Traffic Control Centers (ARTCC)
- Developed ATSMT approved plan for the development and prototyping of an ASO region integrated en route/terminal Balanced Scorecard tool

R&D Partnerships:

In a shared effort, the Capacity Office facilitates FAA and EUROCONTROL agreements on airspace technologies and initiatives that modernize international aviation. The goal of this effort is to ensure that the United States is compatible with the rest of the aviation world in areas such as Free Flight, the Global Positioning System, the Flight Management System, the Precision Runway Monitor, and other emerging technologies. The FAA collaborates with major air carriers and business aviation aircraft in developing financial management systems approaches.

The PDARS program was designed, developed and prototyped in coordination with NASA's Office of Aerospace Technologies. PDARS provides the tools, data and input needed to respond to the goals and objectives of their Aviation Safety Program and their Aviation System Monitoring and Modeling program. For the FAA, PDARS was developed in response to the GPRA of 1993, the ATS Performance Plan and ATS Performance Initiatives.

The Capacity Office partners with aircraft manufacturers Boeing and Airbus Industries, avionics manufacturers, Municipal Airport Authorities, Airports Council International – North America (ACI-NA), Air Transport Association, and the Airlines Pilots Association for proposed New Large Aircraft (NLA). Work in these partnerships has included the Wide Area Augmentation System/Local Area Augmentation System for Minimum Vectoring Altitude and Automatic Dependent Surveillance – Broadcast for closely-spaced parallel runway analysis for ACI-NA.

MAJOR ACTIVITIES AND ANTICIPATED FY 2004 ACCOMPLISHMENTS:

Capacity

- Continue to provide studies and analysis of Airport design (runways, ground movements, terminals) at JFK, ANC, BOS, MDW, OAK, MSY that allow the smooth flow of people, cargo and equipment in, through and around airports
- Continue New Large Aircraft (NLA) simulator studies
- Complete the NLA FAA and ICAO Operational Documents and Issue papers
- Complete Phase I of the PDX and PHL Capacity Enhancement Studies
- Publish and distribute the 2003 ACE Plan
- Begin IND NLA Runway / Midfield Terminal Design Team study
- Study Annual Service Volume (ASV) procedures at CMH, PVD, JAX, BUR, DAL, RIC, PBI, ORL, SRQ, PIE, TUS, TUL, XNA, SDF
- Complete Ground Movement Study at JFK
- Install and conduct training of PDARS in the remaining eight of the twenty domestic ARTCCs
- Install PDARS in ten of the thirty-five OEP TRACONS

International Leadership

- Complete development criteria, gather data, and present initial analysis for the International Terminal Benchmarking Study

Organizational Excellence

- Develop and prototype an ATS integrated en-route/terminal Balance Scorecard tool within the ASO region
- Identify cost and performance metrics for ASO region Balance Scorecard tool
- Prototype a web-based software application infrastructure to provide ATS headquarters and ATS ASO region managers with centralized access to ASO Region Balance Scorecard cost and performance analysis, forecasting, reporting and initiative tracking capabilities

KEY FY 2005 PRODUCTS AND MILESTONES:

Capacity

- Complete New Large Aircraft (NLA) simulator studies
- Publish and distribute the 2004 ACE Plan
- Complete IND NLA Runway / Midfield Terminal Design Team study
- Present findings of ASV procedure studies.
- Conduct Airport Design Team Studies of runways at ATL, IAH, HOU, BDL and PHX
- Maintain PDARS in all twenty domestic ARTCCs and the thirty five OEP TRACONS
- Baseline the NAS operations for the last three years
- Develop, test and improve NAS performance metrics
- Integrate PDARS metric with the Balanced Scorecard Program to provide automated performance information to FAA management

International Leadership

- Complete data gathering and present final analysis for the International Terminal Benchmarking Study

Organizational Excellence

- Develop ATSMT approved plan for the development and prototyping of and AGL region Balanced Scorecard tool
- Develop and prototype AGL region Balanced Scorecard tool
- Identify COTS software for Balance Scorecard cost and performance reporting and initiative tracking
- Develop and ATS/ATO Balanced Scorecard tool development and implementation plan for ATS

FY 2005 PROGRAM REQUEST:

The requested funding will support the Agency goals documented in the FAA Flight Plan by continuing to focus on maximizing airport capacity through improvements in runways, taxiways, navigational/guidance aids, and operational procedures, which permit increased capacity and reduce delays. The Capacity program will effectively design data systems to measure and analyze operational performance for the assessment of system improvements. The program will produce capacity studies and analysis for the nations most congested airports to improve operational activity.

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2003)	$18,771
FY 2004 Enacted	6,462
FY 2005 Request	6,500
Out-Year Planning Levels (FY 2006-2009)	26,000
Total	$57,733

Budget Authority ($000)	FY 2001 Enacted	FY 2002 Enacted	FY 2003 Enacted	FY 2004 Enacted	FY 2005 Request
Contracts:					
Aviation System Capacity Improvement	5,300	5,300	5,116	6,462	6,500
Personnel Costs	0	0	0	0	0
Other In-house Costs	0	0	0	0	0
Total	**5,300**	**5,300**	**5,116**	**6,462**	**6,500**

OMB Circular A-11, Conduct of Research and Development ($000)	FY 2001 Enacted	FY 2002 Enacted	FY 2003 Enacted	FY 2004 Enacted	FY 2005 Request
Basic	0	0	0	0	0
Applied	0	0	0	0	0
Development (includes prototypes)	5,300	5,300	5,116	6,462	6,500
Total	**5,300**	**5,300**	**5,116**	**6,462**	**6,500**

Note: FY 1999 funding for this budget line item included the allocation for Separation Standards.

Aviation System Capacity Improvement Product and Activities	FY 2005 Request ($000)	Program Schedule					
		FY 2004	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009
Aviation System Capacity Improvement							
NAS Performance Measurement	**$4,000**						
Develop En Route Balance Scorecard			◇	◇			
Develop Terminal Balance Scorecard		◆	◇	◇			
ATS/ATO Balance Scorecard		◆	◇	◇			
Develop AT Systems Metrics - PDARS		◆	◇	◇			
Develop En Route Capacity Metric		◆	◇	◇			
SATS Demonstration		◆					
Airport Development	**$1,000**						
Conduct Benchmarking		◆	◇	◇	◇	◇	◇
Model & Simulate NLA Ground Movements		◆	◇	◇	◇		
Conduct Regional Jets Departure Procedures Modeling at DFW		◆					
Develop Metrics for OEP 8 Pacing Airports		◆					
Complete and Distribute 2003 ACE Plan		◆					
Begin Data Gathering for 2004 ACE Plan		◆	◇				
2005 – 2008 ACE Plans				◇	◇	◇	◇
Capacity Improvement Initiatives	**$600**						
Model Airspace Redesign at Houston		◆	◇				
Develop, Model and Implement GPS Support Initiatives		◆	◇				
Conduct SFO Bay Analysis			◇	◇	◇		
Architecture Deployment Support	**$900**						
Conduct Simulation and Analysis of SOIA		◆					
Along Track Separation Simulation and Analysis		◆					
Simulate and Analyze Wake Turbulence Separation Standards			◇				
Review Required Navigation Performance (RNP) Operations		◆	◇	◇			
Analyze NAS System Modernization Capacity Impacts		◆	◇	◇			
Total Budget Authority	**$6,500**	**$6,500**	**$6,500**	**$6,500**	**$6,500**	**$6,500**	**$6,500**

◆ - Activities Accomplished ◇ - Activities Planned

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CENTER FOR ADVANCED AVIATION SYSTEM DEVELOPMENT (CAASD) R&D PROGRAM

GOALS:

Intended Outcomes: The FAA applies knowledge and expertise developed at the Center for Advanced Aviation System Development (CAASD) to produce a safer, more efficient global air transportation system. Studies performed at CAASD comprise an essential component of FAA research, system engineering and operations research.

Agency Outputs: CAASD research and development identifies and tests new technologies for worldwide application to air traffic management, navigation, communication, separation assurance, security, surveillance technology, and system safety.

CAASD produces detailed reports and briefings on subjects across the entire spectrum of their work program. CAASD also develops sophisticated models and prototypes to test concepts and/or systems proposed for use in the management and control of air traffic. Presently, some of these new Air Traffic Management (ATM) products are helping to shape a next generation ATM and control system that will be safer, more efficient, and more readily available.

Customer/Stakeholder Involvement: The FAA responds to a constant challenge to increase safety in the nation's civil aviation system while increasing capacity and efficiency. Collaborative traffic flow management, communications, navigation and surveillance evolution are among these important issues and needs.

The CAASD effort directly contributes to the goals and activities of the RTCA Free Flight Steering Committee. This committee is the principal forum to bring industry, aircraft operators, and FAA representatives together to define the operational needs of free flight and identify an affordable NAS Architecture capable of satisfying those needs.

Additionally, the CAASD effort contributes to the goals of the International Civil Aviation Organization (ICAO) in developing worldwide navigation capabilities, including: a wide-area augmentation system; a local-area augmentation system; and a worldwide air-ground communication capability using very high frequency air-ground digital radio. ICAO is the principal venue for international standards development.

Accomplishments: CAASD has supported the following accomplishments:

- Conducted laboratory evaluations of prototypes of key Free Flight capabilities to define requirements and estimate potential system benefits. These include enhancements to the User Request Evaluation Tool (URET) for severe weather display, accommodating traffic flow restrictions and generating conflict resolution advisories. Enhancements to the Collaborative Routing Coordination Tool include capabilities to assess the impact of multiple traffic flow management initiatives and to generate balanced re-route solutions via automation.
- Developed and presented an end-to-end demonstration of creating and executing a traffic flow management re-route initiativ
- Developed a flight plan pre-processing prototype capability – a related software client component has been provided to several U.S. airlines for operational evaluation and integration with airline flight planning tool
- Reviewed and analyzed current wake vortex data and technology to help the FAA and NASA define programs and procedures to meaningfully enhance the NAS. Specifically, CAASD conducted laboratory evaluations to establish operational feasibility of proposed near-term wake vortex procedures. CAASD also developed concepts for mid-term procedures.
- Developed procedural changes to improve runway safety and efficiency in the en route, terminal, and oceanic domains.
- Conducted analyses to develop and assess regional and national airspace design changes that improve NAS performance.

- Completed four simulations of Cockpit Display of Traffic Information (CDTI) Enhanced Flight Rules (CEFR) in the CAASD Air Traffic Management Laboratory. The results of these simulations have supported the approval of the CEFR concept for the Operational Evolution Plan and, by 2004, are likely to lead to its operational use in Louisville by UPS.
- Performed research on Traffic Information Services – Broadcast (TIS-B) which is leading to initial implementation on the U.S. east coast and in Anchorage, Alaska.
- Performed analysis, prototyping and laboratory evaluations of key capabilities in the en route and Traffic Flow Management domains to allow air traffic control specialists to provide a higher level of service to airspace users and to enhance the domain architectures.

R&D Partnerships: Extensive partnerships have been forged with industry suppliers, aircraft operators, other government entities and other non-profit research institutions through the CAASD work program. These relationships include:

- Interdisciplinary Center for Economic Science at George Mason University – related to economic analyses
- NASA Langley on Wake Vortex and surface issues – related to capacity improvement
- EUROCONTROL – related to future ATM developments
- NASA Ames – related to Multi-Center Traffic Management Advisor
- NASA Langley's Small Aircraft Transportation System (SATS) program, Johns Hopkins Laboratory, and the states of North Carolina, Maryland and Virginia – related to broadcast services
- Cargo Airlines Association, Embry-Riddle Aeronautical University, on ADS-B and its use – related to situational awareness (traffic and weather information in the cockpit) and self-spacing
- MIT Lincoln Laboratory – related to wake vortex technologies and surveillance requirements and solutions resulting from evolving FAA security requirements
- The Volpe National Transportation Systems Center – related to operational evaluation of Air Traffic Management research topics

CAASD is partnering with Georgia Tech to develop a modeling and simulation curriculum, and with the Santa Fe Institute on agent-based modeling. CAASD also is working with Catholic University on human factors stress monitoring techniques. CAASD specialists collaborate with their counterparts at the Volpe National Transportation Systems Center on evolving TFM operational capabilities and infrastructure modernization.

MAJOR ACTIVITIES AND ANTICIPATED FY 2004 ACCOMPLISHMENTS:

- Conduct further laboratory evaluations of enhancements to URET for severe weather display. This work will include field evaluations on URET enhancements to accommodate traffic flow restrictions and the integration of air-ground data link with URET.
- Develop and conduct laboratory evaluations of an expanded capability to assess the impact of multiple traffic flow management initiatives. These evaluations will be used to develop requirements for and to prioritize enhancements to the Traffic Flow Management infrastructure.
- Prototype and evaluate automated decision support capabilities for developing Traffic Flow Management initiatives that consider the uncertainty in actual en route sector aircraft counts. This work will specifically address both the underlying algorithms and the visual representation of the data to traffic management specialists.
- Develop and conduct laboratory evaluations of a set of capabilities to enhance Area Supervisor situational awareness and predict the operational impact of Air Traffic Management initiatives.
- Conduct analyses in support of gaining approval for near-term wake vortex procedures. Further develop a detailed operational concept for mid-term procedures.

- Perform prototype development and assessment of flight data processing capabilities for rapid system requirements validation.
- Evaluate enhanced vision systems in conjunction with LAAS Category I to achieve Category III capabilities.
- Evaluate the feasibility of using Automatic Dependent Surveillance – Broadcast (ADS-B) for radar-like services in the Gulf of Mexico.

APPROPRIATION SUMMARY

	Amount ($000
Appropriated (FY 1982-2003)	$74,836
FY 2004 Enacted	47,108
FY 2005 Request	46,056
Out-Year Planning Levels (FY 2006-2009)	235,889
Total	$403,888

Budget Authority ($000)	FY 2001 Enacted	FY 2002 Enacted	FY 2003 Enacted	FY 2004 Enacted	FY 2005 Request
Contracts:					
Center for Advanced Aviation System Development (CAAS	3,991	5,143	45,268	47,108	46,056
Personnel Costs	0	0	0	0	0
Other In-house Costs	0	0	0	0	0
Total	**3,991**	**5,143**	**45,268**	**47,108**	**46,056**

OMB Circular A-11, Conduct of Research and Development ($000)	FY 2001 Enacted	FY 2002 Enacted	FY 2003 Enacted	FY 2004 Enacted	FY 2005 Request
Basic	0	0	0	0	0
Applied	3,991	5,143	45,268	47,108	46,056
Development (includes prototypes)	0	0	0	0	0
Total	**3,991**	**5,143**	**45,268**	**47,108**	**46,056**

Notes:
- Out year funding is under review.
CCAASD moved to F&E by Congress in FY 02. CAASD funding prior to FY 04 is for research efforts only.
CAASD funding FY 04 and beyond includes all of CAASD F&E efforts.

Center for Advanced Aviation System Development (CAASD) Product and Activities	FY 2005 Request ($000)	Program Schedule					
		FY 2004	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009
Center for Advanced Aviation System Development (CAASD)							
Research, Engineering and Development	**$18,422**						
Develop and Integrate Detailed Next Generation Air/Ground Communications System Program Plan		◆	◇	◇			
Define Relationships Among Safety, Separation Standards, and Operational Capability to Enhance Safety Management		◆	◇	◇	◇	◇	
Investigate the Expand use of GPS and Advanced Navigation Systems		◆	◇	◇	◇	◇	◇
Continue Investigating Procedures, User Needs, System Requirements, and Architecture Implications for Enhanced Information Systems		◆	◇	◇	◇	◇	◇
Air Traffic Operational Research	**$16,120**						
Conduct Evaluations of Airspace Redesign Enhancements in all Operational Domains to Improve System Performance and Utilization of Resources		◆	◇	◇	◇		
Research New Air Traffic Management and Control Operating Concepts Evaluation and/or Infrastructure Replacements		◆	◇	◇	◇	◇	◇
Incorporate GPS Technology into Ongoing Work in Area of Low Cost Avionics to Make Full Use of Traffic Alert and Collision Avoidance System (TCAS)		◆	◇	◇	◇	◇	◇
Special Situation Support	**$11,514**						
Define and Develop Requirements for Advanced Free Flight Concepts and Capabilities that will be Needed Beyond Free Flight Phase 1		◆	◇	◇	◇	◇	◇
Deliver and Evaluate Core Set of Operational Capabilities (SMA, CDM, CTAS and URET) at a Limited Number of Sites		◆	◇				
Develop Alternative Methods for Using GPS Technology Inclusion of Free Flight Concepts in Domestic Airspace		◆	◇	◇	◇	◇	◇
Integrate Decision Support System Requirements with FAA and Industry Technology		◆	◇	◇	◇	◇	◇
Total Budget Authority	**$46,056**	**$46,056**	**$46,056**	**$53,424**	**$56,000**	**$58,800**	**$61,768**

◆ - Activities Accomplished ◇ - Activities Planned

NOTES: OUT YEAR NUMBERS ARE FOR PLANNING PURPOSES ONLY. ACTUAL FUNDING NEEDS WILL BE DETERMINED THROUGH THE ANNUAL BUDGET PROCESS. IN THE FACILITIES AND EQUIPMENT APPROPRIATIONS, PERSONNEL AND OTHER COSTS ARE BUDGETED IN ACTIVITY 6, NOT THE PROGRAM BUDGET LINE ITEM..

DOMESTIC REDUCED VERTICAL SEPARATION MINIMA (DVRSM)

GOALS:

Intended Outcomes: The Domestic Reduced Vertical Separation Minima (DRVSM) Program is working to reduce separation standards within the domestic airspace of the continental United States, in order to achieve the following benefits for providers and users of the domestic air traffic control system:

- Increase system efficiency, through reduced fuel-burn and decreased departure delays, and
- Increase theoretical system capacity, through increased capability of controllers to support greater numbers of routes and flight levels safely within the same airspace.

Agency Outputs: The DRVSM Plan describes a systematic process for revising domestic separation standards between Flight Level (FL) 290 and FL 410 and establishes priorities for implementing changes. To document and evaluate each separation change, the FAA produces the following supporting products:

- Operational assessments of the value the change brings to providers and users of the Air Traffic Control (ATC) System
- A benefit-cost analysis
- A safety assessment of the system before and after application of the change
- Documentation of rulemaking (as required)
- Published regulations (as required)
- ATC procedures (as required)
- New or changed guidance material and procedures, as required, to standardize and make the reduced separation standard safe for domestic operations
- Documentation of long-term safety oversight function, as required, for the implementation and continued safe use of the reduced separation standard

Customer/Stakeholder Involvement: The DRVSM Program hosts or facilitates appropriate government-industry forums to draw all concerned parties into a common process. The cooperating entities include: DoD, Canada, Mexico, ATS providers, ATC system users, industry trade organizations, and unions representing controllers and pilots.

Accomplishments: The DRVSM Program is the vehicle for the FAA to bring about a major reduction in the separation standards affecting domestic airspace within the United States. This recently funded program has acted on a comprehensive plan to achieve its objectives. First, it conducted fast-time simulations to reach a preliminary assessment of potential benefits. Then, it brought users and stakeholders together in an industry day seminar to get their support and cooperation. The United States, Canada and Mexico have also formalized bilateral RVSM implementation agreements for those portions of Canadian and Mexican airspace that abut the United States.

R&D Partnerships: A relationship was established with EUROCONTROL and the United Kingdom to collect and analyze data related to RVSM in Europe.

MAJOR ACTIVITIES AND ANTICIPATED FY 2004 ACCOMPLISHMENTS:

- Develop and deploy a ground-based system for monitoring aircraft height-keeping performance and establish North American Approvals Registry and Monitoring Organization as ICAO-required regional monitoring agency to support North American RVSM implementation
- Complete rulemaking for implementing DRVSM
- Conduct a sixth and, potentially, seventh DRVSM seminar for customers and stakeholders
- Develop pilot procedures for application within DRVSM airspace
- Develop ATC procedures for use within DRVSM airspace
- Develop and publish procedures for handling mountain wave activity within DRVSM airspace

- Complete necessary NAS automation system changes and plan for modifications to NAS air traffic management procedures and systems
- Complete a pre-implementation safety analysis

FY 2005 PROGRAM REQUEST:

The FY 2005 program request provides for:

- Completing a final assessment of operator readiness for DRVSM implementation
- Finalizing bilateral plans with Canada and with Mexico for common North American RVSM implementation
- Implementing RVSM in sovereign U.S. and designated portions of delegated international airspace
- Continuing safety post-implementation safety oversight

KEY FY 2005 PRODUCTS AND MILESTONES:

- Implement NAS automation systems modifications required for DRVSM implementation
- Complete air traffic controller and operator/ pilot training
- Implement RVSM on January 20, 2005
- Continue monitoring aircraft height-keeping performance post-implementation
- Examine operator compliance with requirement for RVSM approval to operate in U.S. RVSM airspace after January 20, 2005.
- Initiate work on post-implementation safety assessment
- Continue post-implementation operation of North American Approvals Registry and Monitoring Organization as coordinator of RVSM safety oversight activities

APPROPRIATION SUMMARY

	Amount ($000
Appropriated (FY 1982-2003)	$6,173
FY 2004 Enacted	1,889
FY 2005 Request	2,200
Out-Year Planning Levels (FY 2006-2009)	0
Total	$10,262

Budget Authority ($000)	**FY 2001 Enacted**	**FY 2002 Enacted**	**FY 2003 Enacted**	**FY 2004 Enacted**	**FY 2005 Request**
Contracts:					
Domestic Reduced Vertical Separation Minima Program	0	2,100	4,073	1,889	2,200
Personnel Costs	0	0	0	0	0
Other In-house Costs	0	0	0	0	0
Total	**0**	**2,100**	**4,073**	**1,889**	**2,200**

OMB Circular A-11, Conduct of Research and Development ($000)	**FY 2001 Enacted**	**FY 2002 Enacted**	**FY 2003 Enacted**	**FY 2004 Enacted**	**FY 2005 Request**
Basic	0	0	0	0	0
Applied	0	0	0	0	0
Development (includes prototypes)	0	2,100	4,073	1,889	2,200
Total	**0**	**2,100**	**4,073**	**1,889**	**2,200**

Note: FY 2002 was the fist year of funding under Facilities and Equipment Advanced Technology Development and Protopyping.

*** Out year funding under review**

Domestic Reduced Vertical Separation Minima Program Product and Activities	FY 2005 Request ($000)	Program Schedule					
		FY 2004	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009
Domestic Reduced Vertical Separation Minima							
DRVSM	**$1,900**						
Conduct Rule Making		◆	◇				
Conduct Safety Assessment		◆	◇	◇	◇	◇	
Develop Database		◆	◇	◇	◇	◇	
Develop Monitoring Procedure		◆	◇				
Conduct Modeling and Simulations		◆	◇	◇			
Conduct Analysis of Data		◆	◇	◇	◇	◇	
Develop Procedures		◆	◇	◇			
Conduct Monitoring			◇	◇	◇	◇	◇
Post Implementation Safety Assessment			◇	◇	◇	◇	◇
Total Budget Authority	**$1,900**	**$2,100**	**$1,9000**	*	*	*	*

◆ - Activities Accomplished ◇ - Activities Planned

NOTE: OUT YEAR NUMBERS ARE FOR PLANNING PURPOSES ONLY. ACTUAL FUNDING NEEDS WILL BE DETERMINED THROUGH THE ANNUAL BUDGET PROCESS. IN THE FACILITIES AND EQUIPMENT APPROPRIATIONS, PERSONNEL AND OTHER COSTS ARE BUDGETED IN ACTIVITY 6, NOT THE PROGRAM BUDGET LINE ITEM.

* PROGRAM REQUESTS FOR ALL YEARS ARE UNDER REVIEW.

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ENVIRONMENT AND ENERGY

GOALS:

Intended Outcomes: The Environment and Energy Program contributes to achievement of the FAA's enabling goal in the area of environmental compatibility and supports the Administrators Flight Plan 2004-2008.

The Program focuses its activities to:

- Improve analytic and planning tools that reveal aviation's impacts upon the environment (by themselves and compared to pollutants from other sources) and the consequences of alternative courses of action
- Work with the international aviation community to reduce aviation noise – actions include: improving aircraft certification standards and operational procedures; promoting compatible land use; and applying abatement technologies around populations exposed to aircraft operations
- Minimize the impact of aircraft emissions – actions include: advancing the state of science/knowledge concerning atmospheric/health effects of aviation emissions; improving aircraft certification standards and operational procedures; and implementing improved control technologies and mitigation measures
- Develop comprehensive environmental design space analytical tools that address the interrelationships between noise and emissions and among environmentally beneficial actions affecting various emissions

Agency Outputs: The findings of aviation environmental research have resulted in publications of significant interest to the full aviation community. These outputs include:

- Computer models and impact criteria for use by civil aviation authorities in assessing proposed actions
- Standards for the certification of new and modified designs to reduce aircraft noise and engine exhaust emissions
- Technical reports, handbooks, Advisory Circulars, training courses, and procedures for use by the aviation community and the public

Customer/Stakeholder Involvement: The FAA works closely with other federal agencies, industry, academia, and international governments and organizations to design R&D efforts to mitigate the environmental impact of aviation. This unified regulatory approach to research identifies and influences technologies, models, regulations, and certification criteria that can improve our present and future global environment.

The FAA established the Aviation Rulemaking Advisory Committee (ARAC) as a formal standing committee composed of representatives from aviation associations and industry. The committee conveys its recommendations, advice, and information to the FAA for consideration in rulemaking activities. ARAC harmonization working groups ensure that domestic and international aircraft noise certification regulations impose uniform standards upon the aircraft of all countries.

Along with representatives of other civil aviation authorities and observers from the aviation industry, the FAA represents the United States on the International Civil Aviation Organization's (ICAO) Committee on Aviation Environmental Protection (CAEP). This committee establishes and continually assesses the adequacy of international aviation environmental standards for aircraft noise and engine exhaust emissions.

The FAA and other interested federal agencies established the Federal Interagency Committee on Aviation Noise (FICAN) to encourage debate and agreement over needs for future aviation noise abatement and resulting new research efforts. FICAN conducts annual public forums in different geographic regions with the intent to better align noise abatement research with local public concerns.

Accomplishments: Reduced the negative impact of aviation noise by 80 percent from the 1992 Level

- Reported to Congress regarding:
  - Quiet technology for air tour aircraft operating in Grand Canyon National Park
  - The annual progress of the FAA/NASA subsonic jet noise research program from FY 1994 to FY 2002
  - Non-military helicopter noise impacts on densely populated communities
- Developed highly influential advanced computer models for airport and heliport noise analysis – over 600 copies of the models have been sold around the world and used in over 160 U.S. airport studies involving more than $1.3 billion in airport noise compatibility grants; they have provided the basis for an aircraft overflight noise exposure prediction model for Grand Canyon National Park
- Offered public forums on aviation noise research in Atlanta, Minneapolis, San Diego, Seattle, Washington, DC, and Columbus
- Published special reports and findings:
  - Annual reports of FICAN activities since 1994
  - A compendium on federal aviation noise research projects
  - Federal findings on: (1) the relationship between aircraft noise and sleep awakenings, (2) research on natural quiet, (3) effects of aircraft noise on classroom learning, (4) value of supplemental noise metrics in aircraft noise analysis, and (5) effects of low frequency on residences
- Developed new Continuous Descent Approach noise abatement procedures in collaboration with NASA, Academia, manufacturers, and operators
- Developed and enhanced the computer model that is used extensively in airport air quality analyses and has won the Environmental Protection Agency's (EPA) highest endorsement
- Developed a handbook on performing civil and military airport air quality analyses that promises to improve the quality of environmental assessments reviewed by the Federal Government
- Developed a modeling capability that will be used to produce annual inventories of aircraft greenhouse gas emissions and to assess aviation's forecasted global emissions

R&D Partnerships: Through a series of Memorandums of Agreement, the FAA works closely with NASA to identify source abatement technologies for noise and emissions. Together, the agencies also work with industry and academia to assess the possible global impact of aircraft engine exhaust emissions. The FAA is also pursuing collaborative agreements with DoD, DoE, and EPA to leverage resources to address aviation's environmental impact.

The Volpe National Transportation Systems Center (VNTSC) continues, in collaboration with the Environment and Energy Program, to provide substantial technical assistance in the areas of aircraft noise and engine emissions measurement and assessment.

FICAN also offers a forum for partnership, as the Committee comprises all Federal agencies concerned with aviation noise. The FAA works with this committee to foster greater, more cost-effective partnering in aviation noise research among all agencies.

MAJOR ACTIVITIES AND ANTICIPATED FY 2004 ACCOMPLISHMENTS:

Aircraft noise reduction and control

- Propose new federal noise certification standard for subsonic jet and large transport airplanes
- Continue to examine and validate methodologies used to assess aircraft noise exposure and impact
- Continue research activities through the Center of Excellence (COE) for Aircraft Noise and Aviation Emissions Mitigation to gain a better understanding of low frequency noise, metrics to assess impact of noise exposure, operational procedures, land use and airport controls, and impacts of supersonic aircraft boom

- Together with the "Engine emissions reduction and control activity", conduct the first annual COE conference
- Publish:
  - Second assessment of the FAA/NASA aircraft noise reduction technology research FAA augmentation
  - FAA Advisory Circular 36-4 on aircraft noise certification

Engine emissions reduction and control

- Update FAA Advisory Circular 34-1, the aircraft engine emissions certification handbook
- Finalize an Aerospace Information Report on the measurement and sampling of particulate matter emissions from aircraft engines
- Assess the potential benefits of incorporating emissions reduction technologies drawn from NASA research programs
- Perform measurements and analyses to characterize particulate matter emissions from aircraft engines
- Continue to examine alternative, simplified engine exhaust emissions measurement procedures that can reduce certification test costs to manufacturers
- Initiate research activity through the COE to gain a better understanding of the science related to the atmospheric and health effects of aviation emissions

Aviation noise analysis

- Obtain acceptance of Society of Automotive Engineers (SAE) new guidelines for the calculation of airplane noise in the vicinity of airports
- Continue updating the Modeling System for Assessing Global Noise Exposure (MAGENTA)
- Together with the "Aviation emissions analysis activity", develop a framework for an integrated Aviation Environmental Design Tool that considers the interrelationships between noise and emissions
- Release new Integrated Noise Model (INM) database of aircraft (including helicopters) noise and performance values/parameters

Aviation emissions analysis

- Finalize:
  - Reports on validation activities for the Emissions And Dispersion Modeling System (EDMS)
  - A first-order approximation method for calculating particulate matter emissions from aircraft engines and integrate into the EDMS
- Publish
  - An update (addendum) to the handbook for airport air quality analyses
  - Guidance concerning the reduction of emissions from ground support equipment (GSE), including revised emissions calculation methodology
  - Resource and guidance materials for addressing issues related to hazardous air pollutants associated with aircraft, airports, and aviation
- Continue validation for the modeling System for assessing Aviation's Global Emissions (SAGE), version 1, and update modular components
- Continue air quality research and methodology development to enhance the EDMS capability to more accurately estimate aviation emissions in the vicinity of an airport
- Assess baseline national and global emissions inventories; also determine the potential benefits of operational procedures and air traffic modernization using SAGE version 1

- Deliver the first version of the Screening Model for Airport Air Quality (SMAAQ) to FAA Flight Standards field personnel
- Initiate research activity through the COE to gain a better understanding of the science related to the atmospheric and health effects of aviation emissions

FY 2005 PROGRAM REQUEST:

The FAA will continue to work with NASA in the Quiet Aircraft Technology research program identifying noise reduction technologies that may enter the marketplace within the next 10-15 years. The agency will use these research findings to consider new environmental certification standards and procedures for the next generation of transport aircraft.

In accordance with the National Environmental Policy Act, the FAA must consider and mitigate the environmental consequences of its actions. The FAA will continue to work with NASA, the manufacturing industry, and international authorities to support the development and implementation of aircraft environmental certification regulations through proactive response to changes in airplane and engine technology, measurement/analysis technology, regulatory policy, and international regulatory initiatives.

Ongoing Activities

- Support the FAA role in the ICAO CAEP working groups for assessing the technological, scientific, operational, and economic aspects associated with maintaining international standards and recommended practices for aircraft noise and engine exhaust emissions
- Examine and validate methodologies used to assess aircraft noise exposure and impact
- Enhance MAGENTA
- Enhance and continue to validate EDMS, SMAAQ, their input databases, and SAGE
- Maintain the currency of the regulation and technical guidance materials concerning aircraft noise and engine exhaust emissions certification requirements
- Continue activities through the COE to identify and better measure the issues and impacts associated with aircraft noise and aviation emissions, and generate improved solutions to deal with these problems

New Initiatives

Aerospace systems have historically been designed – and regulations for their certification and use have been written – as though aviation noise and various emissions had nothing to do with one another. But aviation noise and emissions are actually highly interdepent phenomena. Future environmentally responsible aviation policy and rulemaking has to be based on a new, interdisciplinary approach. Furthermore, this approach must be made as affordable as it is effective.

Existing analytical tools are inadequate to assess interdependencies between noise and emissions or analyze the cost/benefit of proposed actions. Accordingly, the FAA plans to develop a robust new comprehensive framework of aviation environmental analytical tools and methodologies to perform these functions. The long-term aim is provide a seamless, comprehensive set of tools to address all aspects of noise and emissions. The elements of the this framework will include:

- Environmental Design Space (EDS) capability to provide integrated analysis of noise and emissions at the aircraft level
- Aviation Environmental Design Tool (AEDT) comprises EDS and other integrated aviation noise and emissions modules – will provide integrated capability of generating interrelationships between noise and emissions and amongst emissions at the local and global levels
- Aviation Environmental Portfolio Management Tool (APMT) comprises AEDT and other modules – will provide the common, transparent cost/benefit methodology needed to optimize national aviation policy in harmony with environmental policy

- These framework of tools will allow:
  - Government agencies to understand how proposed actions and policy decisions impact and are impacted by aviation noise and emissions
  - Industry to understand how operational decisions impact and are impacted by proposed projects affecting aviation noise and emissions
  - The public to understand how actions by government and industry impact and are impacted by aviation noise and emissions

Anticipated benefits of this initiative include:

- Optimize environmental benefits of proposed actions and investments
- Improved data and analysis on airport/airspace capacity projects
- Increased capability to address noise and emissions interdependencies in the resolution of community concerns
- More effective R&D portfolio management
- Removal of environmental roadblocks to capacity growth
- Continued global leadership for the United States in environmentally responsible aviation

KEY FY 2005 PRODUCTS AND MILESTONES:

Aircraft noise

- Promulgate new federal noise certification standard for subsonic jet and large transport airplanes
- Develop methods and techniques to improve use of supplemental noise metrics through the COE
- With the "Aviation emissions activity", conduct the second annual Noise COE conference
- Plan for an interactive website/software development effort to communicate complex noise technical information in a manner suitable for public distribution (NoiseQuest)

Aviation emissions

- Develop and publish:
  - Procedures and technical guidance materials for affordable engine exhaust emissions testing and certification that are both harmonized and simplified
  - Protocol for assessing hazardous air pollutants in the aviation environment
- Continue to:
  - Assess potential benefits of using NASA-developed emissions reduction technologies; identify technology goals for long term reduction of aircraft engine emissions
  - Assess the atmospheric and health effects of aviation related emissions through the COE
- Test and analyze particulate matter emissions from aircraft engines to support further development of SAE E31 aerospace recommended practices

Noise and Emissions Analyses and interrelationships (to better understand and exploit the interrelationships between noise and emissions; combines analytical elements previously found under aircraft noise and aviation emissions)

- Continue examining and validating methodologies used to assess aircraft noise exposure and impact [INM, Area Equivalent Method (AEM)]
- Release new INM software and database of aircraft (including helicopters) noise and performance values/parameters

- Complete:
  - SAGE model, version 1.1 development and validation
  - Annual inventory of national and global emissions
- Continue to:
  - Examine and validate methodologies used to assess aviation emissions and their impact on air quality; identify and implement enhancements to EDMS
  - Develop and enhance SMAAQ
- Initiate efforts to develop the elements of AEDT:
  - Formulate and develop EDS module
  - Integrate acoustics and engine design modules
  - Create interface managements among noise and emissions modules
  - Harmonize database architecture
  - Create user interface
- Initiate efforts to develop the elements of APMT:
  - Develop architecture for integrating AEDT, traffic and economic modules
  - Create and integrate socioeconomic database
  - Create user interface

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2003)	$101,420
FY 2004 Enacted	7,928
FY 2005 Request	16,008
Out-Year Planning Levels (FY 2006-2009)	66,180
Total	$191,536

Budget Authority ($000)	**FY 2001 Enacted**	**FY 2002 Enacted**	**FY 2003 Enacted**	**FY 2004 Enacted**	**FY 2005 Request**
Contracts:					
Aircraft Noise	678	19,822	18,192	3,921	1,164
Engine Emissions	2,115	989	1,941	2,340	467
Noise & Emissions Analyses					12,649
Personnel Costs	653	1,086	1,383	1,580	1,575
Other In-house Costs	27	184	97	87	153
Total	**3,473**	**22,081**	**21,612**	**7,928**	**16,008**

OMB Circular A-11, Conduct of Research and Development ($000)	**FY 2001 Enacted**	**FY 2002 Enacted**	**FY 2003 Enacted**	**FY 2004 Enacted**	**FY 2005 Request**
Basic	0	0	0	0	0
Applied	3,473	22,081	21,612	7,928	16,008
Development (includes prototypes)	0	0	0	0	0
Total	**3,473**	**22,081**	**21,612**	**7,928**	**16,008**

Environment and Energy Product and Activities	FY 2005 Request ($000)	Program Schedule					
		FY 2004	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009
091-110 Aircraft Noise	**$1,164**						
Assess FAA/NASA Aircraft Noise Reduction Technology Research		◆	◇	◇	◇	◇	◇
Provide Noise COE reports, conferences, findings, and other activities		◆	◇	◇	◇	◇	◇
Publish Advisory Circular 36-4 (and Updates)		◆		◇		◇	
Promulgate New Noise Standard for Subsonic Jets and Large Airplanes			◇				
New Noise Standard for Helicopters					◇		
Validate the Methodologies Used to Assess Aircraft Noise Exposure and Impact (INM, AEM)		◆		◇		◇	
COE reports, findings, and other activities			◇	◇	◇	◇	◇
091-111 Engine Emissions	**$567**						
Assess Technological and Scientific Bases to Support Future ICAO Engine Emission Standards		◆		◇		◇	
Alternative, Simplified Engine Exhaust Emissions Certification Test Procedures			◇		◇		◇
Update Advisory Circular 34-1		◆			◇		◇
Measurement/sampling Protocol for Particulate Matter (PM) Emissions from Aircraft Engines		◆			◇		◇
Measurement/sampling Protocol for Particulate Matter (PM) Emissions from Aircraft Engines		◆			◇	◇	
COE reports, findings, and Other Activities			◇	◇	◇	◇	◇
091-016 Noise and Emissions Analysis	**$12,549**						
Architecture for noise/emissions modules communication		◆		◇			◇
Develop Model for Assessing Global Exposure to Noise from Transport Aircraft		◆		◇			◇
Validate the Methodologies Used to Assess Aircraft Noise Exposure and Impact (INM, AEM)		◆		◇		◇	
Release Integrated Noise Model (INM) Updates			◇		◇	◇	
Enhanced Aircraft Noise Modeling for Airspace Management Activities				◇	◇		◇
Release Emissions and Dispersion Modeling System (EDMS) Updates		◆		◇			
Forecast Future Global Emissions and Complete Updates to the SAGE Model		◆		◇			
Release Screening Model for Airport Air Quality (SMAAQ), Version 1, and Updates		◆		◇			
Validate Methodologies Used to Assess Aviation Emissions and Their Impact on Air Quality		◆	◇	◇			
First-Order Approximation Method for Aircraft Engine PM Emissions		◆		◇			
Publish Handbook for Airport Air Quality Analysis and Updates			◇	◇	◇		
Guidance Document for Estimating and Reducing Emissions from Ground Support Equipment		◆					
Resource and Guidance Materials, and Assessment Protocol Concerning Hazardous Air Pollutants		◆	◇	◇		◇	
Develop Aviation Environmental Design Tool (AEDT)			◆	◇	◇	◇	

Environment and Energy Product and Activities (Cont.)	FY 2005 Request ($000)	Program Schedule					
		FY 2004	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009
Develop Aviation Environmental Portfolio Management Tool (AEPMT)			◆	◇		◇	
Harmonize AEDT and APMT Databases and Code Management Protocols			◆		◇		◇
Integrate Cost and socioeconomic data			◆		◇		◇
Personnel and Other In-House Costs	**$1,728**						
Total Budget Authority	**$16,008**	**$7,928**	**$16,008**	**$16,204**	**$16,407**	**$16,602**	**$16,967**

◆ - Activities Accomplished ◇ - Activities Planned

NOTE: OUT YEAR NUMBERS ARE FOR PLANNING PURPOSES ONLY. ACTUAL FUNDING NEEDS WILL BE DETERMINED THROUGH THE ANNUAL BUDGET PROCESS.

NAS REQUIREMENTS DEVELOPMENT

GOALS:

Intended Outcomes: This program prepares and validates strategies and proposals designed to increase the FAA's ability to reach its System Capacity mission goal: "*Work with local governments and airspace users to provide capacity in the United States airspace system that meets projected demand in an environmentally sound manner*."

As part of the agency's Acquisition Management System (AMS) process, the FAA examines current and future NAS systems needs and develops preliminary acquisition requirements to fill any identified gaps. This budget line item provides an established means to evaluate selected services or technologies independent of their venders. These evaluations are vital to selecting the options most able to increase NAS system efficiency.

Agency Outputs: Activities funded by this program include:

- Simulation
- Human factors
- Procedure development
- Performance definition
- Impact analysis
- Workload analysis
- Hazard analysis
- NAS architecture development

NAS Requirements Development is contained within the F&E budget in Advanced Technology Development and Prototyping (1C01).

MAJOR ACTIVITIES AND ANTICIPATED FY 2004 ACCOMPLISHMENTS:

- Research, for the National Academy of Sciences:
  - Weather radar technology beyond Next Generation Radar
  - Weather Forecasting Accuracy for FAA Air Traffic Control
- Evaluate operational facilities supporting the Airport Equipment Decision Tool.
- Provide Operations and Maintenance rough order magnitude estimates for budget formulation.
- Provide technical and analytical support to:
  - Aviation weather issue management and coordination
  - AMS acquisition management and requirements development
  - NOAA weather services and volcanic ash studies
  - North American Air Surveillance Modernization
  - Turbulence Joint Safety Implementation Team under Safer Skies
  - Aviation Weather Technology Transfer process

FY 2005 PROGRAM REQUEST:

A major key to maintaining objective, integrated NAS requirements development is ensuring a reliable, sustainable funding source that allows critical analyses of selected developmental systems – those systems that provide both the greatest potential payoffs for NAS system efficiency and the greatest risk of failure. The requested funding will allow investigations that will increase the probability of system success and identify factors and situations that require solutions before development begins.

KEY FY 2005 PRODUCTS AND MILESTONES:

- Continue to support the AMS process through research and investigation of selected programs and/or technologies. This includes the following:
  - Provide O&M rough order magnitude estimates for budget formulation.
  - Provide acquisition management support for the NAS Implementation Support Contract.

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2003)	$5,900
FY 2004 Enacted	2,982
FY 2005 Request	2,000
Out-Year Planning Levels (FY 2006-2009)	13,100
Total	$23,982

Budget Authority ($000)	FY 2001 Enacted	FY 2002 Enacted	FY 2003 Enacted	FY 2004 Enacted	FY 2005 Request
Contracts:					
NAS Requirements	2,900	3,000	0	2,982	3,000
Personnel Costs	0	0	0	0	0
Other In-house Costs	0	0	0	0	0
Total	**2,900**	**3,000**	**0**	**2,982**	**2,000**

OMB Circular A-11, Conduct of Research and Development ($000)	FY 2001 Enacted	FY 2002 Enacted	FY 2003 Enacted	FY 2004 Enacted	FY 2005 Request
Basic	0	0	0	0	0
Applied	0	0	0	0	0
Development (includes prototypes)	2,900	3,000	0	2,982	2,000
Total	**2,900**	**3,000**	**0**	**2,982**	**2,000**

NAS Requirements Development Product and Activities	FY 2005 Request ($000)	Program Schedule					
		FY 2004	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009
NAS Requirements Development							
Fund Studies and Other Efforts and Validate Strategies and Proposals Designed to Increase Overall NAS Efficiency *(Specific projects vary by year)*					◇	◇	◇
Conduct Analysis of Navigation and Landing Service Area	**$120**						
Perform Sustainability Study and Develop Requirements Document		◆	◇	◇			
Develop Performance Definition and Perform Impact Analysis		◆					
Develop Strategic Planning and Mission Need Statement		◆	◇				
NAS Voice Communications	**$60**						
Provide Sustainability Study, Performance Definition and Strategic Planning		◆					
Develop Requirements Document and NAS Architecture Documents and Perform Human factor Analysis		◆	◇				
ASB-B Initiatives	**$120**						
Perform Strategic Planning		◆	◇	◇			
Perform Mission Need Statement		◆					
Develop Requirements Document and Operational Concept of Use			◇	◇			
Perform NAS Architecture Development				◇			
System Wide Information Management and Aeronautical Information Management Service Area Analysis	**$120**						
Perform Mission Need Statement Development, Requirements Development, Strategic Planning, Operational Concept of Use Development, and Performance Definition		◆	◇	◇			
Human Factors Prototyping		◆	◇				
Alaska Capstone	**$108**						
Develop Requirements Document		◆	◇	◇			
Develop Operational Concept of Use			◇				
Develop Procedures			◇	◇			
Aviation Weather Initiatives	**$1,472**						
Develop Requirements Document and Performance Definition		◆	◇				
Develop Operational Concept of Use Development and Procedures			◇	◇			
Develop Strategic Planning and Mission Need Statement				◇			
Total Budget Authority	**$2,000**	**$3,000**	**$2,000**	**$2,000**	**$2,000**	**$2,000**	**$2,000**

◆ - Activities Accomplished ◇ - Activities Planned

Notes:

- OUT YEAR NUMBERS ARE FOR PLANNING PURPOSES ONLY. ACTUAL NEEDS WILL BE DETERMINED THROUGH THE ANNUAL BUDGET PROCESS.
- IN THE FACILITIES AND EQUIPMENT APPROPRIATIONS, PERSONNEL AND OTHER COSTS ARE BUDGETED IN ACTIVITY 6, NOT THE PROGRAM BUDGET LINE ITEM.

NATIONAL PLAN FOR TRANSFORMATION FOR AIR TRANSPORTATION

GOALS:

Intended Outcomes: Economic growth through air mobility may be the next major revolution.

- Today, air travel directly and indirectly supports 11 million jobs and about 9% of the GDP. Doubling the number of air travelers over the next 20 years will generate more than 10 million additional jobs.
- We are the most mobile society in history, with air travel comprising over half of the trips of 1000 miles or more. Air travel and communications have enabled the global marketplace. Air travel is now essential to our way of life.
- Travel and tourism is America's fourth largest export category, and the largest positive balance of trade. Last year, 50.9 million international visitors contributed $103 billion in revenues to the U.S. economy. International tourism is on pace to triple by 2025.

A Joint Planning office, established in 2003, involving Department of Transportation and FAA, Department of Defense, Department of Commerce, Department of Homeland Security and NASA will develop a "National Plan for the Transformation of Air Transportation" in FY 2004. The National Plan will establish a vision for the future air transportation system, set national aerospace goals and combine the resources of government and industry to ensure that the United States remains at the forefront of aviation. The program will lay the groundwork for a future aerospace transportation system that meets the needs of all users and is efficient in the application of FAA and aerospace resources. This future system will provide increased capacity and flexibility needed to support future demands for access to the system, while, at the same time, ensuring the safety of the flying public. The air transportation system will be part of an integrated national and global transportation system that simultaneously satisfies the nation's economic, defense and homeland security needs. If these goals are achieved, the aerospace system will stimulate and support economic growth, providing an enhanced quality of life for all citizens.

This initiative, in cooperation with NASA and other agencies, will perform the systems-of-systems analyses necessary to define and validate the future aviation system concepts and requirements that could transform air transportation in accordance with the National Plan.

Agency Outputs: By 2008, this joint activity with NASA and inputs from other agencies, will have validated the candidate air transportation system concepts from the National Plan for 2025 and beyond that could meet the objectives of the National Plan and an evolutionary plan for a transforming the system.

Key outputs of this effort include:

- Validation of candidate system concepts alternatives for meeting the National Plan objectives, including a robustness assessment against potential alternate future scenarios
- Estimated system performance benefits
- System performance requirements and allocations to system elements for the candidate concepts
- The validation will update the Transition roadmap through 2015 (as described in the Operational Evolution Plan (OEP) & Target System Description (TSD)) and will extend the roadmap to the desired 2025 system
- R&D requirements to support the system concepts

The program will re-evaluate the air transportation requirements annually based on the changing national and international environment and new technology options.

Customer/Stakeholder Involvement: The Joint Planning Office (PJO) has established an advisory committee for the purpose of engaging industry and customer input. Although this is a new start, many coordination activities have already been successfully accomplished:

- Coordination across Government agencies: To date, the FAA has discussed the National Plan Transformation of Air Transportation with the staff for the House and Senate Science & Technology Committees and DHS/TSA, DoD, DOC, NASA, and DOT
- Coordination with Industry: To date, the FAA has discussed high-level JPO plans with the AOPA, ATA, ATCA, ACI, AIA, Boeing, MBAA, NATA, NASAO, Raytheon, RAA, REDAC, and RTCA
- Draft framework for the National Plan is being developed for review and inputs from all stakeholders

Accomplishments:

None. This is a new start.

R&D Partnerships:

- The National Plan will include a coordinated R&D plan across DOT/FAA, NASA, DHS/TSA, DoD, and DOC for those elements that required for defining and transforming the future air transportation system.
- In particular, the system concepts development and validation on this initiative involves a strong partnership between FAA and NASA.

MAJOR ACTIVITIES AND ANTICIPATED FY 2004 ACCOMPLISHMENTS:

- Formally establish the Joint Planning Office
- Establish a Policy Committee for the purpose of addressing legislative and policy issues
- Establish an Advisory Committee for the purpose coordinating industry and stakeholder input
- Develop and coordinate the National Plan to include:
  - National Vision for 2025
  - Socio-Economic Demand
  - National Goals, Objectives and Policies
  - Operational Concepts and Transition Roadmap
  - Coordinated Research Plan
- Complete a Joint Planning Office (JPO) Master Program Plan

FY 2005 PROGRAM REQUEST:

The FAA, in conjunction with NASA and other government agencies, will initiate the program, which is envisioned as a multi-year effort. Specifically, we will initiate the development and validation of system concepts for 2025 and beyond. Building upon concepts initially published in FY 2004 in the National Plan, we will further develop details to these concepts as well as examine new alternatives in conjunction with the aviation community and the public.

As these concepts are developed to a sufficient level of detail, we will initiate "systems of systems" analyses and simulation studies of these concepts to obtain a first-look at their feasibility, identifying concepts which merit further development and analysis in the program's next phases.

Ongoing Activities

New start in FY 05 no ongoing activities.

New Initiatives

This program is a new start in FY 05 and all the above activities are "new initiatives."

KEY FY 2005 PRODUCTS AND MILESTONES:

- Identify candidate system concepts.
- Initiate systems-of-systems analyses and simulations.

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2003)	$0
FY 2004 Enacted	0
FY 2005 Request	5,100
Out-Year Planning Levels (FY 2006-2009)	21,287
Total	$26,287

Budget Authority ($000)	**FY 2001 Enacted**	**FY 2002 Enacted**	**FY 2003 Enacted**	**FY 2004 Enacted**	**FY 2005 Request**
Contracts:	0	0	0	0	
National Plan for Transformation for Air Transportation	0	0	0	0	2,600
Personnel Costs	0	0	0	0	2,200
Other In-house Costs	0	0	0	0	300
Total	**0**	**0**	**0**	**0**	**5,100**

OMB Circular A-11, Conduct of Research and Development ($000)	**FY 2001 Enacted**	**FY 2002 Enacted**	**FY 2003 Enacted**	**FY 2004 Enacted**	**FY 2005 Request**
Basic	0	0	0	0	0
Applied	0	0	0	0	5,100
Development (includes prototypes)	0	0	0	0	0
Total	**0**	**0**	**0**	**0**	**5,100**

National Plan for Transformation for Air Transportation Product and Activities	FY 2005 Request ($000)	Program Schedule					
		FY 2004	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009
027-100 Flight Plan 2025	**$2,600**						
Develop and Validate System Concept for 2025							
Develop Operational Concept Alternatives			◆	◇			
Conduct Systems-of-Systems Analyses and Simulations			◆	◇	◇		
Evaluate Alternative System Concepts vs. System Requirements				◇	◇		
Evaluate System Concepts for Robustness against Potential Future Scenarios				◇	◇		
Complete Systems-of-Systems Analyses, Requirements, and Transformational Roadmap (These are joint activities with NASA)							
Estimate System Performance Benefits				◇	◇		
Develop Performance Requirements and Allocation to System Elements					◇	◇	
Develop Transition Roadmap from the 2015 System to 2025					◇	◇	
Re-Evaluate Based on Changing Environmental Factors and Technology Options							◇
Personnel and Other In-House Costs	**$2,500**						
Total Budget Authority	**$5,100**	**$0**	**$5,100**	**$5,184**	**$5,268**	**$5,353**	**$5,482**

◆ - Activities Accomplished ◇ - Activities Planned

NOTE: OUT YEAR NUMBERS ARE FOR PLANNING PURPOSES ONLY. ACTUAL FUNDING NEEDS WILL BE DETERMINED THROUGH THE ANNUAL BUDGET PROCESS.

OPERATIONS CONCEPT VALIDATION

GOALS:

Intended Outcomes: Operational concept validation will challenge the validity of common situational awareness assumptions behind new mechanized systems for distributing weather and traffic information and will provide the high-quality performance requirements needed to ensure that the next generation of NAS ground and airborne support systems succeed. Tactical and strategic assumptions behind decision support tools in general – as well as requirements affecting information type, update rate, and display within the systems – will all be brought under strict scrutiny and redirected, and needed, for the mutual benefit of the public and the aviation community.

Agency Outputs: This process of identifying and refining a valid structure for operating the next generation NAS requires the development of many planning documents and work products including:

- Documentation of a validated overall concept, or "target system," for the future management and control of NAS operations – the documents are well-defined and understandable, and the validations are based on credible systems modeling and simulation.
- Requirements for the subsystems of the new target system – these integrated, configuration-managed research criteria are individually and collectively validated to provide a coherent, comprehensive framework to guide anticipated research and development activities.
- Top-level designs for the major new Air Traffic Management (ATM) capabilities associated with the modernized operational concept – the subsystems enabling these capabilities include new ground-based and airborne information infrastructures needed to allow air traffic controllers to tailor their airspace responsibility dynamically to accommodate changing traffic demands more efficiently.
- A system-level safety assessment of the operational concept and associated new capabilities.
- A risk-mitigation plan to guide development activities for new capabilities.
- A human factors validation plan that provides a comprehensive roadmap of activities to ensure that new functionality will be operationally acceptable to flight crews and controllers.

Customer/Stakeholder Involvement: The RTCA Select Committee for Free Flight Implementation has been a strong external influence to the FAA in many aspects of operational concept development and validation. The Agency also has conducted a detailed survey of major stakeholders to obtain their ranking of future concept sub-elements to support modernization. This level of stakeholder participation ensures that the evolving concept is fully mindful of aviation user community requirements – an essential prerequisite to validating the concept of a modern NAS based on a shared, integrated infrastructure.

Accomplishments: The vision for the modern NAS has been developed and published in the *Government/Industry Operational Concept for Free Flight* (RTCA, August 1997), *A Concept of Operations for the NAS Airspace System in 2005* (Air Traffic Services, September 1997) and *RTCA NAS Concept of Operations and Vision of Future Aviation* (RTCA, December 2002). These documents have provided guidance to the development of the NAS Architecture Version 5. Additional details appear in the appendices to this document.

Starting in FY 1999, the program initiated the following activities to ensure high standards of top-level design, risk-mitigation planning, and attention to the influence of human factors in arriving at a validation plan:

Operational concept development

- Developed concepts for NAS Common Reference and the management of airspace resources information needed to facilitate improved flight planning and impact assessment
- Developed a framework for individual service enhancement and domains to support the development of system-level requirements for modernization
- Developed a NAS performance model for evaluating the impact of proposed concepts on operational performance; developed quantitative measures and goals for mid-term concept capabilities

- Developed concepts for individual service enhancement and domains to support the specification of system-level requirements for modernization (in particular, to support development of a Concept of Use for integrated Decision Support Tools within the 2003-2005 timeframe)

Concept validation

- Compared U.S. Eastern Triangle operations to European core airspace
- Established a validation data repository for the reuse of experimental data and results
- Developed a capability for the fast-time analysis of new concepts such as multi-sector planning and dynamic resectorization
- Developed detailed scenarios of operational changes in support of architecture and research requirements
- Conducted joint FAA/NASA/user concept validation activities, including human-in-the-loop simulations

Concept system design

- Analyzed core factors related to common trajectory
- Analyzed the effects of dynamic boundaries on operational and controller performance in preparation for the implementation of dynamic sectorization
- Analyzed en route sectorization strategies to support the mid-term design for the Eastern Triangle
- Assessed controller workload in various traffic situations for use in validating density concepts and alerts for Collaborative Decision-Making (CDM) and Traffic Flow Management (TFM) products
- Developed and analyzed the separation normalization concept referred to as "three miles everywhere"

R&D Partnerships: This work directly relates to the FAA/NASA Memorandum of Understanding on ATM research and development. Work under this program is coordinated through the joint Integrated Product Team Plan to ensure NASA's efforts both complement and are integrated into the NAS Operational Concept. As agreed to in the memorandum, NASA contributes regularly to the long-term development of ATM systems and to the validation of flightdeck concepts.

The concept development and concept validation effort described here is also coordinated with the European community via agreements with EUROCONTROL. This cooperation ensures that unique solutions and transitions are not developed in different quadrants of the globe, a situation which would impose an undue burden on all carriers and manufacturers participating in the global airspace system.

MAJOR ACTIVITIES AND ANTICIPATED FY 2004 ACCOMPLISHMENTS:

Operational concept development

- Expand the TFM concept through comparison of existing U.S. and European practices
- Expand the TFM en route evolution concept to incorporate Flight Data Management (FDM)
- Deliver a Concept of Use for Management by Trajectory

Concept validation

- Develop a modernization testbed
- Develop a model for the strategic controller and assess its role in a CDM separation environment
- Develop an information flow model to translate concepts into interface requirements

Concept system design

- Deliver an information model to translate concepts into NAS interface requirements
- Study the technical and human factor parameters underlying flight strip replacements

FY 2005 PROGRAM REQUEST:

The FY 2005 request continues to evolve the NAS operations concept. From its initial broad perspective and early validation emphasis the concept is transitioning toward specific development of the complex airspace and traffic flow scheduling and controlling structures the FAA needs to fulfill its increasingly vital mission.

As with other envisioned programs, the NAS Common Reference concept lacks detailed procedures and full statements of participant roles and responsibilities. Further demonstration and validation are required to show if this concept can support the integration of the entire NAS infrastructure with all airspace definitions within the proposed En Route Automation Modernization methodology.

Potentially valuable technologies still lack detailed proof of their concept. These programs include general Flight and Surveillance Data Processing initiatives and specific programs that will apply new common trajectory standards ("management by trajectory") to improve aviation efficiency and capacity.

Leveraging work is being performed by: (1) EUROCONTROL on the European Air Traffic Management System Concept and the associated ATM 2000+ strategy, and (2) FAA in support of the International Civil Aviation Organization Air Traffic Management Concept Panel.

KEY FY 2005 PRODUCTS AND MILESTONES:

Operational concept development

- Expand the high altitude concept through the analysis of cognitive and situational awareness issues, such as the development of point-to-point strategies that eliminate the need for latitude/longitude data from flight plans and verbal exchanges
- Conduct an analysis and develop the concept to support change in cross facility coordination (terminal and en route)
- Develop detailed Concepts of Operations for the interaction of service providers in en route and terminal airspace to support the validation of the FAA's Airspace Management Concept
- Develop a performance framework for concepts including Required ATM System Performance and Real-Time Streaming Protocol (RTSP)

Concept validation

- Populate the Validation Data Repository to capture all FAA activities and results associated with concept and concept-of-use validation. Establish metrics to allow comparability of results across program validation efforts in the U.S. and Europe.
- Validate the flight intent Concept of Use to ensure completeness and harmonization of the definition for integration into ground and airborne decision support systems in the US and Europe
- Provide a capability to model ATM influences (strategic simulator)

Concept system design

- Extend closed-loop system dynamic modeling of decisions and demand dynamics related to scheduling and management of aircraft in congested en route airspace
- Leverage human factors research work, and human factors and operational validations experimentation, to define the information type, update rate, and display requirements needed to support agreed-to operational improvements of the NAS Concept of Operations through 2010
- Provide capability to model ATM influences (strategic simulator)

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2003)	$14,160
FY 2004 Enacted	2,684
FY 2005 Request	3,000
Out-Year Planning Levels (FY 2006-2009)	12,000
Total	$31,844

Budget Authority ($000)	FY 2001 Enacted	FY 2002 Enacted	FY 2003 Enacted	FY 2004 Enacted	FY 2005 Request
Contracts:					
Operations Concept Validation	1,400	2,500	1,242	2,684	3,000
Personnel Costs	0	0	0	0	0
Other In-house Costs	0	0	0	0	0
Total	**1,400**	**2,500**	**1,242**	**2,684**	**3,000**

OMB Circular A-11, Conduct of Research and Development ($000)	FY 2001 Enacted	FY 2002 Enacted	FY 2003 Enacted	FY 2004 Enacted	FY 2005 Request
Basic	0	0	0	0	0
Applied	0	0	0	0	0
Development (includes prototypes)	1,400	2,500	1,242	2,684	3,000
Total	**1,400**	**2,500**	**1,242**	**2,684**	**3,000**

Operations Concept Validation Product and Activities	FY 2005 Request ($000)	Program Schedule					
		FY 2004	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009
Operations Concept Validation							
Operational Concept Development	**$500**						
Develop Detailed Concepts of Operations for Interaction of Service Providers in En Route and Terminal Airspace		◆	◇	◇	◇	◇	◇
Develop Detailed Concept of Ops for Evolution of TFM		◆	◇	◇	◇	◇	
Develop Performance Framework for RTSP		◆	◇	◇	◇	◇	
Develop En Route Evolution Concept Including Flight Data Management Across NAS		◆	◇	◇			
Develop Terminal Airspace Evolution Concept		◆	◇	◇	◇	◇	
Concept Validation	**$1,200**						
Establish the VDR to Capture Activities and Results Associated with Concept		◆	◇	◇			
Establish metrics to Allow Comparability of Results Across Program Validation Efforts in the U.S. and Europe		◆	◇	◇	◇	◇	◇
Conduct Validation of Information Management Concept		◆	◇	◇	◇	◇	◇
Concept System Design	**$600**						
Extend Closed-Loop System Dynamic Modeling of Decisions and Demand Dynamics Related to Scheduling and Management of AC in Congested En Route Airspace		◆	◇	◇	◇	◇	◇
Leverage Work in Human Factors Research and Operational Validation to Define Information Type, Update Rate, and Display Requirements to Support NAS Concept Through 2010		◆	◇	◇	◇	◇	◇
RTCA	**$400**						
Develop Aviation Community to MASPS, MOPS and Integrated Plans to Support Future Concepts and Modernization		◆	◇	◇	◇	◇	◇
Total Budget Authority	**$2,700**	**$2,500**	**$2,700**	**$5,000**	**$5,000**	**$6,200**	**$8,000**

◆ - Activities Accomplished ◇ - Activities Planned

NOTES: OUT YEAR NUMBERS ARE FOR PLANNING PURPOSES ONLY. ACTUAL FUNDING NEEDS WILL BE DETERMINED THROUGH THE ANNUAL BUDGET PROCESS.
IN THE FACILITIES AND EQUIPMENT APPROPRIATIONS, PERSONNEL AND OTHER COSTS ARE BUDGETED IN ACTIVITY 6, NOT THE PROGRAM BUDGET LINE ITEM.

SAFE FLIGHT 21 – OHIO RIVER VALLEY

GOALS:

Intended Outcomes: Intended Outcomes: The Ohio River Valley portion of the Safe Flight 21 Program is an initial step in implementing important aviation capabilities. The project is also initiating other pockets of service implementation in response to customer requirement for technology evaluation in the lower 48 states. This project combines the efforts of government and industry to demonstrate the potential of new air traffic procedures to increase NAS capacity and efficiency. It concentrates on validating advanced communications, navigation, and surveillance capabilities in a challenging operational environment. Project focus:

- Addresses pilot and controller human factors issues
- Develops and assesses new operational procedures and associated training
- Streamlines certification processes and procedures
- Develops a cost-effective avionics and NAS infrastructure
- Defines a realistic NAS transition path supported by the user community

The Safe Flight 21 activities contribute to following goals and objectives:

- FAA Strategic Goal – Increased Safety

  Objective 1, Reduce the commercial airline fatal accident rate

  Objective 2, Reduce the number of fatal accidents in general aviation

  Objective 3, Reduce accidents in Alaska

  Objective 4, Reduce the risk of runway incursions

- FAA Strategic Goal – Increased Capacity

  Objective 1, Increase airport capacity to provide a system that meets projected demand

Agency Outputs: Safe Flight 21 – Ohio River Valley is essential to risk mitigation related to the process of bringing emerging technologies into the NAS. The program addresses the risks and challenges of fielding advanced communications, navigation, and surveillance systems, such as Automatic Dependent Surveillance – Broadcast (ADS-B), Controlled Flight Into Terrain (CFIT) avoidance, Flight Information Services – Broadcast (FIS-B), and the Traffic Information Service – Broadcast (TIS-B).

These objectives will be achieved through:

- Implementing the ADS-B link decision [i.e., 1090 MHz and Universal Access Transceiver (UAT)]
- Conducting operational tests of the nine operational enhancements identified by RTCA:
  - FIS-B for Special Use Airspace status, weather, wind-shear, Notices To Airmen, and Pilot Reports
  - Cost-effective CFIT avoidance through graphical position display
  - Improved Terminal operations in low-visibility conditions
  - Enhanced see-and-avoid
  - Enhanced en route air-to-air operations
  - Improved Surface surveillance and navigation for pilots
  - Enhanced airport Surface surveillance for controllers
  - ADS-B surveillance in non-radar airspace
  - ADS-B-based separation standards

Customer/Stakeholder Involvement: The Safe Flight 21 Program resulted from inputs that the FAA Administrator requested from the RTCA Select Committee on Free Flight Implementation and is strongly endorsed by the RTCA

Free Flight Steering Committee. The Safe Flight 21 Steering Committee (with representatives from the RTCA Select Committee, the FAA, the Aircraft Owners and Pilots Association, the Airline Pilots Association, the Air Traffic Control Association, the Cargo Airline Association, the MITRE Corporation, and U.S. airlines) coordinates between stakeholders and the Safe Flight 21 program.

Accomplishments:

- Published the operational evaluation (OpEval) final report from the first operational evaluation OpEval in Wilmington, Ohio, conducted in FY 1999
- Established or modified operational concepts and procedures required to support the Safe Flight 21 – Ohio River Valley applications evaluated in OpEval-2, including:
  - Approach spacing
  - Departure spacing
  - Runway and final approach occupancy awareness
  - Airport Surface situational awareness
- Acquired and installed a "single stack" Common ARTS automation system and displays, at the Louisville Terminal Radar (TRACON) facility, for evaluation by air traffic controllers in their work with for airborne ADS-B applications
- Coordinated avionics requirements with manufacturers and awarded four contracts to develop prototype avionics systems
- Installed a multilateration/ADS-B Surface surveillance system at Memphis in preparation for an FY 2001 OpEval focused on Surface management
- Hosted Air Traffic Modernization Day at Memphis in the third quarter of FY 2001 focused on Surface safety applications and system integration of the multilateration system
- Updated nine ADS-B Operational Safety Assessments, one each for the nine operational enhancements being evaluated in the context of Safe Flight 21 – Ohio River Valley ADS-B applications
- Installed a multilateration system at the Louisville test bed
- Conducted:
  - OpEval-2 at Louisville, in the first quarter of FY 2001, to demonstrate applications and gather data on approach spacing, departure spacing, runway and final approach occupancy awareness, and airport Surface situational awareness
  - Detailed OpEval-2 data analysis, and published the final report
  - Comparative Safety Assessment (CSA) of a future NAS with and without the use of ADS-B
  - CSA of Airborne Conflict Management (ACM) criteria
  - Preliminary Hazard Assessment (PHA) of ADS-B technology in accordance with NAS Modernization System Safety Program Plan requirements
- Completed:
  - ADS-B technical work assessment as input to an ADS-B link decision
  - Preliminary analysis, begun in FY 2000, for NAS-wide implementation of ADS-B
- Developed and received approval for:
  - Concepts of operation for Terminal and Surface applications
  - Call sign procedure and phraseology for testing in FY 2003
- Continued:
  - Developing procedures affecting air traffic in the Terminal environment
  - Developing requirements and specifications for TIS-B and FIS-B

– Responding to customer requirements to achieve early ADS-B benefits

R&D Partnerships: The Safe Flight 21 – Ohio River Valley program is based on the principle that government and industry will share in the development and implementation of new communications, navigation, and surveillance technologies as the nation moves toward full commitment to free flight.

The FAA, State governments and the aviation industry will share in the funding of Safe Flight 21 program avionics and ground systems, and together the partners will build upon ongoing initiatives that include:

- Identifying and resolving ADS-B technology issues
- Developing ADS-B operational concepts
- Focusing data collection activities during OpEvals and test events to answer as many operational and avionics certification issues as practical
- Focusing on cockpit human factors issues
- Exploring the use of TIS-B and FIS-B data link messages to receive traffic, weather, and other information in the cockpit
- Developing, in conjunction with industry partners, an integrated cockpit display of terrain, traffic, and weather information
- Ensuring that organizations representing controllers and commercial and general aviation pilots are included in Safe Flight 21 program planning and in the evaluation of operational enhancements

MAJOR ACTIVITIES AND ANTICIPATED FY 2004 ACCOMPLISHMENTS:

In FY 2004, the FAA anticipates accomplishing the following activities in support of Safe Flight 21:

- Continue air traffic procedure development for Terminal environment with ATM-lab evaluations
- Develop TIS-B and FIS-B requirements and specifications; plan testing in the small airport test bed at Prescott, AZ
- Execute ADS-B installation agreements with the State of North Carolina, University Research Lab in Maryland and Embry Riddle Aeronautical University (ERAU) Arizona and Florida
- Develop Small Airport Architecture in support of Safe Flight 21 General Aviation requirements and applications
- Continue airport surface moving map prototype database development and maintenance and update procedure development
- Conduct data collection activities and metrics development using the call sign procedure at the Louisville test bed
- Continue evaluating SF-21 applications, including avionics and vehicle tracking, at the Louisville and Memphis test beds

FY 2005 PROGRAM REQUEST:

For FY 2005, the SF-21 program will continue to evaluate nine high-priority communication /navigation/surveillance (CNS) operational enhancements using global positioning system (GPS)-based automatic dependent surveillance broadcast technology (ADS-B) and other information services. The nine operational enhancements are:

1) Weather and Other Information in the Cockpit
2) Improvement of Controlled Flight into Terrain (CFIT) Avoidance
3) Improved Terminal Operations in Low Visibility Conditions
4) Enhanced See and Avoid
5) Enhanced En Route Air to Air Operations
6) Improved Surface Operations

7) Airport Surface Display for the Controller
8) ADS-B for Surveillance in non-radar airspace
9) ADS-B separation standards establishment

In FY 2005, the $32,100,000 requested will continue the automation systems integration and installation and modification of ground infrastructure in the Ohio River Valley, along the east coast of the U.S. and Prescott, AZ. The West Coast is being planned for the next pocket of implementation but other areas will be considered based on user demand. Continue the assessment of SF 21 applications associated with ADS-B and broadcast service technology, allow for continuation and expansion of the broadcast services infrastructure and procedures, continuation of operational concepts evaluation efforts, operational demonstrations and simulations. The SF-21 program will also focus on surface and terminal activities that directly relate to runway safety and the Operational Evolution Plan. The SF-21 program will be migrating service capabilities such as "radar like services" to the lower 48 states to take advantage of efforts being undertaken in Alaska to improve safety in non-radar areas.

KEY FY 2005 PRODUCTS AND MILESTONES:

Key FY 2005 products and milestones involve activities related to the limited implementation of ADS-B applications that prove beneficial in meeting the intended outcomes of increasing the safety and capacity of the NAS.

Avionics and ground systems

- Coordinate within FAA to integrate ADS-B into the ARTS and STARS baselines
- Continue testing and demonstrating prototype avionics with airport surface moving maps, and with TIS-B and FIS-B products
- ADS-B Joint Resources Council 2A deployment decision

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2003)	$70,179
FY 2004 Enacted	6,859
FY 2005 Request	6,004
Out-Year Planning Levels (FY 2006-2009)	11,400
Total	$94,442

Budget Authority ($000)	FY 2001 Enacted	FY 2002 Enacted	FY 2003 Enacted	FY 2004 Enacted	FY 2005 Request
Contracts:					
Safe Flight 21 - Ohio Valley	22,700	14,000	18,479	6,859	6,004
Personnel Costs	0	0	0	0	0
Other In-house Costs	0	0	0	0	0
Total	**22,700**	**14,000**	**18,479**	**6,859**	**6,004**

OMB Circular A-11, Conduct of Research and Development ($000)	FY 2001 Enacted	FY 2002 Enacted	FY 2003 Enacted	FY 2004 Enacted	FY 2005 Request
Basic	0	0	0	0	0
Applied	0	0	0	0	0
Development (includes prototypes)	22,700	14,400	18,479	6,859	6,004
Total	**22,700**	**14,400**	**18,479**	**6,859**	**6,004**

Safe Flight 21 – Ohio River Valley Product and Activities	FY 2005 Request ($000)	Program Schedule					
		FY 2004	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009
Safe Flight 21 – Ohio River Valley							
Optional Enhancements	**$32,100**						
Provide Weather and Other Information in the Cockpit		◆	◇	◇	◇		
Improve Controlled Flight into Terrain (CFIT) Avoidance		◆	◇	◇	◇		
Improve Terminal Operations in Low Visibility Conditions		◆	◇	◇	◇		
Enhance See and Avoid		◆	◇	◇	◇		
Enhance En Route Air to Air Operations		◆	◇	◇	◇		
Improve Surface Operations		◆	◇	◇	◇		
Provide Airport Surface Display for the Controller		◆	◇	◇	◇		
Perform Surveillance with ADS-B in Non-Radar Airspace		◆	◇	◇	◇		
Establish ADS-B Separation Standards		◆	◇	◇	◇		
Continue Air Traffic Procedure Development for Terminal Environment with ATM-Lab Evaluations		◆					
Develop TIS-B and FIS-B Requirements and Specifications; Plan Testing in the Small Airport Test Bed at Prescott, AZ		◆					
Execute ADS-B Installation Agreements with the State of North Carolina, University Research Lab in Maryland and Embry Riddle Aeronautical University (ERAU) Arizona and Florida		◆					
Develop Small Airport Architecture in Support of Safe Flight 21 General Aviation Requirements and Applications		◆					
Continue Airport Surface Moving Map Prototype Database Development and Maintenance and Update Procedure Development		◆	◇	◇	◇		
Conduct Data Collection Activities and Metrics Development Using Call Sign Procedure at Louisville Test Bed		◆					
Continue Evaluating SF-21 Applications, Including Avionics and Vehicle Tracking, at the Louisville and Memphis Test Beds		◆					
Total Budget Authority	**$32,100**	**$6,900**	**$32,100**	**$6,000**	**$5,400**	**$0**	**$0**

◆ - Activities Accomplished ◇ - Activities Planned

NOTE: OUT YEAR NUMBERS ARE FOR PLANNING PURPOSES ONLY. ACTUAL FUNDING NEEDS WILL BE DETERMINED THROUGH THE ANNUAL BUDGET PROCESS.LINE ITEM.

SEPARATION STANDARDS

GOALS:

Intended Outcomes: The Separation Standards Program supports meeting the "Greater Capacity" goal of the FAA Flight Plan 2004-2008, Objective 2, "Improve efficient air traffic flow over land and sea." The Program also supports meeting the "International Leadership" goal of the Flight Plan, specifically Objective 2, "Promote global seamless operations in cooperation with bilateral, regional and multilateral aviation partners." The Separation Standards Program reduces separation standard values within international airspace to increase the following benefits to providers and users of oceanic air traffic control systems:

- System efficiency – measured by reduced aircraft fuel-burn and transit times
- Theoretical system capacity – measured by numbers of routes and flight levels controllers can safely support within the same volume of airspace
- International standardization of separation criteria and resultant enhanced system safety

Agency Outputs: The FAA's "Strategic Plan for Oceanic Enhancements and Separation Reductions" describes a prioritized, systematic process for revising international separation values. To document and evaluate each separation change, the FAA produces a series of supporting products:

- Operational assessment of the value that the change brings to Air Traffic Control (ATC) system providers and users
- Benefit-cost analysis
- Safety assessment of the system before and after application of the change
- Publication of FAA regulatory material
- Completion of required new rulemaking
- Development of ATC-required procedures
- Development of new or changed International Civil Aviation Organization (ICAO) guidance material, annexes, or regional supplementary procedures required to standardize and make the reduced separation value safe for international operations
- Establishment and maintenance of long-term safety oversight functions required for the implementation and continued safe use of the reduced separation value

Customer/Stakeholder Involvement: The Separation Standards Program establishes ICAO-government-industry forums to draw all parties concerned with changing separation standards into a common process. State Civil Aviation Authorities, ICAO Regional and Headquarters elements, ATS providers, ATC system users, industry trade organizations, aircraft and avionics manufacturers, and unions representing controllers and pilots often attend these meetings.

Participants in the various change processes include:

- Asia Pacific separation standards — changes occur with the coordination and endorsement of the (North Pacific) Oceanic Work Group, Informal (North) Pacific ATC Coordinating Group, and Informal South Pacific ATS Coordinating Group, as well as the ICAO Pacific Reduced Vertical Separation Minimum Task Force established by the ICAO regional planning group, the Asia Pacific Air Navigation Planning and Implementation Regional Group
- North Atlantic separation standards — changes are carried out through the ICAO Regional Planning Group, the North Atlantic Systems Planning Group
- West Atlantic Route System Separation Standards — changes involve participation of the New York Oceanic Capacity Enhancement Task Force

- Gulf of Mexico and Caribbean Separation Standards — changes involve participation of the Gulf of Mexico Work Group and the ICAO CAR/SAM Regional Planning and Implementation Group

The program also provides FAA representation on ICAO's Separation and Airspace Safety Panel (SASP) — the focal point for development of the technical justification for new separation minima as well as the global and regional forum for assessing application of recommended ICAO separation practices.

Accomplishments: Through the Separation Standards Program, the FAA has made major reductions in the separation standards affecting international airspace. These include:

- Introduced Northern Pacific 50-nm lateral separation standard based on operator compliance with Required Navigation Performance (RNP)-10 requirements (April 1998; December 1998; and February 2000)
- Introduced North Atlantic Implementation Management Group Cost Effectiveness (NICE) Program (October 1999)
- Introduced Pacific RVSM (February 2000)
- Expanded Pacific RVSM from Flight Level (FL) 390 to FL 410 throughout the Pacific (October 2000)
- Introduced RVSM into West Atlantic Route System portion of international airspace over North Atlantic (November 2001)
- Developed requirements for 30-nm lateral separation standard based on automatic dependent surveillance in oceanic and remote airspace (May 2001)
- Introduced RVSM into most of Western Pacific/ South China Sea portion of Asia Pacific Region (February 2002)
- Prepared to introduce NICE simulation methodology into northern Pacific air traffic system planning and analysis (April 2002)
- Prepared draft ICAO manual to introduce global standardization of RVSM regional monitoring agency practices, procedures and data sharing (August 2003)
- Prepared to introduce RVSM into ICAO Caribbean and South American (CAR/SAM) Regions in January 2005 through exertion of leadership in ICAO CAR/SAM RVSM Task Force (September 2003)
- Completed first phase of final recommendations for introduction of a comprehensive airspace safety monitoring oversight function in the Asia Pacific Region through Asia Pacific Airspace Safety Monitoring Task Force (May 2003)

R&D Partnerships: The Separation Standards Program provides FAA representation to ICAO's SASP, the principal global forum for moving ahead with the development of new separation minima. The FAA and other state-based Civil Aviation Authorities (CAA) typically cooperate in such work, and all participants share research results. The program maintains close research ties with academia through a contractual relationship with Rutgers University in the development of large fast-time simulation models of oceanic airspace. It also has a direct link with international separation research activities in which the FAA's GPS Monitoring System supports EUROCONTROL's RVSM safety oversight activities. EUROCONTROL, in turn, provides access to the products of its RVSM research.

MAJOR ACTIVITIES AND ANTICIPATED FY 2004 ACCOMPLISHMENTS:

- Finalize long-term RVSM monitoring requirements, and standardizing procedures and data treatment by RVSM regional monitoring agencies
- Develop detailed plans to apply 30-nm lateral and longitudinal separation standards in FAA-administered oceanic airspace of the South Pacific through application of specified technologies
- Initiate development of safety oversight function through Asia Pacific Airspace Safety Monitoring Advisory Group

- Finalize training of and guidance to CAR/SAM regional monitoring agency and RVSM Task Force in connection with planned January 2005 RVSM implementation in CAR/SAM Regions
- Complete participation in CAR/SAM RVSM Task Force

FY 2005 PROGRAM REQUEST:

The requested funding will allow the Separation Standards Program to:

- Reduce horizontal-plane separation minima to 30-nm – based on technologies called for in the FAA Operational Evolution Plan En Route Project 6
- Complete safety assessments and other support for implementation of the RVSM in the ICAO Caribbean and South American Regions
- Complete recommendations for northern Pacific airspace improvement options
- Continue RVSM safety oversight in portions of ICAO Asia Pacific and North Atlantic and Pacific regions
- Continue supporting the Domestic RVSM implementation called for in FAA Operational Evolution Plan En Route Project 4

KEY FY 2005 PRODUCTS AND MILESTONES:

- Initiate the one-year pre-implementation safety assessment associated with planned March Fourth Quarter calendar year 2005 introduction of 30-nm lateral and 30-nm longitudinal separation standards in South Pacific airspace administered by FAA
- Publish ATC procedures and operator approval criteria to support application of 30-nm lateral/30-nm longitudinal separation standards in the South Pacific
- Participate in preliminary and final safety assessments for planned December 2004January 2005 introduction of RVSM in CAR/SAM Regions
- Continue providing RVSM safety oversight in portions of ICAO Asia Pacific and North Atlantic Regions
- Publish final results of the cost-effectiveness study of cost-effectiveness of candidate improvement options for northern Pacific airspace

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2003)	$9,131
FY 2004 Enacted	2,485
FY 2005 Request	2,500
Out-Year Planning Levels (FY 2006-2009)	10,000
Total	$24,116

Budget Authority ($000)	FY 2001 Enacted	FY 2002 Enacted	FY 2003 Enacted	FY 2004 Enacted	FY 2005 Request
Contracts:					
Separation Standards	2,200	2,200	2,186	2,485	2,500
Personnel Costs	0	0	0	0	0
Other In-house Costs	0	0	0	0	0
Total	**2,200**	**2,200**	**2,186**	**2,485**	**2,500**

OMB Circular A-11, Conduct of Research and Development ($000)	FY 2001 Enacted	FY 2002 Enacted	FY 2003 Enacted	FY 2004 Enacted	FY 2005 Request
Basic	0	0	0	0	0
Applied	0	0	0	0	0
Development (includes prototypes)	2,200	2,200	2,186	2,485	2,500
Total	**2,200**	**2,200**	**2,186**	**2,485**	**2,500**

Separation Standards Product and Activities	FY 2005 Request ($000)	Program Schedule					
		FY 2004	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009
Separation Standards							
30-nm Lateral/30-nm Longitudinal Separation Standard in FAA-Administered Oceanic Airspace	**$700**						
Develop ICAO Documentation and Specifications		◆					
Develop Implementation Requirements, Operational Concept, and Procedures		◆	◇				
Conduct Trials		◆	◇	◇			
Implement			◇				
Conduct Safety Oversight			◇	◇	◇	◇	◇
Asia Pacific and North Atlantic RVSM	**$200**						
Conduct Readiness and Safety Assessments		◆					
Implement		◆					
Conduct Safety Oversight - Pacific		◆	◇	◇	◇	◇	◇
Asia Pacific and Global Standardization of RVSM and Other Airspace Safety Functions	**$700**						
Develop Common Principles and Practices		◆					
Develop Long-Term Monitoring Requirements		◆	◇				
Reduced Vertical Separation Minimum in ICAO Caribbean and South America	**$700**						
Develop Planning Through Task Force		◆	◇				
Conduct Data Collection and Analysis		◆	◇	◇	◇		
Implement		◆	◇				
Assist in Safety Oversight			◇	◇			
Investigation of Northern Pacific Airspace Improvement Options Using North Atlantic Cost Effectiveness Methodology	**$200**						
Provided Initial Report		◆					
Identify Promising Options; Conduct Simulation and Analysis; Identify Best Options; Make Final Reports		◆	◇				
Total Budget Authority	**$2,500**	**$2,200**	**$2,500**	**$2,500**	**$3,100**	**$3,700**	**$5,000**

◆ - Activities Accomplished ◇ - Activities Planned

NOTES: OUT YEAR NUMBERS ARE FOR PLANNING PURPOSES ONLY. ACTUAL FUNDING NEEDS WILL BE DETERMINED THROUGH THE ANNUAL BUDGET PROCESS. IN THE FACILITIES AND EQUIPMENT APPROPRIATIONS, PERSONNEL AND OTHER COSTS ARE BUDGETED IN ACTIVITY 6, NOT THE PROGRAM BUDGET LINE ITEM.

WAKE TURBULENCE

GOALS:

Intended Outcomes: The Wake Turbulence Program addresses the FAA Flight Plan 2004 - 2008 goal for Capacity as well as the DOT Mobility Strategic Objective: "Advance accessible, efficient, intermodal transportation for the movement of people and goods." The Wake Turbulence Program seeks to increase trip time reliability by adding aviation system capacity at a rate that matches demand, so that on-time arrival performance improves by one percentage point per year.

Program outcomes intended to facilitate achievement of this performance goal include:

- Implementation of new wake turbulence standards and procedures that will improve flight efficiency, flight planning, and airport planning, and thus will increase system productivity and capacity, and
- Reduction in delays during less than VFR conditions.

Agency Outputs: The Wake Turbulence Program focuses on conducting applied research to solve operational problems through the development of improved wake avoidance procedures and weather dependent solutions for closely spaced parallel runways. During periods of less than ideal weather and visibility conditions that presently constrain the use of an airport's closely spaced parallel runways, implementation of these procedures and solutions will allow increased utilization of the parallel runways. These procedures and solutions will permit air traffic control to operate the airports closer to their design capacity during less than ideal weather and visibility conditions.

Customer/Stakeholder Involvement: The wake research priorities and plans are consistent with user needs. The program addresses the stated needs of Air Traffic Procedures (ATP) and works in concert with ATP, Flight Standards (AFS) and the Terminal Business Unit (ATB) to ensure the procedures and solutions are safe and target airports that are critical to reducing air traffic delays. The program works with controllers, airlines, and pilots to ensure that user recommendations are included and that training and implementation issues are addressed from the start. The program also works with NASA to support their long-term research activities in wake turbulence and to ensure that their solutions will focus on remaining wake constraints and more effectively integrate into the NAS.

Accomplishments: The following represent major accomplishments of the wake turbulence program:

- Installed and validated the Airspace Simulation and Analysis for TERPS (Vertical Flight Terminal Instrument Procedures) wake turbulence safety assessment capability operated by Flight Standards Services
- Completed Simultaneous Offset instrument Approach/Precision Runway Monitor safety assessment of wake at the San Francisco International Airport
- Completed the joint FAA/NASA Research Management Plan (RMP), defining near-term procedural solutions, mid-term weather and procedural solutions, and long-term automation solutions
- Began collecting data for modifying the 2500 ft rule, the first effort defined in the RMP
- Began implementing a wake turbulence procedural solution at one of the top-35-delayed airports
- Began researching wind stability for mid-term application

R&D Partnerships: In addition to its partnership with the FAA's Terminal Business Unit, Air Traffic Procedures, Flight Standards, Airlines, Controller and Pilots, the wake turbulence research activities are closely coordinated and leveraged with industry, academia, and other government agencies. This coordination is done directly through interagency agreements, university grants and Memorandums of Agreement. Principal partners include the Volpe National Transportation Center, Mitre/CAASD, Massachusetts Institute of Technology's Lincoln Laboratory; and NASA's Ames and Langley research centers. The wake turbulence program also partners with EUROCONTROL and the European Wakenet community to share results of the international wake research activities.

MAJOR ACTIVITIES AND ANTICIPATED FY 2004 ACCOMPLISHMENTS: *

- Implement a procedural solution to enhance capacity during reduced visibility conditions at one of the top ten airports with closely spaced parallel runways
- Collect and analyze wake data at the initial airport selected to support changes to the 2500 ft. rule
- Enhance pulsed Lidar's ability to detect and track aircraft wakes

* Supported by FY 2004 Enacted F&E Appropriation for Aviation Weather Services Improvement

FY 2005 PROGRAM REQUEST:

Ongoing Activities

- Initiate wake data collection and analysis at three additional airports to support changes to 2500 ft rule
- Complete analysis and formal changes to Air Traffic Control Order 7110.65 regarding the 2500 ft rule at the initial selected airport

New Initiatives

No new initiatives are planned in FY 2005.

KEY FY 2005 PRODUCTS AND MILESTONES:

- Complete wake turbulence data analysis required for changing wake turbulence mitigation procedures for closely spaced parallel runways at the initially selected airport
- Modify Air Traffic Control Order 7110.65 as it affects closely spaced parallel runways (2500 ft rule) at the initially selected airport
- Complete plan for developing and validating modifications to wake avoidance procedures for closely spaced parallel runways during less than ideal conditions at six of the top-35-delayed airports
- Continue developing and validating concepts for weather-dependent wake avoidance solutions to address capacity constraints at the top-35-delayed airports

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2003)	$11,923
FY 2004 Enacted	274
FY 2005 Request	2,296
Out-Year Planning Levels (FY 2006-2009)	9,476
Total	$23,969

Budget Authority ($000)	**FY 2001 Enacted**	**FY 2002 Enacted**	**FY 2003 Enacted**	**FY 2004 Enacted**	**FY 2005 Request**
Contracts:					
Wake Turbulence	0	3,577	7,580	0	2,000
Personnel Costs	0	352	315	259	163
Other In-house Costs	0	71	28	15	133
Total	**0**	**4,000**	**7,923**	**274**	**2,296**

OMB Circular A-11, Conduct of Research and Development ($000)	**FY 2001 Enacted**	**FY 2002 Enacted**	**FY 2003 Enacted**	**FY 2004 Enacted**	**FY 2005 Request**
Basic	0	0	0	0	0
Applied	0	4,000	7,923	274	2,296
Development (includes prototypes)	0	0	0	0	0
Total	**0**	**4,000**	**7,923**	**274**	**2,296**

Wake Turbulence Product and Activities	FY 2005 Request ($000)	Program Schedule					
		FY 2004	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009
041-150 - Wake Turbulence	**$2,000**						
Adapt, Certify and Implement Wake Avoidance Procedures for Closely Spaced Parallel Runways at 1 Additional Top-35-Delayed Airports			◆	◇			
Develop and Validate Weather Dependent Wake Avoidance Concepts for Less Than VfFRConditions			◆	◇			
Develop, Certify and Implement Weather Dependent Wake Avoidance Solutions at 3 Additional Top 35 Delayed Airports					◇	◇	◇
Personnel and Other In-House Costs	**$296**						
Total Budget Authority	**$2,296**	**$274**	**$2,296**	**$2,323**	**$2,350**	**$2,376**	**$2,427**

◆ - Activities Accomplished ◇ - Activities Planned

NOTES: OUT YEAR NUMBERS ARE FOR PLANNING PURPOSES ONLY. ACTUAL FUNDING NEEDS WILL BE DETERMINED THROUGH THE ANNUAL BUDGET PROCESS.
IN THE FACILITIES AND EQUIPMENT APPROPRIATIONS, PERSONNEL AND OTHER COSTS ARE BUDGETED IN ACTIVITY 6, NOT THE PROGRAM BUDGET LINE ITEM.

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2.3 Operational Excellence in Aviation Research and Development Goal Area Description

Mission

The unifying mission of activities in the Operational Excellence in Aviation Research Program Area, also known as the Mission Support area, is to provide leadership and services to support FAA strategic goals and objectives affecting industry vitality, global leadership, business practices, and communications. While this program area does not itself produce research, it guides and facilitates the research efforts of others.

Figure 2.3-1 indicates the percentage of the total requested FY 2004 R&D funding that will be devoted to activities intended to promote organizational excellence.

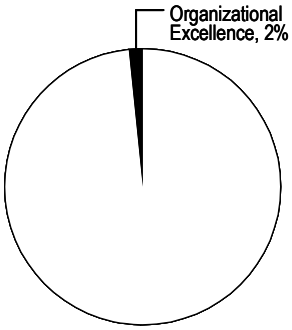

Figure 2.3-1: Percentage of Requested FY 05 R&D Funding Supporting the FAA Goal for Organizational Excellence

Effective Mission Support management helps to ensure that:

- FAA R&D programs are conducted safely, efficiently, and in the fullest possible collaboration with internal and external customers.
- Sponsoring and performing organizations interface efficiently and responsibly with required authorities in the planning and execution of FAA R&D annual budget cycles.
- Vital ongoing activities of permanent research performed at the Air Traffic Management Laboratory at the William J. Hughes Technical Center (WJHTC)
- FAA R&D Strategic Partnerships with government and private research institutions, universities, and industry continue and improve in effectiveness.

Program Area Structure

The Operational Excellence in Aviation Research activities are reported annually in the *National Aviation Research Plan* (*NARP*) in the following areas:

- R &D Portfolio Strategic Management
- R,E&D Financial Management
- R,E&D Advisory Committee
- International cooperative research and development programs
- Collaboration with NASA on aviation research and development
- R,E&D Partnerships
- Center for Advanced Aviation System Development (CAASD)
- William J. Hughes Technical Center (WJHTC) Laboratories

With the exception of the F&E activities performed at CAASD, all FAA R&D Mission Support is funded through the R,E&D Budget Request.

Effective stewardship of the FAA R,E&D program requires that all NAS users receive the best systems and services achievable for their investment. In the first three elements just listed, the FAA strives to ensure that its R&D program

portfolio effectively targets the needs of those who rely on the NAS, that the Agency provides for R&D in its budget, and that it properly accounts for R,E&D financial resources.

The next three elements help to ensure that the Agency's research and development program is coordinated with other aviation research programs and that others conducting research and development are cognizant of FAA needs and direction. With limited resources available, virtually all entities conducting aviation-related R&D must collaborate to conduct their programs effectively and share in the results.

The final elements provide the in-house component of our air traffic management research program. CAASD, the FAA's Federally Funded Research and Development Center, conducts fundamental, cutting-edge research and development of future ATM systems and procedures. A report of these activities is found in 2.2, the Capacity section of this document. The WJHTC laboratories provide the test beds for proposals for new systems, processes, or procedures.

Program Area Outputs

Detailed outputs of FAA Aviation Research Mission Support activities can be found in the individual program descriptions that follow this program area description. Among the most important general outputs of Operational Excellence/Mission Support are:

- The annual National Aviation Research Plan (NARP)
- Periodic and special R,E&D Advisory Committee reports and recommendations
- The annual proposed FAA R,E&D Budget
- International planning and implementation documents providing for world-wide aviation research harmonization and interoperability
- Agreements with other international civil aviation authorities for the cooperative development of aviation systems research programs
- Cooperative research agreements with academia, other government agencies, and industry
- Modern Air Traffic Management (ATM) laboratories available to meet the needs of the individual ATM research programs

R&D Partnerships

Details of partnering between the FAA and other research entities can be found in the individual program descriptions that follow this program area description. Significant partnerships reflecting the work of this program area include:

- Received and incorporated periodic R,E&D Program guidance from the R,E&D Advisory Committee
- Established 125 research and development agreements with 19 countries and with a single air traffic organization representing 17 member states
- Established an agreement with EUROCONTROL to do cooperative research and development in air traffic management programs

Intended Outcomes

Detailed anticipated benefits and recent accomplishments of components of FAA Aviation Research Mission Support can be found in the individual program descriptions that follow this program area description.

All work in this program area serves the interests of the nation and flying public through some combination of the following:

- Increasing knowledge of the R,E&D program among the Agency’s customers and stakeholders
- Increasing the participation of R,E&D customers and stakeholders in the program’s formulation
- Better managing limited R&D resources through more efficient and effective processes for the development and management of the FAA R,E&D investment portfolio

- Fostering U.S. aviation industry leadership through international cooperation and harmonization in developing and implementing technologies that improve air traffic safety and efficiency
- Achieving higher quality research and greater value though increased collaboration (partnerships) with the best academic and industrial R&D talent, both within the United States and internationally
- Vitalizing the U.S. aviation industry by supporting R&D efforts toward the future technological and operational needs of NAS users

Long-Range View

Activities to foster Operational Excellence will continue as long as the FAA performs research and development. Expected resource requirements in the "out-years" will remain at under three percent of the total R,E&D budget.

SYSTEMS PLANNING AND RESOURCE MANAGEMENT

Goal:

Intended Outcomes: The FAA intends that its R,E&D programs more effectively meet customer needs, increase program efficiency, and reduce management and operating costs. The FAA further intends to increase customer and stakeholder involvement in its programs and foster greater proliferation of U.S. standards and technology to meet global aviation needs. Since these activities, while essential to the effective management of the FAA R&D program, do not in general develop new research products, we intend to carefully manage these efforts to ensure that costs are contained to reasonable levels.

For FY2005 through FY 2009 maintain operating costs as 2% of overall budget.

For the period FY 2005-2009, increase the efficiency and effectiveness of FAA/NASA collaboration with a 35% increase in Memoranda of Agreement or Understanding, including joint R&D Implementation Plans and other specific collaborative arrangements, through which resources can be shared and common program goals established.

Agency Outputs: In support of the above outcomes, in FY 2005 the FAA will:

- Host two Research, Engineering and Development Advisory Committee meetings and, at least, 12 subcommittee meetings. The Committee produces periodic and special reports providing advice and recommendations to the FAA on its R,E&D program.
- Support the Research, Engineering and Development Advisory Committee Executive Council in its support of the Joint Planning and Development Office and the national initiative to transform the U.S. air traffic control system for 2025.
- Co-host, with EUROCONTROL, 4 quarterly FAA/EUROCONTROL R&D Committee meetings.
- Host the 6th USA-Europe Air Traffic Management Seminar, which is the only such symposium held specifically to discuss air traffic management research worldwide.
- Update and publish, on the Internet, the FAA Research and Development Strategy.
- Submit the annual R,E&D budget submission to Congress.
- Publish the annual National Aviation Research Plan (NARP).
- Produce coordinated research plans with NASA supporting both the efficiency and safety strategic goals of the FAA.

Customer/Stakeholder Involvement:

The REDAC reviews FAA research commitments annually and provides guidance for future R,E&D investments. The members of this committee and its associated subcommittees are subject matter experts drawn from various associations, user groups, corporations, government agencies, as well as universities and research centers. Their combined presence in the REDAC fulfills a congressional requirement for FAA R&D to be mindful of aviation community and stakeholder input.

Accomplishments: Each year, the Agency provides R,E&D program status information through the *NARP* and submits the R,E&D budget requests to the Office of Management and Budget (OMB) and Congress. REDAC has provided the FAA with an independent strategic view on the Agency's research commitments. The committee reviewed and offered recommendations on the FAA's planned FY 2005 R,E&D Investments (April 2003). The Committee has also participated in a joint meeting with Aerospace Technology Advisory Committee (October 2002).

The *National Aviation Research Plan*, which is submitted to the Congress concurrent with the President's Budget submission, is available to the public on the FAA's web site. The FAA R&D Strategy, published in September 2002 is also available on the FAA web site.

The scope of research activities and the results of the research produced by the FAA and NASA's Joint University Program (JUP) are available on web sites maintained by Princeton University, one of the participants in the JUP, and the FAA's William J. Hughes Technical Center.

R&D Partnerships: The FAA's R&D partnerships are described in each budget line item.

MAJOR ACTIVITIES AND ANTICIPATED FY 2004 ACCOMPLISHMENTS:

R,E&D plans and programs

- Publish the National Aviation Research Plan (February 2004)
- Publish the FAA Research and Development Strategy Performance Goals and Measures Addendum (September 2004)

R,E&D advisory committee

- Submit Committee review of and recommendations for FY 2006 R,E&D Program (April 2004)
- Submit Committee guidance for FY 2006 R,E&D Program (October 2003)
- Participate in joint meetings with NASA's Aero-Space Technology Advisory Committee (October 2003)

FY 2005 PROGRAM REQUEST:

This request will be used to further FAA's R,E&D program strategic management of its R&D activities.

Specifically, the Agency will evaluate the Research and Development Strategy against the Agency's R&D Program and Agency goals. This will be done to ensure that the strategy remains viable in a changing world and that the program itself continues to support the most pressing needs of the Agency. Results of this evaluation will be used in the update of the strategy planned and the program.

The Agency will continue to support the work of the REDAC in its task to advise the Administrator about the FAA R&D Program. In particular, the Agency will seek the counsel and guidance of the committee for the FY 2006 program, review the proposed FY 2006 program prior to submission of the budget requirements to the Department of Transportation, and seek the committee's guidance during the execution of our R&D program.

The Agency will continue to publish, as required by Congress, the *National Aviation Research Plan* and submit it annually to Congress as part of the President's Budget Request.

The Agency will continue to provide cross-functional management team support for the *FAA R&D Strategic Plan*, ensure that programs planned in response to that plan are balanced across FAA strategic objectives, and ensure the most important and beneficial work is accomplished within the available resources.

The Agency will continue to maintain its field offices at the NASA Ames and Langley Research Centers as a vital part of our efforts to coordinate and integrate the research and development programs of the two organizations. Additionally, we will continue to support, along with NASA, the Joint University Program. This program continues to be an important incubator of new ideas, which in the past have made significant contributions in advancing aviation safety and efficiency of operations in the National Airspace System.

Ongoing Activities

Ongoing activities include:

- Update the R&D Strategic Plan
- Publish the National Aviation Research Plan
- Sustain R,E&D Advisory Committee Activities
- Publish the *National Aviation Research Plan*

New Initiatives

No new initiatives are planned in FY 2005.

KEY FY 2005 PRODUCTS AND MILESTONES:

R,E&D plans and programs

- Publish the National Aviation Research Plan
- Update and publish the *FAA R&D Strategy*

R,E&D advisory committee

- Prepare recommendations on planned R,E&D investments for FY 2006
- Prepare other reports as requested by the Administrator
- Participate in joint meetings with NASA's Aero-Space Technology Advisory Committee

NASA Field Offices

- Continue developing and implementing Free Flight Phase 1 and 2 tools
- Continue participating in the Joint Aviation System Transformation Program design effort and related development of the FAA Flight Plan 2020 Initiative
- Continue developing and implementing aircraft structural safety programs
- Support the FAA/NASA Virtual Airspace Modeling System (VAMS) project goal of developing and airspace system modeling, simulation and evaluation environment
- Continue studying the feasibility of the Small Aircraft Transportation System (SATS)

Joint University Program

- Publish and disseminate research results reported on at the quarterly reviews

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2003)	$35,728
FY 2004 Enacted	497
FY 2005 Request	1,275
Out-Year Planning Levels (FY 2006-2009)	5,262
Total	$42,762

Budget Authority ($000)	**FY 2001 Enacted**	**FY 2002 Enacted**	**FY 2003 Enacted**	**FY 2004 Enacted**	**FY 2005 Request**
Contracts:					
R,E&D Plans and Programs	886	1,130	902	436	1,214
Personnel Costs	246	49	43	56	53
Other In-house Costs	30	21	2	5	8
Total	**1,162**	**1,200**	**947**	**497**	**1,275**

OMB Circular A-11, Conduct of Research and Development ($000)	**FY 2002 Enacted**	**FY 2002 Enacted**	**FY 2003 Enacted**	**FY 2004 Enacted**	**FY 2005 Request**
Basic	0	0	0	0	0
Applied	1,162	1,200	947	497	1,275
Development (includes prototypes)	0	0	0	0	0
Total	**1,162**	**1,200**	**947**	**497**	**1,275**

System Planning and Resource Product and Activities	FY 2005 Request ($000)	Program Schedule					
		FY 2004	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009
011-130 R,E&D Plans and Programs							
R,E&D Plans and Programs	**$494**						
Publish Annual Plan for R&D		◆	◇	◇	◇	◇	◇
Ensure R,E&D Financial Management		◆	◇	◇	◇	◇	◇
Prepare Annual Budget Submissions		◆	◇	◇	◇	◇	◇
R,E&D Advisory Committee	**$120**						
Develop Recommendations on FAA, R,E&D Investments		◆	◇	◇	◇	◇	◇
Hold Joint Meetings with NASA's Aero-Space Technology Advisory Committee		◆	◇	◇	◇	◇	◇
NASA Field Offices	**$400**	◆	◇	◇	◇	◇	◇
Joint University Program (Quarterly Research Reviews)	**$200**	◆	◇	◇	◇	◇	◇
Personnel and Other In-House Costs	**$61**						
Total Budget Authority	**$1,275**	**$497**	**$1,275**	**$1,291**	**$1,305**	**$1,319**	**$1,347**

◆ - Activities Accomplished ◇ - Activities Planned

NOTE: OUT YEAR NUMBERS ARE FOR PLANNING PURPOSES ONLY. ACTUAL FUNDING NEEDS WILL BE DETERMINED THROUGH THE ANNUAL BUDGET PROCESS.

WILLIAM J. HUGHES TECHNICAL CENTER LABORATORY FACILITY

Goal:

Intended Outcomes: The FAA maintains and operates Agency research facilities located at the William J. Hughes Technical Center (WJHTC) in support of R,E&D program goals to:

- Reduce the number of accidents and accident risk
- Perform airspace studies and improve airspace design
- Increase airport capacity
- Reduce delays due to weather and system outages
- Reduce user costs

These centralized facilities consist of NAS systems, aircraft, simulation facilities, communication systems laboratory, and a Human Factors laboratory.

Agency Outputs: R,E&D programs require various well-equipped, routinely available facilities to emulate and evaluate field conditions. Human factors projects require laboratories to perform human-in-the-loop simulations, measure human performance, and evaluate human factors issues. Airborne and navigation projects require "flying laboratories" that are specially instrumented and reconfigurable to support different projects.

Accomplishments: The technical laboratory facilities provide the reliable test bed infrastructure to support R,E&D program goals and outputs.

R&D Partnerships: In addition to the R,E&D programs listed, WJHTC laboratories cooperate with the Canadian Ministry of Transport, NASA, U.S. Air Force, Aircraft Owners and Pilots Association, International Civil Aviation Association, academia and industry.

MAJOR ACTIVITIES AND ANTICIPATED FY 2004 ACCOMPLISHMENTS:

The following programs, are supported by the laboratories:

- Runway Incursion Reduction
- Information Security
- Separation Standards
- GPS/WAAS/LAAS
- TERPS
- Satellite Communication
- Data Link
- TCAS/ADS-B
- Acquisition Human Factors
- Delay Reduction
- Runway Pavement Testing
- Safe Flight 21

FY 2005 PROGRAM REQUEST:

The WJHTC will maintain and operate technical laboratories/facilities that support R,E&D programs.

Ongoing Activities

- Free Flight Phase 2
- Capacity Initiatives (Airspace, Procedures)
- Information Security

- ADS-B/Data Link
- Satellite Communication and Navigation Programs
- Separation Standards
- GPS WAAS/LAAS
- TERPS
- Runway Incursion
- Aircraft Safety
- ATC/AF Human Factors
- OEP Concept Validation

New Initiatives

No new initiatives are planned in FY 2005.

KEY FY 2005 PRODUCTS AND MILESTONES:

The test beds at the WJH Technical Center provide the necessary infrastructure for R,E&D programs to achieve their goals. Specific milestones and products are contained within individual programs.

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2003)	$89,919
FY 2004 Enacted	3,405
FY 2005 Request	3,389
Out-Year Planning Levels (FY 2006-2009)	14,491
Total	$111,204

Budget Authority ($000)	**FY 2001 Enacted**	**FY 2002 Enacted**	**FY 2003 Enacted**	**FY 2004 Enacted**	**FY 2005 Request**
Contracts:					
WJHTC Laboratory Facility	2,710	3,540	3,683	979	1,010
Personnel Costs	8,044	8,046	2,281	2,401	2,293
Other In-house Costs	1,469	664	33	25	86
Total	**12,223**	**12,250**	**5,997**	**3,405**	**3,389**

OMB Circular A-11, Conduct of Research and Development ($000)	**FY 2001 Enacted**	**FY 2002 Enacted**	**FY 2003 Enacted**	**FY 2004 Enacted**	**FY 2005 Request**
Basic	0	0	0	0	0
Applied	12,223	12,250	5,997	3,405	3,389
Development (includes prototypes)	0	0	0	0	0
Total	**12,223**	**12,250**	**5,997**	**3,405**	**3,389**

WJHTC Laboratory Facility Product and Activities	FY 2005 Request ($000)	Program Schedule					
		FY 2004	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009
011-140 WJHTC Laboratory Facility							
Systems Support Laboratory (En Route, Terminal, Automated Flight Station, Communications, and Scan Radars)	**$110**						
Free Flight Phase 2		◆	◇	◇			
Operational Evolution Plan Concept Validation		◆	◇	◇	◇	◇	◇
Capacity Initiatives (Airspace, Procedures)		◆	◇	◇	◇	◇	◇
Information Security		◆	◇	◇	◇	◇	◇
Research & Development Laboratory (Target Generator Facility, Cockpit Simulator, Auto Tracking, Tech Center Data)	**$300**						
Approach Procedures (SOIA)		◆	◇	◇	◇		
Free Flight Phase 2		◆	◇	◇	◇	◇	◇
Airspace Design		◆	◇	◇	◇	◇	◇
Operational Evolution Plan Concept Validation		◆	◇	◇	◇	◇	◇
Data Link		◆	◇	◇	◇	◇	◇
STARS Integration		◆	◇	◇	◇		
Aviation Support Laboratory (Aircraft)	**$300**						
Satellite Communications and Navigation Programs		◆	◇	◇	◇	◇	◇
Separation Standards		◆	◇	◇	◇		
GPS WAAS/LAAS		◆	◇	◇	◇	◇	◇
TERPS		◆	◇	◇	◇	◇	◇
Data Link		◆	◇	◇	◇	◇	◇
Runway Incursion		◆	◇	◇	◇	◇	◇
ADS-B		◆	◇	◇	◇	◇	◇
Aircraft Safety		◆	◇	◇	◇		
Human Factors Laboratory	**$300**						
Air Traffic Control Human Factors		◆	◇	◇	◇	◇	◇
Airway Facilities Human Factors		◆	◇	◇	◇	◇	◇
Operational Evolution Plan Concept Validation		◆	◇	◇	◇		
Personnel and Other In-House Costs	**$2,379**						
Total Budget Authority	**$3,389**	**$3,405**	**$3,389**	**$3,482**	**$3,572**	**$3,665**	**$3,772**

◆ - Activities Accomplished ◇ - Activities Planned

NOTE: OUT YEAR NUMBERS ARE FOR PLANNING PURPOSES ONLY. ACTUAL FUNDING NEEDS WILL BE DETERMINED THROUGH THE ANNUAL BUDGET PROCESS.

APPENDIX A – Research Engineering and Development Advisory Committee

The FAA values the ongoing involvement of the Research, Engineering and Development Advisory (R,E&D) Committee in reviewing its current and planned R,E&D programs. A formal process has been established whereby the agency replies to the Committee's reports. This document summarizes recent Committee recommendations and FAA responses.

FAA's R,E&D Advisory Committee and NASA's Aerospace Technology Advisory Committee (ATAC) will continue joint meetings to establish a framework that allows FAA and NASA to communicate, coordinate, and manage their safety and capacity goals.

Since preparation of the 2003 FAA National Aviation Research Plan, the Committee submitted the following reports:

- Recommendations on Fiscal Year 2005 R&D Investments, dated December 3, 2002
- Committee/Subcommittee Guidance on Fiscal Year 2005-2009 R&D Investments, dated June 3, 2003
- Report on Recommendations for Aviation Communications Research Investments, dated June 3, 2003
- Joint Recommendations from NASA's Aerospace Technology Advisory Committee and FAA's R,E&D Advisory Committee on the Joint Planning Office Status, dated September 23, 2003

In 2004, the FAA expects to receive the Committee's recommendations on FAA's planned research and development investments for Fiscal year 2006, including detailed recommendations from the standing subcommittees.

The Committee will also be providing recommendations to the Joint Planning Office on the National Plan.

RECOMMENDATIONS ON FISCAL YEAR 2005 R&D INVESTMENTS, DATED DECEMBER 3, 2002

At the September 30, 2002 meeting, the Committee reviewed FAA's planned Research and Development investments for Fiscal Year 2005. Committee provided recommendations in a letter dated December 3, 2002 from Committee Chair Dr. Deborah Boehm-Davis to Administrator Marion Blakey. Below are the Committee's recommendations and FAA's response. A formal response was provided May 19, 2003.

Recommendation 1: FAA and the National Aeronautics and Space Administration (NASA) should realign their internal resources to define the revolutionary air transportation system needed by the United States in the future. This process should culminate in the development of national goals for the airspace and benchmarks that can be used to assess when those goals have been achieved. Such a vision and set of benchmarks could be used to leverage research funding. Further, there is a great need for investment in longer-range issues, past the Operational Evolution Plan (OEP), that can only come from a longer-range vision of the national airspace.

Recommendation 2: FAA and NASA should focus on establishing a continuing process and mechanism for accountability for technology and the associated applications knowledge transfer between NASA, FAA, and implementation/maintenance organizations.

Response to 1 & 2: Your recommendation to look beyond the OEP is consistent with the advice the agency is receiving from many sectors of the aviation community. For several months, we have been working with the National Aeronautics and Space Administration, Transportation Security Administration, and Department of Defense to develop a program to transform the current air transport system into one that will meet the Nation's needs beyond the current OEP. Such a program will establish long-term U.S. goals and objectives for our aviation system and will agree on a shared research agenda and resource requirements to meet those goals. We are currently in the planning process and expect to make a formal announcement in the next few weeks. I believe these efforts will fulfill your first recommendation and meet the intent of your second recommendation to establish a continuing process to transfer successful NASA research products/prototypes into processes and systems that will be used by the FAA and the aviation community.

Recommendation 3: Associate Administrators should attend meetings with the REDAC to describe how they see the research and development process fitting into their operations and to outline their strategic plan for incorporating R&D into their programs. Specifically, the Committee would like the administrators to articulate their research needs and describe how they prioritize work and manage their programs. Although this recommendation was made in the past, few Associate Administrators have attended REDAC meetings.

Response: We understand the benefit of continued interaction between the agency's Associate Administrators and the REDAC to discuss research needs and priorities. The Associate Administrators or executive representatives for air traffic service, certification and standards, airports, and policy and programs have met with you individually over the past several meetings, and I will encourage their continued participation at the REDAC meetings.

Recommendation 4: FAA should develop and circulate criteria for determining when a research project should be dropped.

Response: In most cases, we define the exit criteria in the research objectives of our projects. For example, test standards for fire resistant insulation and other individual projects seldom exceed one year in length. A few projects do take years to develop the research methodology, collect adequate data, and validate the results. Because projects like these may be at risk of continuing past their cost effective life, the FAA will prepare guidelines for those projects that need exit criteria defined and will provide guidance on what those criteria should be. These will be presented to the REDAC for comment at the spring meeting in 2004.

Subcommittee on Aircraft Safety

Recommendation: We support the following research programs that have been funded:

- FAA Cabin Air Quality R&D initiatives and the strong linkage to the work being done at TSA in aircraft toxicity detection and elimination.
- FAA's proactive research with respect to the application of advanced materials and manufacturing processes in aircraft primary structures and for fire resistant cabins.
- FAA aircraft safety R&D planning for security-safety system integration of possible TSA security R&D hardware and procedures.

Response: Cabin Air Quality: The FAA is implementing the research recommended by the National Research Council's report on The Airliner Cabin Environment and the Health of Passengers and Crew. The FAA is working closely with the American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE). The sampler/sensor demonstration project will apply existing technology to monitor the aircraft cabin environment. This demonstration will support the ASHRAE research and lay the groundwork for the Chemical/Biological Threat Mitigation Project. With this technology, cabin air can be continuously monitored for contamination important to defining passenger and crew health issues.

The Chemical/Biological Threat Mitigation Proposal involves applying the technology common to cabin air quality monitoring to detect and mitigate chemical and biological threats. This proposal will identify incidents of airplane air quality contamination associated with typical operations, and in the case of intentional chemical/biological contamination, will identify processes necessary to return contaminated aircraft to service. The FAA is contacting TSA in an effort to integrate the requirements for both TSA and FAA.

Advanced Materials: The FAA appreciates the Subcommittee's support of our research into the application of advanced materials and manufacturing processes in aircraft primary structure and for fire resistant cabins. Our future-year research plans include furthering the understanding of these important subjects. Our plans emphasize research to respond to recent certification programs; accidents, such as AA587, and lessons learned from them. Our research will also address the key safety issues arising from the use of new materials and processes introduced by aircraft manufacturers. This will help us determine what regulation and policy is needed.

FAA aircraft safety R&D planning for security-safety system integration: TSA, NASA, and FAA are sponsoring a Fire/Fuel Safety & Security Workshop. This workshop will assemble subject matter experts to evaluate technologies with potential for countering intentional fire on aircraft or countering fire in buildings resulting from intentional impact of aircraft. Experts from the Department of Defense, National Institute of Science and Technology, the Jet Propulsion Laboratory, California Institute of Technology, Sandia National Laboratories, and transport airframe and propulsion industries have been invited. This workshop will be a benchmark for a process that establishes common initiatives and defines each agency's requirements and issues.

Recommendation: We strongly recommend FAA form an airline industry/FAA partnership that uses airline safety officers to build a risk analysis safety data system to improve upon FAA's System Approach to Safety Oversight approach.

Response: This recommendation is in line with the System Approach for Safety Oversight and Flight Standards Service objectives for further systems safety program development. The FAA will form an advisory group of airline safety officers to assist in defining R&D objectives and validating products from the Risk Management Decision Support Research Program. The FAA plans to have the group formed by the fourth quarter of 2003.

Recommendation: We are concerned that NASA's movement of safety initiatives to security "sponsorship" will take these efforts out from FAA and industry review, reduce resources for safety, and have negative safety implications.

Response: Since 1998, the FAA and NASA have worked closely to address aviation safety research. Since September 11, 2001, NASA has taken an initiative to address security issues with TSA. The FAA believes that this

will further promote collaboration, coordination, and consolidation of research efforts among the principal agencies responsible for aviation safety, security, and research.

Subcommittee on Airports

Recommendation (a): We recommend using Technical Notes to rapidly disseminate research findings to airports (such as Terminal Planning Workshop and Paint Reflectivity Measuring Research). This will get important information out to airports sooner than is currently the case.

Recommendation (b): We recommend expediting taxiway deviation studies and analysis of the data generated.

Recommendation (c): We recommend that the FAA not increase Full Time Equivalent (FTE) staffing in the Airport Technology Program at this time. If substantial increases in the funding for this program require additional project management resources, the need should be met by contract personnel until it is clear that any higher funding levels are permanent and warrant a permanent increase in staff.

Recommendation (d): In reviewing the research program, we recommend that the FAA provide research summaries and data in advance of subcommittee meetings and make increased use of peer review to manage the research program.

Response to a-d: We work closely with the Subcommittee on Airports and are working to implement their recommendations. Some of the items have already been accomplished:

- The Administration's FY 2004 Airport Technology request does not ask for increased staffing.
- We distributed information to the Subcommittee before the February 19-20 Subcommittee meeting.

Subcommittee on Air Traffic Services

Recommendation: We recommend including the 21st Century Aviation System Initiative as part of the FY 05 Budget Proposal. This look to the future should not be one time and end in FY 07; rather, it should become a cyclic five-year program.

Response: Air Traffic Services (ATS) concurs with the Air Traffic Services Subcommittee's recommendation to include the 21st Century Aviation System Initiative as part of the FY-05 budget proposal. The RTCA Concepts of Operations and Vision for the Future of Aviation and The Report of the Commission on the Future of the United States Aerospace Industry have set a high level framework for identifying future research initiatives

Recommendation (a): We recommend that the FY 05 budget be constructed such that the Aviation Weather Research program is not in the same line item as the Wake Vortex Research program.

Recommendation (b): We recommend that the FAA request for the Wake Research program for FY 05 (and FY 04) should be at or higher than appropriated in FY 02 to maintain an effective program of research.

Response to a-b: ATS concurs with the REDAC recommendations. The ATS Program Planning Team has recommended moving the Wake Vortex Research Program to Facilities and Equipment (F&E) because it is no longer research. Recommended funding for FY 05 is $5 million to aid Boeing in aircraft equipage and an additional $5 million to fund the development of procedures.

Recommendation: We recommend that the FAA reestablish its expertise in Traffic Alert and Collision Avoidance Systems (TCAS). The United States has lost its technical capability in TCAS and cannot currently provide needed evaluations of TCAS or of modifications to TCAS systems.

Response: ATS concurs with the recommendation to reestablish its expertise in TCAS. The ATS Program Planning Team has recommended that NASA use a portion of congressional funding to support further technical updates to TCAS systems.

Please note the additional recommendations from the Air Traffic Services (ATS) Program Planning Team:

- The ATS Program Planning Team recommends presenting the Advanced Technology Data Prototyping programs to the congressional committee under Facilities and Equipment (F&E) rather than Research, Engineering and Development (R,E&D), as the programs are funded through F&E.
- The ATS Program Planning Team recommends an increase in funding for the Aviation Weather Research Program to include Terminal Area Low Altitude Turbulence documented as a serious safety issue in the terminal area. The current terminal wind shear or microburst detection systems do not diagnose this type of turbulence.

  Budget Profile

  $480,000 the first year

  $495,000 to $500,000 the following years
- The ATS Program Planning Team recommends an increase in funding for Human Factors Research to do parallel research in accordance with the Aviation System initiative. This up-front research will mitigate the impact to budget and acceptance of a new system.

  Budget Profile

  $500K the first year

  $500K the following years

Subcommittee on Environment and Energy

Recommendation: The subcommittee feels that the budgeted FY 04 programs are appropriate and that no additional areas need to be considered. However, the committee did support augmenting Office of Environment and Energy funding by another $15 million to $20 million to accelerate noise research with NASA.

Response: NASA and FAA have traditionally worked closely together on joint noise reduction technology programs, such as the Advanced Subsonic Technology (AST) and the Quiet Aircraft Technology (QAT) programs. NASA's primary role is to conduct exploratory research and early technology development while the FAA focuses on assessing noise compatibility, aircraft certification, and regulatory issues, as well as developing aircraft noise modeling and assessment tools to help shape and guide the regulatory process. In FY 02, Congress directed FAA to provide an additional $18.1 million to NASA for the QAT program. NASA and FAA focused these resources on exploring additional noise reduction approaches such as new operating procedures, and reducing risk and advancing technology readiness level of airframe and engine noise reduction technologies. However, in FY 2003 the FAA received mixed messages from Congress regarding Environmental R,E&D funding. While the President's Budget requested $7.968M for FAA's Environmental R,E&D program, the Senate and House marked the program at $2.968M and $22.1M, respectively. The House targeted $15M to NASA's QAT program. Although the House action indicated support for augmenting noise research funding, we felt it was premature to consider augmenting Environmental R,E&D funding in FY 2004 for noise research until final Congressional FY 2003 action. The House funding levels ultimately prevailed in the conference agreement (which did not occur until we submitted the FY 2004 budget request), and we will consider this sense of Congress as we build the FY 2005 program. The FAA is also cognizant that compared to the amount spent on noise reduction R&D, noise mitigation expenditures such as sound proofing have been increasing, resulting in an imbalance in Federal Government endeavors to address near-term local noise mitigation and long-term national noise relief solutions. We are considering measures to address this imbalance.

Recommendation: Although the committee felt that the relative ranking of noise programs and emissions programs (within each respective category) were appropriate, we wanted to integrate the noise and emissions programs into a single priority list.

Response: The FAA endorses the subcommittee's efforts to integrate the aircraft noise and aviation emissions program areas and to consider funding priorities within a single environmental design space. However, the FAA feels that

making such far reaching recommendations based on a 1-2 hour discussion does not properly allow for weighing the relative merits of each program and its impact and interconnectivity with other efforts. The FAA urges the subcommittee to spend some time reviewing their recommended priorities.

Recommendation: The committee has provided a set of recommended priorities for the Office of Environment and Energy research program.

Response: Overall, the FAA finds the committee's recommended priorities very useful when considering investment priorities and program impact. However, as stated above, the FAA feels that in some cases the committee arrived at these priorities hastily and some merit further consideration.

The FAA feels that the Noise Center of Excellence is a critical priority item. The large reduction in noise in the late 1960s and early 1970's was a result of the introduction of the turbofan engine. The technological advances leading to this breakthrough would not have occurred without Federal investment. The noise reduction technologies of the 1980s and 1990s, i.e., increased by-pass ratio engines, better acoustic liner technology, etc., were more evolutionary. The FAA feels that a Noise Center of Excellence is critical to focus the creative thinking and foster the well-trained workforce necessary to enable future revolutionary noise reduction breakthroughs.

Subcommittee on Human Factors

Recommendation: The committee raised several concerns about the sponsorship process model used to develop funding priorities. First, the sponsorship obligation is viewed as an "unfounded mandate" by some performing organizations, which are often consumed with near-term issues. Second, the model is dependent on individuals to identify and articulate needs. Finally, the research organization should have some capability to sponsor or define research needs.

Response: The committee was addressing the AVR requirements process. The "unfounded mandate" was really stated by one FAA briefer as an "unfunded mandate." The inference, although not really discussed or clarified, was that the process was very time consuming and not really part of the person's primary, or "funded," job responsibilities. The comment was unfortunate and lead to a misunderstanding by the Subcommittee. What should have been communicated was that the implementation of the AVR requirements process is fully funded through the use of in-house funding and the assignment of duties to FTEs in order to address the functional responsibilities of those offices as outlined in the Associate Administrator for Regulation and Certification R&D Requirements Process document. The process allows for research needs to be identified from a variety of sources including research organizations. These needs are evaluated by formally identified specific groups possessing the appropriate technical expertise, and these groups decide if the proposed needs are legitimate research requirements and as such would go forward in the research requirements prioritization process.

Recommendation: The committee recommends an initiative to look in depth at the historical record and problems of transitioning technology and/or new functionality into the existing NAS. The goal of this project would be to identify whether there are attributes to look for in a new research area that would point to a likely successful transition (if it could be developed) into operation (implying operational acceptance).

Response: We agree that reflecting on the historical record can provide invaluable insight and understanding on the transitioning of technology and enhanced capabilities into the existing NAS. Substantial work has already been accomplished in assessing program and technical issues in the past, including the Standard Terminal Automation Replacement System (STARS) and even as far back as the Advanced Automation System (AAS), to garner lessons learned and best practices. Assessments have addressed broad issues in human-system integration (HSI) for the NAS as well as a more detailed HSI assessment for terminal automation modernization. The Free Flight office completed a thorough human factors assessment of fourteen Free Flight Phase 2 research capabilities, and has a detailed research management plan that includes human factors issues for the five capabilities having the best potential to be successfully transitioned to acquisition. The Free Flight office and Air Traffic are leveraging human factors expertise at Civil Aeromedical Institute (CAMI) and academia to closely examine usability of the User Request Evaluation Tool. The focus now is on understanding how to best identify and assess human factors issues with enhanced capabilities

progressing through the R&D pipeline, and collaborative work between the FAA and NASA has produced initial guidance to support successful transitions.

Recommendation: The committee feels there is a critical need for enhanced up-front mission analysis and investment analysis activities in the development of the FAA acquisition activities. This should include a holistic systems analysis, to include information on human roles and responsibilities, information requirements and flows, operating environments, and proposed procedures and operating rules.

Response: The integration of human factors research and engineering in early system acquisition activities (especially requirements determination and investment analysis) is being enhanced by executing an approach under the Associate Administrator for Research and Acquisitions (ARA) Performance Plan, defining the concepts supporting human factors integration in these activities, establishing working relationships with Program Director, Investment Analysis and Operation Research (ASD-400) and the Mission and Requirements Development Division (ARQ-300) for continued Human Factors Division (AAR-100) involvement, devising templates for initial human factors input into critical Acquisition Management System documentation, and focusing human factors resources on these activities. In addition, Program Director, Architecture and System Engineering (ASD-100) has initiated activities to increase the effectiveness of integrating human capabilities and limitations in the NAS by modeling the NAS operational relationships and promoting system engineering in system acquisitions. It is also acknowledged that the enhancement of human factors activities is limited by the degree to which:

- Mission analyses and functional analyses focus on well-defined, coordinated, time-phased, future functional capabilities (and shortfalls) within the NAS,
- Clear, specific, well-defined operational and maintenance concepts are developed and assessed,
- System analysis and system engineering activities are fully incorporated in system acquisition activities, and
- Analyses and decisions for fulfilling NAS capability shortfalls are data-driven and based upon (operational and maintenance) quantitative assessments of deployed systems.

Recommendation: The committee believes there is an opportunity to use increasingly available data to define objective measures of performance. We recommend that data be used to define baseline measures of performance. Further, we recommend that meta-analysis techniques be used to evaluate new systems and procedures as these techniques can protect individuals and organizations.

Response: We agree in the efficacy of having data-driven objective measures of performance. Baseline measures of en route controller performance were used by the Technical Center's NAS Human Factors Branch in the operational test and evaluation of the Display System Replacement (DSR), including use of the same traffic scenarios and airspace to ensure comparability of the data sets between DSR and the then-current Plan View Display legacy system. More recent simulation studies have used objective measures to assess transitions to new controller tools in comparison to baseline operations to help understand cumulative impacts on human performance.

CAMI's ATC research with Performance and Objective Workload Evaluation Research analyzes real-time radar and voice recordings to provide objective metrics of controller task load.

The mining of trends in performance databases will be supported through collaborative work with EUROCONTROL in developing a Virtual Data Repository (VDR). This VDR will provide a framework to integrate metrics and data sets from multiple studies, and would support a meta-analytic approach using a larger number of studies and controllers to examine changes in controller performance associated with new technologies and procedures.

COMMITTEE/SUBCOMMITTEE GUIDANCE ON FISCAL YEAR 2005-2009 R&D INVESTMENTS, DATED JUNE 3, 2003

At the April 29-30, 2003, Committee meeting, the Committee reviewed the FAA's planned FY 2005-2009 R&D Investments. Recommendations were provided to FAA in a letter dated June 3, 2003 from Committee Chair Dr. Deborah Boehm-Davis to Administrator Marion Blakey. Below are the Committee's recommendations and FAA's response. A formal response was provided September 15, 2003.

Recommendation 1: We recommend that FAA develop a mechanism for supporting deployed technology, especially that technology designed or developed by FAA. FAA needs to maintain the expertise needed to keep systems (such as TCAS) functional.

Response: We already have a way to preserve and support expertise for the Traffic Alert and Collision Avoidance System (TCAS) Program informally called the TCAS Transition Program. This program evaluates ongoing issues and proposed system changes and maintains an accident and incident database. An ARINC/Lincoln Labs contract also tracks trends and supports international forums. These activities have been advancing for four years and we expect them to continue. We will use the TCAS model to develop a way to support and preserve the expertise we need to keep future systems working.

Recommendation 2: We continue to believe that funding R&D out of the Facilities and Equipment (F&E) account creates several impediments to the conduct of research. Placement of money in this category of funding makes it difficult to identify what is being spent on research; it makes it easy to divert funds intended for research to other activities; and it does not allow funding to go to universities, where much research is conducted. The committee would like the opportunity to work with you to inform Congress of the difficulties created by funding R&D out of F&E funds.

Response: We understand the committee's concern and recognize there are some drawbacks in funding R&D under the F&E account. However, Congress moved these R&D programs from the RE&D account into the F&E account to improve how we coordinate and deploy air traffic management products. The FAA continues to include those programs moved to F&E in the National Aviation Research Plan we publish every year. This Plan discusses the goals, accomplishments, future investments and expected outcomes for those programs. We agree that near term funding priorities within F&E funds places pressure on the research portion of the money. The limit on using F&E funds for research grants has affected a portion of the R&D program. FAA is working with Congressional staff to lift that restriction.

Recommendation 3: Lack of access by researchers to aviation-related facilities continues to be an impediment to research. Access to airports, air traffic control and maintenance facilities, and to the cockpit is needed to ensure that research focuses on actual practice rather than a researcher's interpretation of what practice might be based on available documentation. Although the committee recognizes the paramount importance of safety and security precautions, we recommend that mechanisms be developed to allow legitimate researchers to gain access to relevant facilities for the conduct of their research.

Response: We agree that following 9/11 increased security and safety concerns have limited-access to the flightdeck. While the threat continues to change, we will find alternative ways, such as through training simulators, for researchers to connect to flightdeck operations. Also, as the threat level stabilizes toward green, we will work with our Flight Standards Service (AFS-200) organization and the Transportation Security Administration to develop a way to provide increased access to the flightdeck. In contrast, the limited number of maintenance personnel available to take part in studies puts constraints on maintenance research. We are working those maintenance requirements that do not require large numbers of maintenance personnel. The Research Management Process authorizes access to air traffic control facilities and requires the applicant to send documentation for FAA review and approval before granting access. We are working to speed up how we grant access to Air Traffic facilities for research.

Recommendation 4: We support the formation of a Joint Program Office on the Next Generation Air Transportation System to increase interagency coordination, focus on moving R&D products into operations, and develop a strong systems engineering basis for decision-making.

Response: The Secretary of the Department of Transportation is setting up a Joint Planning Office (JPO) to develop a National Plan to transform the air transportation system. The JPO will be set up with coordination from the Departments of Defense, Commerce, and Homeland Security and the National Aeronautics and Space Administration. The JPO will develop a unified interagency research and development plan to align our vision, goals, objectives, and resources out to 2025. Our first step is developing a document that lays out the need for change, describes the high-level strategies and challenges involved in transforming the system, and sets the long-term national goals for the program. We will draft the document and coordinate it with industry this year through our REDAC subcommittee. The second phase will be to develop the full national plan.

Recommendation 5: We ask that you continue to encourage senior associate administrators to meet with the REDAC to help identify emerging needs. We feel that continued dialogue such as that begun at our last meeting can help move the agency's research program beyond work focused solely on today's operations and help prepare the country for the NAS of the future.

Response: The Associate Administrators value the exchange of ideas with Committee members at the meetings. It provides valuable feedback on their programs. We look forward to continuing discussions at future meetings.

Air Traffic Services

General Recommendations concerning the President's FY04 Budget and FAA's planning for FY05:

1. Current FAA Program Lacks Long Term Research & Development Component:

   Our review of the FAA R,E&D and the F&E Activity One research and development budget plans reveals that the planned research and research support is limited to activities necessary to meet FAA's Operational Evolution Plan (OEP) milestones and is narrow in scope with only safety-related R&D.

   Operational costs of both users and the FAA are skyrocketing. Continuing the OEP work is essential to the aviation industry's near term health but mid and longer term research activities are needed to develop approaches to bringing operational costs under control and providing the capacity needed in the future when the public resumes its full utilization of the air transportation system.

   The Commission on the Future of the United States Aerospace Industry in its November 2002 report, recommended "Rapid deployment of a new, highly automated Air Traffic Management System, beyond the FAA's Operational Evolution Plan, so robust that it will efficiently, safely and securely accommodate an evolving variety and growing number of aerospace vehicles and civil and military operations; accelerated introduction of new aerospace systems, by shifting from product to process certification and providing implementation support; and streamlined new airport and runway development." This Subcommittee agrees with these Commission recommendations.

   We need to begin now to design, develop, and plan the implementation of the "next generation" air transportation system that will enable the United States to achieve a higher standard of living and quality of life while maintaining/enhancing the United States share of the world's aviation market. The time to improve capacity is before it is needed and not after it is required. It is very difficult and doubly expensive to implement improvements in a system under stress. Failure to make these R&D investments in a timely way will surely cause the nation's air transportation system to constrain future U.S. economic growth.

Recommendation: A broad based R&D program that addresses the future needs of the nation and the FAA is needed. In addition to the items currently shown in the FY 05 R,E&D budget planning, the FAA should request sufficient funding to support its role in defining, developing, and implementing the "next generation" air transportation system.

Response: We have included in the FY 2005 Research, Engineering and Development Budget submission to the Department of Transportation an initiative supporting the work on the "next generation air transportation system."

2. Joint Program to Establish Next Generation Air Transportation System:

As part of the Commission on the Future of the United States Aerospace Industry November 2002 report's recommendation for the deployment of a new, highly automated Air Traffic Management System, the Commission also recommended that a Next Generation Air Transportation System Joint Program Office be formed from the resources of FAA, NASA, DoD, DHS, NOAA, and other government organizations. This Subcommittee agrees with the Commission's recommendation. A interagency office that is responsible for the overall strategies, transformational planning, and agencies' performance of assigned tasks is the only way that government can provide the leadership necessary to move to the "next generation" air transportation system.

Recommendation: The Federal Government should form an interagency office to guide the creation and implementation of the "next generation" air transportation system.

Response: Planning is underway to create such an office. Congressional reauthorization legislation is also calling to form an interagency office. Recently we asked the REDAC to form a subcommittee to review the initial joint agency planning documentation.

3. Funding to Accomplish FAA's R&D Role of Transitioning Research to Implementation:

FAA's role is to be a catalyst for NASA, CAASD, and other research to assure that advances toward transformation of the National Airspace System (NAS) are developed in an orderly, effective manner; then, gather the resulting research products and integrate them into the NAS. FAA must have a research and development budget to study and plan the evolution of the NAS, evaluate research products, and adapt them for integration into the NAS. Included in this requirement, is the need to sponsor parallel research with NASA and other agencies on promising technologies that the FAA has identified as the likely path of evolution. This budget requirement is different from NASA's, which is aimed at supporting the FAA and other users of the NAS in addressing fundamental issues and in providing high risk, but high pay-off alternatives. FAA requested funding to accomplish its roll role has been reduced so much that we believe FAA will be unable to accomplish this role to such an extent that we believe that much of the research to improve the air transportation system, on-going within NASA and else where will be lost.

Recommendation: The FAA should either increase its funding request in FY05 for this work (as part of a "next generation air transportation system" funding request) or look to research organizations, needing this role to be accomplished by the FAA, to fund the FAA for this transitioning work.

Response: We have included in the FY 2005 Research, Engineering and Development Budget submission to the Department of Transportation an initiative supporting the work on the "next generation air transportation system."

Specific Comments/Recommendations on the President's FY04 Budget Request and the FAA's FY05 Budget Planning:

1. Aviation Weather Research:

FAA's FY 04 Budget Request and current FY 05 budget plan eliminated the Aviation Weather Research Program's funding for capacity/efficiency related weather research and reduced the Program's funding for the remaining safety related research parts of the program. The Aviation Weather Research Program has produced effective, needed products and has more of them under development. Reductions in FY 04/05 will either halt or slow work in many productive research areas including ceiling and visibility forecast products for Alaskan users, 2 - 4 hour frozen precipitation forecasts for users flying hazardous mountain terrain, and in-flight icing and convective weather induced turbulence forecasts for oceanic flight planners.

Recommendation: We recommend that the Aviation Weather Research Program be funded in FY 2005 at least at its appropriated FY 2003 level.

Response: The fact that the Subcommittee finds the Aviation Weather Research Program effective in its use of research funding and producing products that are of high value to the aviation community pleases us. Unfortunately,

priorities of our current budget planning have forced some reduction (based on FY 2003 Appropriated Funding) in our FY 2005 budget request for Aviation Weather Research.

2. Traffic Flow Management (TFM):

We are pleased to see that research is being proposed to address how FAA copes with uncertainty in TFM. This is a very important area to improve the NAS's efficiency. As weather forecasts become more capable, the effectiveness of TFM will increase, provided that TFM can effectively utilize the forecast improvements.

FAA has also proposed research to better integrate TFM into the overall NAS command and control structure. The current TFM system grew in place to solve discrete problems, with possibly shortsighted objectives. It is important to fund this proposed research that potentially can integrate the distinct TFM tools into a system for achieving the nation's broader traffic flow management objectives.

We are concerned that these proposed TFM research programs will not survive in the smaller Free Flight Phase 2 requested budget in FY04 and planned budget for FY05.

Response: FAA budget priorities have limited the investment we can make in these important research areas. We are hopeful that some work can start, though at a much-reduced level than proposed by your Subcommittee. We are also discussing the research with NASA to see if they could fund a portion of it.

3. Safe Flight 21:

The program appears to be going well, and may well be a stepping-stone to the next generation air traffic control/management system. We believe that Safe Flight 21 must develop, as part of its program, a strong business case so promising results of this program will be incorporated into the NAS.

4. Runway Incursion Reduction Program:

The program briefing we received proposed an evaluation of Runway Status Lights utilizing the Airport Movement Area Safety System (AMASS) as the data source. Our concern is that prior work by Lincoln Laboratory and Volpe National Transportation Systems Center has shown that AMASS by itself is not an acceptable data source. The Committee suggests that Multilateration and possibly ADS-B data would also be needed to adequately drive a runway status lights system.

Response: We agree with your suggestion. The briefing you received neglected the multilateration work that is occurring in connection with runway status lights. Air Traffic, our Office of Communications, Navigation and Surveillance Systems, and our Runway Safety Office, is working with the Research Management Plan to develop runway status lights. They are using both Airport Surface Detection Equipment (ASDE-3) with AMASS and multilateration with ASDE-X as alternative surveillance sources. The multilateration portion of the program is not as mature as the ASDE-3/AMASS because of complications with the multilateration sensors. However, both are practical sources and the research is continuing. We apologize for not clarifying this portion of our research program during the Subcommittee meeting.

5. Wake Turbulence Research:

This activity holds significant promise for great payoff in safety and capacity benefits. A joint FAA/NASA program has been formulated whose content and research strategy agree with the recommendations of an independent joint study by Lincoln Laboratory and MITRE/Center for Advanced Aviation System Development. The research, if successful, will provide near term increases in runway throughput through procedural changes, mid term benefits using weather dependent procedures, and long term benefits by incorporating automation enabled decision support tools. Potentially this research will yield a low-cost, high payoff method for increasing airport capacity.

The Subcommittee is aware that FAA's FY04 Budget Request contained no contract funding for Wake Turbulence research due to higher budget priorities. If no contract funds are appropriated for this work in FY04, it is recommended that FAA insure that government personnel working on the wake turbulence program continue the research even in the absence of contract funds. It is also recommended that the FAA

request steady funding for this Program in FY05 and beyond (as identified in the Wake Turbulence Research Management Plan) to allow the Program to deliver its planned products.

Response: We agree there is a good potential capacity payoff and have included a request for Wake Vortex research in our FY 2005 Research, Engineering and Development budget submission to the Department of Transportation.

6. Research Associated with Free Flight Phase 2:

We are concerned with the FAA decision to curtail funding the research support activities of the Free Flight Phase 2 Program. This will dramatically slow the pace at which needed new capabilities can be introduced into the National Airspace System. (This is a specific example of the problem discussed under our General Recommendation 3 - "Funding to Accomplish FAA's R&D Role of Transitioning Research to Implementation.")

Response: The funding cut for FAA evaluation of research products was an issue addressed at the July 8-10 FAA/NASA Integrated ATM Integrated Product Team meeting. We hope the required funding will be found.

7. Aeronautical Data Link Applications: CPDLC Build 1, Build IA, Flight Information Services:

This is an essential enabler of NAS modernization and global standardization, and an area where air carrier investment in equipage has not received FAA support for real benefit. Specifically, use of FANS has been extremely limited in US airspace. Efforts in this FAA data link applications area should include convergence between oceanic and domestic environment.

Response: We have decided to slow development of data link in recognition that the air carrier industry is not currently in a financial position to expand their data link equipage. While we are in this "pause," there will be an opportunity to review our data link program to allow the best convergence of domestic and oceanic applications.

8. Phased Array Radar (PAR):

This is currently a congressionally directed technology application research program being managed by the staff at the FAA William J. Hughes Technical Center. Work is being done in close collaboration with the Office of Naval Research and NOAA's National Severe Storms Laboratory. FAA should include in its FY05 budget request continued funding of its share of this collaborative research effort because a high-resolution, solid state phased array radar, similar to systems used by the Navy on Aegis Cruisers and by the USAF Dew Line, has the potential of satisfying all FAA surveillance needs (weather, aircraft) with a single system.

The National Research Council has recommended that serious consideration be given to making the next generation NEXRAD a phased array radar. The next generation NEXRAD is now beginning its development and FAA participation in this research and development - through the PAR research program - is vital to insuring FAA's future needs are incorporated into the next generation NEXRAD development. FAA, NOAA and the USAF jointly funded the development of the current NEXRAD radar.

Response: Because of higher FY 2005 budget priorities, we were unable to include a funding request for its share of the joint phased array radar research program.

9. Software-Intensive System Methodology.

It is imperative that the FAA procure ATC systems efficiently and preclude the loss of potential RE&D funds to pay for delays and overruns. Given the relative maturity and availability of CNS equipments and systems and the inherent difficulty of developing and upgrading software-intensive systems in the FAA's challenging environment of users, it is recommended that the FAA convene an independent panel to review the FAA's procurement methodology for complex software-intensive systems. The panel should also address if there are additional mechanisms for FAA to augment RE&D funds through greater exploitation of commercial RE&D programs.

Response: We have adopted control and improvement mechanisms that merge the Carnegie Mellon University and Software Engineering Institute work on applying system engineering practices to acquiring and developing complex software based systems. The FAA published the most recent version (FAA - Integrated Capability Maturity Model

(ICMM), Version 2) several years ago and the FAA Integrated Product Teams have achieved a maturity level 2 or higher. We believe that adopting this structured system engineering process has improved our ability to contract for and implement our ATC systems.

If the Subcommittee would like to lead a review of the how the FAA procures its major systems, we would be pleased to provide whatever aid the Subcommittee requires.

Aircraft Safety

Observations: The System Approach for Safety Oversight (SASO) end goal of PMI standardization is good. The industry has objected because there was no industry involvement and some of the guidelines are not relevant to safety. Recently, the SASO Program Manager in the Flight Standards Service, under the Associate Administrator for Regulation and Certification, has prepared a tentative composition for the SASO group to include representation from the top 10, national, regional, and cargo airlines. The SAS also recommended an OEM (manufacturer). The Program Manager has further considered industry labor organizations (e.g., ALPA) but plans to concentrate on the DOS/Safety department community first. Although the project is moving in the right direction, the committee was disappointed that its recommendations from the last meeting had not been carried out yet.

Recommendation: FAA should continue to get more industry involvement, especially with Directors of Safety at airlines. (This recommendation focuses on issues of implementation and not on the research.)

Response: We concur. Our Flight Standards organization (AFS) is forming an advisory group of airline Safety Directors to review and provide input to System Approach for Safety Oversight (SASO) products. The SASO program is still in the planning stages. Development is scheduled to begin in FY 2004, with deployment and implementation scheduled for FY 2008. We plan to seek contributions from industry in defining the future procedures for certification and surveillance, which we will develop under the SASO program. Also, industry will have the opportunity to comment on all developed business processes.

Airports

The Airport Technology Research Program has struggled for several years to balance the need to operate the expensive pavement test facility and maintain the scheduled airport pavement testing needed to support the development of new pavement design methodology with increasingly pressing needs to address airport safety issues. FAA has attempted to gain increased funding above the F/Y '02 level of approximately $7.5 Million so that these additional needs can be met without reducing the funding available for the paving research. In the F/Y '04 administration request, currently before the Congress, the funding would be increased to approximately $16 Million; a level that the subcommittee feels will allow that balance to be achieved, should it be enacted. The F/Y '05 budget being developed will, for the first time, propose funding the Airport Technology Research Program under F&E. This is recognition of the Congressional action that has for several years moved the FAA's Airport Technology Research program from its AIP request to F&E.

The internal process for developing the F&E budget level for funding the program is currently underway and it is not clear what the ultimate funding level will be for this program. The subcommittee is increasingly concerned that, if substantial new funding does not become available for expansion of research in the safety area, we may not be able to continue to support the full range of pavement research contained in the base budget. Should additional funding not become available in either the F/Y '04 appropriation or the F/Y'05 budget request, we recommend that FAA work with the subcommittee to examine ways to re-allocate a portion of the pavement research to provide additional funding for safety issues in a way that continues to support the core needs of developing new pavement design tools.

With that caveat, the subcommittee supports the FAA F/Y '05 proposed funding program. Among the non-paving projects in the program the subcommittee feels should have high priority are:

- Research regarding New Large Aircraft, with particular emphasis on quickly completing the taxiway deviation studies and assessing the need for new ARFF requirements.

- Wildlife hazard abatement. However, there is some concern that FAA efforts to develop a low cost radar capable providing real time warnings of bird hazards would benefit by better coordination with research underway by Transport Canada and MITRE.
- Runway safety initiatives, including runway incursion prevention, runway friction measurement, development of new arrestor materials and pavement roughness measurement.
- Deicing fluid studies to develop standards that foster improved environmental compatibility and reduced risk of aircraft corrosion.

In addition, the subcommittee wishes to express support for the various capacity enhancing research efforts being undertaken in other parts of the FAA that are crucial to meeting the long term needs of airports, particularly the ongoing wake vortex research.

Response: We agree with the Committee's recommendations for Airport Technology Research and have worked closely with the Committee in developing the

FY 2004 and FY 2005 budget submittals. We will focus any added funding on safety projects the subcommittee supports.

Environment and Energy

Subcommittee Comments: AEE has developed a holistic vision for noise and emissions research in support of their mission.

Recommendation: Move forward aggressively with the holistic approach.

Response: Our Office of Environment and Energy (AEE) is moving forward with its new holistic approach to aviation noise and emissions mitigation. We are funding a scoping study to seek stakeholder participation and establish the foundation for building the tools to enable an "environmental design space" (EDS) process. We plan to engage manufacturers, airlines, airports, academia, and the international community in refining the ideas we presented to the REDAC. This includes designing interfaces with and heightening use of existing tools, and defining desired output modules. We also plan to identify existing data and models (or continuing efforts to develop models), which we can leverage. The Agency seeks added funds to develop EDS tools in the FY 2005 President's Budget request.

Subcommittee Comments: AEE has developed a needs-based budget for their holistic vision that is comprehensive and well balanced.

Recommendation: Increase the RE&D funding for AEE to $22M to support the vision starting in FY05.

Response: While we consider aviation environmental R&D work important, other R&D safety programs have higher priority within the FAA R,E&D program. However, because of the FY 2002 and 2003 appropriations increasing environment and energy R&D funding and the REDAC's recommendation, we request expansion of aviation environmental R&D in the FY 2005 program.

Subcommittee Comments: AEE has proposed a Center of Excellence in aircraft noise mitigation. This is a significant step in the right direction but only addresses part of the holistic vision.

Recommendation: Expand the scope of the center to include both noise and emissions.

Response: We agree with this recommendation. We have expanded the scope of the center to include aviation emissions. The name of the center is now: Center of Excellence for Aircraft Noise and Aviation Emissions Mitigation. The new title and expanded work scope appeared on the Final Solicitation issued on June 2, 2003.

Subcommittee Comments: In addition, the re-authorization for the FAA includes allocation of up to $20M from the from the Airport Improvement Program (AIP) noise set-aside for noise and emissions research. The idea of setting aside additional funding for research is a good idea.

Recommendation: Set aside a fixed fraction of the AIP to support noise and emissions research.

Response: The REDAC's support of the Administration's proposal to use a small part ($20 million) of the AIP noise set-aside for research to advance technology to mitigate aircraft noise and aviation emissions pleases us. This research will be done in collaboration with NASA, industry, and academia. On June 26, the House Science Subcommittee on Space and Aeronautics voted to approve a bill that included the Administration's proposal. Final passage is up to the Congress.

Subcommittee Comments: AEE program changes will require an expanded staff skill set and better external communication of research and ideas.

Recommendation: Build skills and tools necessary to support programs, and be more rigorous about publishing and disseminating results.

Response: We agree with this recommendation. We are establishing a yearly internal review of all environment and energy R&D programs. We also plan to lengthen the Spring REDAC subcommittee meeting to two days to allow for a more in-depth review of our programs. We are also adopting internal metrics and incentives to encourage publication and distribution of research. We expect that the new Center of Excellence will also improve communication. And, we are increasing our participation in external boards such as the Transportation Research Board's Committee on Environmental Impact of Aviation and NASA and DoD Advisory Boards.

Human Factors

The Human Factors Subcommittee reviews a portion of the research portfolio at each of their meetings. At its most recent meeting, the committee reviewed the maintenance research program. In evaluating that part of the R&D portfolio, the committee felt that some elements were missing. These included work on:

1. Cultural Issues:

   Specifically, the subcommittee felt that the role of cultural diversity in the maintenance workforce and the impact of cultural differences across countries on transition issues and organizational safety was not being adequately addressed.

Response: Currently there is no work addressing the role of cultural diversity in the maintenance workforce and the impact of cultural differences across countries on transition issues and organizational safety. Several years ago, research in this area was included in the maintenance research program. The maintenance human factors research program manager will work with the committee to develop a research requirement that we can submit to the maintenance Technical Community Representative Group (TCRG).

2. Fundamental Work on Human Role in Automated Systems:

   Specifically, the subcommittee felt that more basic research was needed to understand how productive and effective are humans in the automated systems loop.

Response: Currently there is no basic research addressing an understanding of how productive and effective humans are in the automated systems loop. Some research in this area has been done in the flightdeck and Air Traffic Service (ATS) domains. The maintenance human factors research program manager will work with the committee to develop a research requirement that we can submit to the maintenance TCRG.

3. Capturing "Lessons Learned" from introducing New Technologies:

   The subcommittee felt it is important to capture reports of difficulties arising from the introduction of new technologies so that these data can be collated and systematically analyzed.

Response: Many "lessons learned" have been captured from introducing new technologies, such as flightdeck automation, Controller-Pilot Data Link Communications (CPDLC), and Standard Terminal Automation Replacement System (STARS). There has been no effort to collate lessons learned across the various new technologies. The maintenance human factors research program manager will work with the committee to develop a research requirement that we can refer to the maintenance TCRG.

The subcommittee felt that one element of the proposed research program, the Sport Pilot Element, should have a lower priority for funding than it currently has.

Response: The Sport Pilot research program requirement has been reassessed and we determined that it is no longer needed.

The subcommittee felt strongly that neither industry nor the REDAC and its subcommittees have been as effective as they might be in helping the FAA prioritize research and in suggesting new avenues for research that might be appropriate. Specifically, the Human Factors Subcommittee felt that it is important for REDAC subcommittee guidance to find its way into the TCRG deliberations. Further, they feel that the Commercial Aviation Safety Team (CAST) should be used as a mechanism to link the research with industry needs.

Response: The Subcommittee can provide research requirements for consideration by the appropriate TCRG. The human factors research program mangers will work with the subcommittee to ensure their requirements are entered into the process. Additionally, the subcommittee will receive a copy of the FY 06 research requirements generated by the Human Factors TCRGs and can provide their comments prior to our Regulation and Certification organization's (AVR) ranking of the F&Y 2006 requirements. The human factors research program is working with the CAST to address human factors research concerns identified by CAST. Current human factors research being done by FAA and NASA addressing these concerns has been identified and submitted to CAST.

In discussing this issue, the subcommittee suggested that it may be worthwhile to consider the implementation of focused study panels (e.g., in the area of safety culture and cultural-technical change) to develop proposals about research that the FAA might consider funding. The output from the study panels could be integrated into the priorities arising in the TCRGs.

Response: We agree that focused study panels could be a productive way for the committee to provide meaningful research proposals that could be integrated into the priorities arising in the TCRGs. We will discuss potential topics for focused study panels at the upcoming Human Factors Subcommittee meeting.

Finally, the subcommittee noted that access to facilities is critical for human factors work. This includes access to Air Traffic Control, Maintenance and Cockpit facilities. Although recognizing the need for safety and security precautions, lack of access to facilities will return research to the status of "ivory tower" work, disconnected from actual practice.

Response: We agree that following 9/11 increased security and safety concerns have constrained access to the flightdeck. During this time of threat level fluctuation, we need to find alternative means to provide researchers with some means of connection to flightdeck operations such as through use of training simulators. Additionally, as the threat level stabilizes toward green we will work with AFS-200 and the Transportation Security Administration to develop a means to provide increased access to the flightdeck. In contrast, maintenance research is constrained by limited availability of maintenance personnel who are needed to participate in studies. Access to air traffic control facilities is authorized through the Research Management Process, which requires documentation for review and approval before access can be granted or research begins.

REPORT ON RECOMMENDATIONS FOR AVIATION COMMUNICATIONS RESEARCH INVESTMENTS, DATED JUNE 3, 2003

The REDAC Air Traffic Services Subcommittee formed a subgroup to review current FAA research and development planning for aviation communications evolution at the request of FAA in June 2001. The REDAC asked the subgroup to define what communications research would be required to accomplish the planned evolution and to identify key ATM communication attributes for the post 2020 period. The Committee provided the report to Administrator Marion Blakey on June 3, 2003. Below are the Committee's recommendations and FAA's response to the Committee on August 8, 2003.

Recommendations

1. The FAA and NASA must focus research on the communications systems that will be deployed in the post 2015 time frame (far-term). Research on communications systems for the near- and mid-term should be limited to resolving issues associated with the implementation of these systems.
2. The FAA and NASA need to conduct the necessary research required to provide mid-term enhanced cost-effective oceanic and remote area communications for broad classes of aircraft to keep pace with the growth of traffic in these areas.
3. The FAA must perform research and analyses to develop a range of communication system performance requirements that match growth/non-growth scenarios for the future air transportation system. These performance requirements can then be used to develop communications concepts of use and for implementing communication system designs. This research should be directed at developing and deploying a future global communications system design that has sufficient flexibility to address the full range of possible performance and economic requirements.
4. A part of the FAA research program should include an analysis of costs vs. benefits for the various communications systems implementation strategies.
5. The FAA should develop an aviation communications system roadmap based on the future air transportation concept of operations and growth projections. Identifying time frames when decisions are required will help the FAA establish the communications research agenda for far-term systems. The FAA should develop this roadmap in coordination with the aviation community, and should give serious consideration to application of DoD-developed communications technology.
6. The FAA should create with NASA a CNS Area Work Team within the NASA/FAA Interagency Air Traffic Management Integrated Product Team (IAIPT). This team will coordinate on-going CNS Research and Technology activities and to establish an enhanced collaboration with EUROCONTROL and DoD. Specific areas/issues to be investigated include:

- Globally inter-operable systems: Global solutions are needed for secure, integrated communications - air/ground, ground/ground, air/air
- Architectures for integrated communications/navigation/surveillance information infrastructure
- Space-based technologies, especially for communications and surveillance
  - Broadband satellite communications for en-route and oceanic
  - Space-based surveillance and oceanic surveillance (ADS over satellite communication links, multi-lateration)
- Spectrum issues:
  - Assessment of far term spectrum requirements
  - Spectrum (bandwidth) management research:

  - Applications across spectral boundaries for better spectrum use and improved global interoperability
  - Dynamic bandwidth allocation

- Oceanic needs: research is required to provide enhanced communication/surveillance/navigation services in oceanic airspace
- Communication policy needs: research must provide information required to set U.S. communication policy.

The area work team will determine if potential areas for application look promising and what, if any, issues might surround that application. The team will also ensure that research and development programs in technology application areas include resources for answering questions peculiar to adapting these technologies to a civilian air transportation system.

- Benefit/cost studies
- Human factors studies (pilots and controllers)
- Certification questions (e.g., software radio certification)

7. FAA must provide strong leadership in setting the communications research agenda. FAA should develop a potential communications architecture for that 2020+, thereby identifying areas for the communications research. To accomplish its leadership and analysis roles, the FAA needs to rapidly increase its in-house system engineering capability.
8. The FAA and NASA must be cognizant of each other's, DoD's, and industry's communication R&T investments to eliminate duplicate investments.
9. The FAA, as the U.S. aviation community spokesperson in ICAO communication system forums, must increase its resources dedicated to these international forums and associated committee work to ensure adopted solutions are compatible with technology being developed in the United States. After safety related work, this activity should have highest priority for in-house resources. The FAA should consider increased use of U.S. industry and other government agency resources in its ICAO work.
10. The FAA should lead an international effort to reach global consensus on operator and user communication system(s) equipage, timing of investments, and operational concepts.

FAA Response to Recommendations

Administrator Blakey has asked me to respond to your comprehensive report "Recommendations for Aviation Communications Research Investments." Your subgroup has fulfilled its terms of reference and I concur with its recommendations.

I agree that our ongoing communications modernization program holds great promise to provide aviation a flexible and robust voice and data system for many years to come. I will place special emphasis on international cooperation to ensure that our program is cost-effective for our airspace user community. To this end, I will provide the necessary leadership to set the agenda and the timetable for future transitions. I am committed to implementing an Air/Ground Communications System that promotes global interoperability in a timely manner with respect to our users' investments.

To assist the agency in this endeavor, I agree that the Federal Aviation Administration (FAA) needs a strong and collaborative effort with the National Aeronautics and Space Administration (NASA) managed under our existing Interagency Air Traffic Management Integrated Product Team. We will establish a new Area Work Team to assess Department of Defense (DoD) technology for its application to civilian use, and coordinate communications research.

Finally, I concur that a broad view of all NASA, FAA, DoD, and industry-planned investments must be conducted. This will ensure that the Government is being both responsive to its constituents needs and efficient with its

investments in meeting those needs. This action will also be assigned to the Interagency Air Traffic Management Integrated Product Team Lead.

Congratulations to you and your team for a job well done.

JOINT RECOMMENDATIONS FROM NASA'S AEROSPACE TECHNOLOGY ADVISORY COMMITTEE AND FAA'S R,E&D ADVISORY COMMITTEE ON THE JOINT PLANNING OFFICE STATUS, DATED SEPTEMBER 23, 2003

On September 17, 2003, the FAA's Research, Engineering and Development Advisory Committee (REDAC) and NASA's Aeronautics Technology Subcommittee (ATS) of the ATAC met in an all-day, joint session to discuss research activities of mutual interest. We reviewed a variety of NASA and FAA collaborative programs and planning efforts; we especially focused on the high-level, multi-agency commitment to create a Joint Planning Office (JPO) and develop a coherent National Plan for the National Airspace System (NAS) to the year 2025. We are pleased to provide this letter as a product of this joint meeting and as an assessment of the JPO status.

On the basis of our joint meeting, we offer the following impressions, opinions and recommendations:

- We are enormously impressed with the progress to date in establishing the Joint Planning Office and with the open, supportive collaboration of each of the participating governmental agencies. This was viewed by all as a potential breakthrough in multi-agency cooperation in aviation and aeronautics research planning - an opportunity to integrate and truly coordinate the research agendas of these agencies.
- The JPO's organizational success in aligning the governmental agencies' research programs needs to be expanded by a more direct and comprehensive inclusion of industry partners. The appropriate role for academia in this long-term planning effort also requires further consideration. The JPO needs to determine the proper phase in steps for increased inclusion of these two stakeholder elements in its plan.
- The JPO is charged with drafting a National Plan for the "next generation air transportation system." This is characterized as neither a modernization nor an evolution, but as a transformation of the NAS. The transformation should: 1) drive productivity and enhance economic growth, 2) deliver capacity to accommodate future demand, 3) expand flexibility while improving system security, and 4) retain U.S. technological leadership.
- The JPO team has called for the creation of a senior-level Policy Committee that will both accept/approve the devised National Plan and guide its implementation; we also endorse this proposal.
- We recommend that the Joint Planning Office evolve into a Joint Program Office to serve as the focus for continued research collaboration among the agencies and facilitate transition to operational capability. Additional resources in terms of people and direct funding will be needed to support this enhanced mission.
- Planning must be sensitive to the realities of future safety, security and efficiency necessities, while unconstrained in terms of technological and operating possibilities. The National Plan should be driven by the imperative for the U.S. to maintain its global aviation leadership into the second century of manned flight.

The members of ATAC and REDAC enthusiastically endorse the initial directions and efforts in establishing the JPO. We believe that our two advisory committees can and should continue to regularly review the JPO activities and its evolution. We propose including such reviews as part of our annual joint sessions.

Finally, we would like to share with you our related impressions regarding the overall status of FAA and NASA research cooperation. This cooperation has extended the time horizon spectrum of aviation research from conception to application. We believe your two organizations have made significant strides toward integrating and sharing common research agendas - we have witnessed numerous examples, including the JPO activities highlighted above, that point toward very rewarding future collaborations.

APPENDIX B – Alphabetical Listing of National Aviation Research Plan Budget Line Items

Budget Program	Item Number	Page
Advanced Materials/Structural Safety	R,E&D A11c	2.1-6
Aeromedical Research	R,E&D A-11j	2.1-11
Aging Aircraft	R,E&D A-11e	2.1-17
Air Traffic Control/Airway Facilities Human Factors	R,E&D A-11i	2.1-22
Aircraft Catastrophic Failure Prevention Research	R,E&D A-11f	2.1-28
Airports Technology – Capacity	F&E 1C01J	2.2-6
Airports Technology – Safety	F&E 1C01J	2.1-33
Atmospheric Hazards / Digital Safety Research	R,E&D A-11d	2.1-37
Automatic Dependent Surveillance – Broadcast (ADS-B)	F&E 1B01C	2.2-10
Aviation Safety Risk Analysis	R,E&D A-11h	2.1-43
Aviation System Capacity Improvement (ASCI)	F&E 1C01C0	2.2-14
Center for Advanced Aviation System Development (CAASD)	F&E 5A29	2.2-19
Commercial Space Transportation Safety	Ops	2.1-49
Domestic Reduced Vertical Separation Minima (DRVSM)	F&E 1C01G	2.2-23
Environment and Energy	R,E&D A-13a	2.2-27
Fire Research and Safety	R,E&D A-11a	2.1-56
Flightdeck/Maintenance/System Integration Human Factors	R,E&D A-11g	2.1-61
General Aviation and Vertical Flight Technology (GA&VF)	F&E 1C01F	2.1-67
NAS Requirements Development	F&E 1C01E	2.2-35
NAS Safety Assessments	F&E 1C01I	2.1-72
National Plan for Transformation for Air Transportation	R,E&D A-12a	2.2-38
Operations Concept Validation	F&E 1C01D	2.2-42
Propulsion and Fuel Systems	R,E&D A-11b	2.1-76
Runway Incursion Reduction	F&E 1C01B	2.1-81
Safe Flight 21 – Alaska Capstone	F&E 1B01B	2.1-84
Safe Flight 21 – Ohio River Valley	F&E 1B01A	2.2-47
Safer Skies	F&E 1C01H	2.1-88
Separation Standards	F&E 1C01A	2.2-53

Budget Program	Item Number	Page
System Planning and Resource Management	R,E&D A-14a	2.3-4
Wake Turbulence	R,E&D A-12b	2.2-58
Weather Program – Safety	R,E&D A-11k	2.1-92
William J. Hughes Technical Center Laboratory Facility	R,E&D A-14b	2.3-8

APPENDIX C – Numerical Listing of National Aviation Research Plan Projects

Project Number	Budget Program	Budget Item
061-110	Fire Research and Safety	A11a
063-110	Propulsion and Fuel Systems	A11b
062-110/111	Advanced Materials/Structural Safety	A11c
064-110/111	Flight Safety/Atmospheric Hazards Research	A11d
065-110	Aging Aircraft	A11e
066-110	Aircraft Catastrophic Failure Prevention Research	A11f
081-110	Flightdeck/Maintenance/System Integration Human Factors	A11g
060-110	Aviation Safety Risk Analysis	A11h
082-110	Air Traffic Control/Airway Facilities Human Factors	A11i
086-110	Aeromedical Research	A11j
041-110	Weather Program – Safety	A11k
027-100	National Plan for Transformation for Air Transportation	A12a
041-150	Wake Turbulence	A12b
091-110/111/116	Environment and Energy	A13a
011-130	System Planning and Resource Management	A14a
011-140	William J. Hughes Technical Center Laboratory Facility	A14b
67100903--	Safe Flight 21 – Ohio River Valley	F&E-1B01A
11280101--	Safe Flight 21 – Alaska Capstone	F&E-1B01B
67100855--	Automatic Dependent Surveillance Broadcast (ADS-B)	F&E 1B01C
26610855--	Separation Standards	F&E-1C01A
45540855--	Runway Incursion Reduction	F&E-1C01B
26600855--	Aviation System Capacity Improvement (ASCI)	F&E-1C01C
98610855--	Operations Concept Validation	F&E-1C01D
40160289--	NAS Requirements Development	F&E-1C01E
98820855--	General Aviation and Vertical Flight Technology (GA&VF)	F&E-1C01F
26620866--	Domestic Reduced Vertical Separation Minima (DRVSM)	F&E-1C01G
98750129--	Safer Skies	F&E-1C01H
98750125--	NAS Safety Assessments	F&E-1C01I
98830855--	Airports Technology – Capacity	F&E-1C01J

Project Number	Budget Program	Budget Item
98830855--	Airports Technology – Safety	F&E-1C01J
98610112--	Center for Advanced Aviation System Development (CAASD)	F&E-5A29
TBD	Commercial Space Transportation Safety	OPS

Note: The final two digits of project numbers for the F&E-1C01 line item correspond to the Fiscal Year.

APPENDIX D – Acronyms and Abbreviations

The Following high-frequency or generally well-known acronyms will often appear in the text of this plan without being "spelled out."

AC	Advisory Circular
ARA	Office of the Associate Administrator for Research and Acquisitions
ATC	Air Traffic Control
ATM	Air Traffic Management
ATS	Air Traffic Services
CONOPS	Concept of Operations
DoD	Department of Defense
DOE	Department of Energy
DOT	Department of Transportation
EPA	Environmental Protection Agency
F&E	Facilities and Equipment
FAA	Federal Aviation Administration
GAO	General Accounting Office
JPO	Joint Planning Office
NAS	National Airspace System
NASA	National Aeronautics and Space Administration
NTSB	National Transportation Safety Board
OMB	Office of Management and Budget
R&D	Research and Development
R,E&D	Research, Engineering and Development
REDAC	Research, Engineering and Development Advisory Committee
TRACON	Terminal Radar Approach Control

The Following will generally appear with their full equivalents stated in its first occurrence in each major section of this plan or each program description.

A	
AACE	[FAA] Center of Excellence for Airworthiness Assurance
AAR	[FAA] Office of Aviation Research
ACI-NA	Airports Council International – North America
ACM	Airborne Conflict Management
ADDS	Aviation Digital Data Service
ADS-B	Automatic Dependent Surveillance – Broadcast
AEDT	Aviation Environmental Design Tool
AEM	Area Equivalent Method
AF	Airway Facilities
AFCB	Arc Fault Circuit Breakers
AFRL	Air Force Research Laboratory
AFS	[FAA] Flight Standards Services
AGATE	
AIA	Aerospace Industries Association
AIO	[FAA] Chief Information Officer
AIP	
AMASS	Airport Movement Area Safety System
AMS	Acquisition Management System
AND	[FAA] Office of Communications, Navigation, and Surveillance Systems
AOZ	[FAA] Free Flight Program Office
APMS	Aviation Performance Measuring System
ARAC	Aviation Rulemaking Advisory Committee
ARFF	Aircraft Rescue Fire Fighting
ARQ	[FAA] Air Traffic Research and Requirements Directorate
ARS	[FAA] Aerospace Weather Policy and Standards Staff
ARS	
ARTCC	Air Route Traffic Control Center
ASA	Airborne Separation Assurance
ASAP	Aviation Safety Action Program
ASAS	Airborne Separation Assistance System
ASC	Aviation System Capacity Improvements
ASC	[FAA] Office of System Capacity
ASCI	Aviation System Capacity Improvement
ASD	[FAA] Office of System Architecture and Investment Analysis

ASDE-X	Airport Surface Detection Equipment - Model X
ASHRAE	American Society of Heating, Refrigeration, and Air Conditioning Engineers
ASRA	Aviation Safety Risk Analysis
AST	[FAA] Commercial Space Transportation
ASTM	American Society for Testing and Materials
ASV	Annual Service Volume
ATAC	[NASA] Aerospace Technology Advisory Committee
ATO	Air Traffic Organization
ATP	[FAA] Air Traffic Planning and Procedures
ATS	Along Track Separation
AT-SAT	Air Traffic Selection and Training
ATSRAC	Aging Transport Systems Rulemaking Advisory Committee
ATT	[FAA] Air Traffic Tactical Operations
AUA	[FAA] Office of Air Traffic Systems Development
AVR	[FAA] Office of the Associate Administrator for Regulation and Certification
AWP	[FAA] Western Pacific Region
AWT	Area Work Teams
C	
C&V	Ceiling and Visibility
CAA	Cargo Airline Association
CAA	[British] Civil Aviation Administration
CAA	Civil Aviation Authority
CAASD	Center for Advanced Aviation System Development
CAMI	Civil Aerospace Medical Institute
CAR/SAM	Caribbean and South American Region
CASR	Center for Aviation Systems Reliability
CASS	Continuing Analysis and Surveillance
CAST	Commercial Aviation Safety Team
CAST	Certification Authorities Software Team
CDM	Collaborative Decision Making
CDTI	Cockpit Display of Traffic Information
CFIT	Controlled-Flight-into-Terrain
CIN	Common Information Network
CIP	Capital Investment Plan
CNS	Communications, Navigation and Surveillance
COE	Center of Excellence
COMSTAC	Commercial Space Transportation Advisory Committee
CONUS	Continental United States

COTS	Commercial-off-the-Shelf
CPDLC	Controller Pilot Data Link Communications
CRC	Coordinating Research Council
CRDA	
CRM	Crew Resource Management
CSA	Comparative Safety Assessment
D	
DHS	Department of Homeland Security
DRVSM	Domestic Reduced Vertical Separation Minima
DSR	Display System Replacement
DSS	Decision Support System
E	
EDMS	Emissions and Dispersion Modeling System
EDS	Environmental Design Space
EEHWG	Electromagnetic Effects Harmonization Working Group
EMS	Emergency Medical Service
ERAU	Embry-Riddle Aeronautical University
ETC	Engine Titanium Consortium
F	
FAR	Federal Air Regulations
FAROS	Final Approach Runway Occupancy Signal
FASTER	Full-Scale Aircraft Structural Test Evaluation and Research
FDM	Flight Data Management
FICAN	Federal Interagency Committee on Aviation Noise
FIS-B	Flight Information Services-Broadcast
FL	Flight Level
FOQA	Flight Operations Quality Assurance
FSS	Flight Safety System
FY	Fiscal Year
G	
GA	General Aviation
GA&VF	General Aviation and Vertical Flight Technology
GCNSS	Global Communications Navigation Surveillance System
GNSS	Global Navigation Satellite System
GPRA	Government Performance and Results Act
GPS	Global Positioning System
H	
HAI	Helicopter Association International

HIC	Head-Neck Injury Criteria
HIRF	High Intensity Radiated Fields
HSI	Human-System Interface
HTRR	Hazard Track and Risk Resolution
HUMS	Health, Usage and Monitoring Systems
HVAC	Heating, Cooling, Ventilation, Air Conditioning, Refrigeration
I	
IAIMT	Interagency Integrated Management Team
IAIPT	Inter-Agency Air Traffic Management Integrated Product Team
ICAO	
IDM	Integrated Design and Manufacturing
IFR	
ILS	Instrument Landing System
INM	
IPHWG	[ARAC] Ice Protection Harmonization Working Group
ISEE	
ITWS	Integrated Terminal Weather System
IVHM	
J	
JAA	Joint Aviation Authorities
JUP	Joint University Program
L	
LAAS	Local Area Augmentation Systems
LOSA	Line Operations Safety Audit
M	
MAGENTA	
MASPS	Minimum Aviation System Performance Standards
MMIR	Maintenance Malfunction Information Reporting
MMPDS	Metallic Materials Properties Development Standards
MOA	Memorandum of Agreement
MOPS	Minimum Operational Performance Standards
MOU	Memorandum of Understanding
N	
NAPTF	National Airport Pavement Test Facility
NARP	National Aviation Research Plan
NDE	Non-Destructive Evaluation
NDI	Non-Destructive Inspection
NDI	Non-Developmental Item

NDT	Nondestructive Testing
NEXRAD	Next-Generation Weather System
NHTSA	
NICE	North Atlantic Implementation Management Group Cost Effectiveness
NLA	
NOAA	National Oceanic and Atmospheric Administration
NSTC	National Science and Technology Council
NWS	National Weather System
O	
O&M	Operations and Maintenance
OEP	Operational Evolution Plan
OOTiA	Object Oriented Technology in Aviation
OpEval	Operational Evaluation
P	
PAR	Phased Array Radar
PED	Portable Electronic Devices
PDARS	Performance Data Analysis and Recording System
PHA	Preliminary Hazard Assessment
PVFR	Precision Visual Flight Rules
Q	
QAT	Quiet Aircraft Technology
R	
RF	Radius to Fix
RFID	
RIRP	Runway Incursion Reduction Program
RITA	
RLV	
RLVWG	Reusable Launch Vehicle Working Group
RNP	
RRLOE	Rapidly Reconfigurable Line-Oriented Evaluation
RTSA	Real-Time Scheduling Analysis
RTSP	
RWSL	
S	
SAE	Society of Automotive Engineers
SAGE	System For Assessing Aviation Global Emissions
SAS	Subcommittee on Aircraft Safety
SASO	

SASP	Separation and Airspace Safety Panel
SATMS	Space and Air Traffic Management System
SATNAV	Satellite Navigation
SATS	Small Aircraft Transportation System
SBIR	Small Business Innovation Research
SCRAM	Statistical Attrition and Requirements Model
SEE	Single Event Effects
SERC	
SLD	Supercooled Large Droplets
SMAAQ	Screening Model for Airport Air Quality
SMPC	Specialty Metals Processing Consortium
SMS	
SNI	Simultaneous Non-Interfering
SRM	
SSH	
SSID	Supplemental Structural Inspection Document
SSMP	[NAS Modernization] System Safety Program Plan
STARS	
STATS	Safety Through Accurate Technical Statistics
SWIM	System-Wide Information Management
T	
TCA	Transport Canada Aviation
TCAS	Traffic Alert and Collision Avoidance System
TCRG	
TERPS	[Vertical Flight] Terminal Instrument Procedures
TFM	
TIS-B	Traffic Information Service-Broadcast
TPS	Thermal Protection System
TRMD	Turbine Rotor Material Design
TSA	Transportation Security Administration
TSD	Target System Description
U	
UAT	Universal Access Transceiver
UEDDAM	Uncontained Engine Debris Damage Assessment Model
URET	User Request Evaluation Tool

V	
VAMS	Virtual Airspace Modeling System
VDR	Virtual Data Repository
VF	Vertical Flight
VFR	Visual Flight Rules
VNTSC	Volpe National Transportation Systems Center
W	
WAAS	Wide Area Augmentation System
WFD	Widespread Fatigue Damage
WJHTC	[FAA] William J. Hughes Technical Center
WRF	Weather Research and Forecast
WSDDM	Weather Support to Deicing Decision Making