Federal Aviation Administration

2006 National Aviation Research Plan (NARP)

Appendices

A - Program Descriptions
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C - Partnership Activities
D - Acronyms and Abbreviations

February 6, 2006

Report of the Federal Aviation Administration
to the United States Congress
pursuant to 49 U.S. Code 44501(c)

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APPENDIX A

Program Descriptions

Listed Alphabetically

* Budget line item numbers are not used for these programs within the Operations (Ops) and Airport Improvement Program (AIP) appropriations.

Listed by FAA Appropriation and Budget Item

* Budget line item numbers are not used for programs within the Ops and AIP appropriations.

FAA Budget Appropriation	Budget Item	Program Title	Budget Request
R,E&D	A11.c.	Advanced Materials/Structural Safety	$2,843,000

Supports FAA Strategic Goal: Increased Safety

Intended Outcomes: The Advanced Materials/Structural Safety Program assesses the safety implications of new and present day composites, alloys and other materials, and associated structures and fabrication techniques that can help to reduce aviation fatalities. By FY 2008, researchers will develop a knowledge base that will result in safe use of advanced materials in aircraft.

The program is also enhancing aircraft crashworthiness, fire resistance, and evacuation practices to increase crash survivability. Researchers are developing the knowledge, tools, and standards to improve the crash characteristics of aircraft structures and systems.

Advanced materials research focuses on:

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

Structural safety research 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 and restraint systems; and
- Improving the efficiency of aircraft certification through the 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 rule making and develops guidance to help the aviation industry 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 structures, 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 Chief Scientist/Technical Advisor 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 and fuel systems, aircraft configurations, seat/restraint systems, and human tolerance injury criteria.

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) – this FAA committee and its subcommittees help to ensure the effectiveness of the Agency's rule making by identifying R&D requirements and priorities, providing guidance for the update of documents, such as AC20-107A, and encouraging industry's full participation in implementing new rules.
- Aircraft Safety Subcommittee of the FAA Research, Engineering and Development Advisory Committee – representatives from industry, academia, and other government agencies annually review the program's activities.
- Technical Community Representative Groups – FAA representatives apply formal guidelines to ensure that the program's research projects support new rule making and development of alternate means of compliance for existing rules.

Accomplishments: The Advanced Materials/Structural Safety Program provides technical reports, handbooks, ACs, and certification guidance to aircraft manufacturers, maintainers, and operators. Program accomplishments include:

Advanced Materials

- Established a Joint Center of Excellence for Advanced Materials at University of Washington and Wichita State University.
- Developed data on the procurement and processing of composites that has resulted in a published AC.
- In the past two years, issued and updated one AC, one handbook, and over 10 technical reports, articles and papers.
- Co-sponsored three technical conferences during the past three years involving over 200 experts.
- Developed an economical data reduction method, characterizing statistically composite materials through shared databases, that is now used worldwide by the general aviation industry.
- Developed software for analyzing bonded joints that can be used by the general aviation industry.

Structural Safety

- Published a draft report of ATR42-300 drop test.
- Published a report on the use of safety foams in aircraft fuel tanks to mitigate post-crash fires.
- Developed computer models of B737 fuselage sections and the ATR42 regional transport airplane.
- Developed a head injury criteria component tester that can replace the full-scale sled test.
- Developed an aircraft seat cushion replacement methodology that can replace the full-scale sled test.

R&D Partnerships: The Advanced Materials/Structural Safety Program benefits from a close working relationship with the Centers of Excellence Program. The research performed under this program is leveraged by the monetary and intellectual contributions of its core universities. The FAA is also participating in the U.S. Air Force Integrated Product Team in Technologies for Efficient Certification of Structures and working with the NATO Research and Technology agencies that are concerned with composite materials.

Advanced Materials

With the help of other government agencies, the FAA sponsors a primary and authoritative handbook (MIL-HDBK-17) facilitating 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 is acceptable for use in the certification process.

Structural Safety

The program maintains cooperative interagency agreements in the structural safety area with the U.S. Army and U.S. Navy in the analytical modeling area.

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. The program has worked closely with Drexel University to develop dynamic crash computer modeling codes for transport airplane structures.

MAJOR ACTIVITIES AND ANTICIPATED FY 2006 ACCOMPLISHMENTS:

Advanced Materials

- Continue to validate analytical methodology to predict residual strength of a composite sandwich structures following an impact event.
- Develop a training course for maintenance of composite aircraft parts.
- Develop analytical models that predict durability of braided materials.
- Evaluate aging composite aircraft by teardown and destructive testing.

Structural Safety

- Conclude research on human neck injury criteria for side-facing aircraft seats.
- Develop occupant protection criteria for side facing seats.
- Publish a technical report on computer modeling of aircraft water impacts to help determine revised rotorcraft water impact/ditching standards.
- Review in-house commuter crash test results to compile a summary report that develops commuter airplane seat/restraint system certification criteria.
- Review auxiliary fuel tank crash and sled test results to compile a summary report on certification service review.
- Review overhead stowage bin crash test results to compile a summary report on the adequacy of current certification standards.
- Publish a report on the design of crash resistant fuel systems.

FY 2007 PROGRAM REQUEST:

Ongoing Activities

The program will continue to focus on aging composite control surfaces on transport airplanes and will link to aircraft safety issues involved with control surface performance. Researchers will also explore the feasibility, and related savings in maintenance costs, of using embedded sensors to monitor in-service damage and will investigate the long-term safety friction stir-welded parts and fiber/metal laminates proposed for use in new aircraft. In addition, they will collect data applicable to rotorcraft and fan blades, including high-cycle fatigue and on certification methodologies for new materials and applications, such as ceramics and high temperatures.

Research will continue to develop analytical models of aircraft crash events, will identify crashworthiness certification issues of non-metallic airplanes, and will generate data necessary to certify new structures.

New Initiatives

Test and analysis protocols will be developed to ensure structural integrity under repeated loads and damage threats.

KEY FY 2007 PRODUCTS AND MILESTONES:

Advanced Materials

- Continue to assess the severity of control surface stiffness degradation and its effect on dynamic characteristics.
- Develop chemical characterization tests to ensure adequate surface preparation for bonded joints.
- Develop safety criteria for damage tolerance of fiber/metal laminates and friction stir welded joints.
- Establish feasibility of embedded sensors to track damage.

Structural Safety

- Publish a report on human neck injury criteria development research for side facing aircraft seats.
- Publish a summary report on aircraft overhead stowage bin testing.
- Publish a summary report on aircraft auxiliary fuel tank testing.
- Publish a summary report of commuter airplane crash tests to develop seat and restraint guidelines.

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2005)	$82,274
FY 2006 Appropriated	5,881
FY 2007 Request	2,843
Out-Year Planning Levels (FY 2008-2011)	11,343
Total	102,341

Budget Authority ($000)	**FY 2003 Enacted**	**FY 2004 Enacted**	**FY 2005 Enacted**	**FY 2006 Enacted**	**FY 2007 Request**
Contracts:					
Advanced Materials	921	5,676	5,087	4,383	1,211
Structural Safety	797	202	96	174	165
Personnel Costs	1,058	1,234	1,345	1,247	1,394
Other In-house Costs	75	111	115	77	73
Total	**2,851**	**7,223**	**6,643**	**5,881**	**2,843**

OMB Circular A-11, Conduct of Research and Development ($000)	**FY 2003 Enacted**	**FY 2004 Enacted**	**FY 2005 Enacted**	**FY 2006 Enacted**	**FY 2007 Request**
Basic	0	0	0	0	0
Applied	2,851	7,223	6,643	5,881	2,843
Development (includes prototypes)	0	0	0	0	0
Total	**2,851**	**7,223**	**6,643**	**5,881**	**2,843**

A11c – Advanced Materials/Structural Safety Product and Activities	FY 2007 Request ($000)	Program Schedule					
		FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011
062-111 Advanced Materials Structures							
Advanced Materials	**$1,211**						
Validate analysis to predict residual strength after impact		♦					
Develop training course for maintenance of composite parts		♦					
Develop analytical models that predict durability of woven materials		♦					
Conduct teardown and destructive testing of aging composite aircraft		♦					
Ascertain the effect of stiffness loss due to damage for dynamic characteristics			◊				
Establish feasibility of embedded sensors to track damage			◊				
Develop safety criteria as they concern damage tolerance of fiber/metal laminates and friction stir welded joints			◊				
Develop chemical characterization tests to assure adequate surface preparation for bonded joints			◊				
Develop test and analysis protocols for repeated loads and damage threats				◊			
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	**$165**						
Conclude research on human neck injury criteria for side-facing seats		♦					
Publish final report on crash resistant fuel systems		♦					
Publish technical report on computer modeling of aircraft water impacts to help determine revised water impact requirements for rotorcraft		♦					
Compile summary report of commuter airplane crash tests to develop seat certification criteria		♦					
Compile summary report of auxiliary fuel tank crash and sled tests		♦					
Compile summary report of overhead stowage bin crash tests		♦					
Publish report on human neck injury criteria for side-facing seats			◊				
Publish summary report of auxiliary fuel tank testing			◊				
Publish summary report of commuter airplane crash tests			◊				
Publish Summary Report of Overhead Stowage Bin Testing			◊				
Develop neck injury certification criteria for side-facing seats				◊			
Develop enhanced occupant impact protection that can form the basis for improved certification guidelines and standards						◊	
Develop analytical modeling techniques of aircraft structures							◊
Personnel and Other In-House Costs	**$1,467**						
Total Budget Authority	**$2,843**	**$5,881**	**$2,843**	**$2,811**	**$2,824**	**$2,824**	**$2,884**

FAA Budget Appropriation	Budget Item	Program Title	Budget Request
R,E&D	A11.j.	Aeromedical Research	$6,962,000

Supports FAA Strategic Goals: Increased Safety, Greater Capacity, International Leadership, and Organizational Excellence.

The Aeromedical Research Program focuses on the effects of the human element on aviation safety as it:

- Investigates and analyzes injury and death patterns in civilian flight accidents and incidents to determine their cause and develop preventive strategies;
- Supports FAA regulatory and medical certification processes that develop safety and health regulations affecting the flight environments of all aerospace craft occupants; and
- Recommends and develops equipment, technology, and procedures for optimal:
  - Evacuation and egress of all humans from aerospace craft
  - Dynamic protection and safety of all humans on aerospace craft
  - Safety, security and health of all humans on aerospace craft.

By FY 2007, researchers will evaluate operational sensors to provide real-time detection and warning to ensure aircraft cabin air quality.

By FY 2008, researchers will develop the regulatory information necessary to update aircraft-specific cabin evacuation guidelines.

By FY 2009, researchers will develop enhanced medical/toxicological intervention methodologies to support standards and guidelines that will enhance the health, safety, and security of pilots, flight attendants and passengers.

Intended Outcomes: Program outcomes include the supporting studies that develop the regulatory information necessary to develop enhanced medical/toxicological intervention methodologies to support standards and guidelines that will enhance the health, safety, and security of pilots, flight attendants and passengers. Research program outcomes include improved safety, security, protection, survivability and health of aerospace craft passengers and aircrews. The Civil Aerospace Medical Institute (CAMI) is uniquely positioned to evaluate existing and exploit new bioaeronautical guidelines, standards, and models for aerospace craft cabin equipment, procedures, and environments. Aeromedical research underlies new regulatory action and evaluation of existing regulations to continuously optimize human performance and safety at a 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 situations 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; and
  - Enhanced egress, flotation and onboard life support/rescue equipment certification.
- Quantitative bioaeronautical data associated with:

  - Regulatory oversight of health, safety and security risks for flight deck, cabin crew, and other occupants;
  - Aerospace radiation and environmental factors and their threat to all aerospace craft occupants; and
  - 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; and
  - Aircrew medical standards, assessment/certification procedures, and pilot special medical issuance.

Customer/Stakeholder Involvement: The Aeromedical Research Program is consistent with the bioaeronautics agenda set forth in the 1995 *National Plan for Civil Aviation Human Factors: An Initiative for Research and Application.* The program is also an integral participant and research provider under the FAA, Joint Aviation Authorities, and the Transport Canada Aviation *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 program 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. Currently, the program is supporting the FAA's congressionally mandated National Center of Excellence for the Airliner Cabin Environment in its partnered research with academia, industry, and other governmental agencies as they evaluate cabin environmental safety, security and health. Scientists have actively participated in formulating proposed out year or "stretch" goal research projects that are consistent with the National Aviation Research Plan of 2006, including future needs of the national air transportation system.

Accomplishments: Program highlights include:

- Integrated toxicological and biomedical data on all aerospace craft accidents and significant incidents.

  In this ongoing effort, advanced integrated data analysis and recommendations are continuously provided to research sponsors. Current findings indicate that about one in five 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 in twelve is using a significant controlled dangerous substance. State-of-the-art techniques and methodologies are continuously developed and maintained in this world-class research program.

- Conducted biodynamic evaluations for test devices developed via FAA contracts with academic and government institutions.

  The test devices, a head-injury-criteria component tester and a seat cushion impact tester, were developed to support the FAA seat certification streamlining project. The objectives of the streamlining project are to reduce the cost and simplify seat certification testing while maintaining safety. Results from impact simulations using the alternative test devices were compared to results from dynamic impact sled tests to determine applicability and effectiveness. Test results indicated that the alternative test devices could realistically duplicate the sled tests in some conditions, and that further developmental work was required. In addition to impact testing, mathematical modeling was conducted to assess the performance of the test devices and to aid the development of modeling capability. Development of computer-modeling methods will help provide faster, safer, more cost-effective aircraft certification decisions.

- Used the computational fluid dynamics model of aircraft airflow and particle distribution, developed by the University of Tennessee and CAMI, to conduct development and testing of an aircraft cabin decontamination procedure.

  The aircraft decontamination testing was conducted under a Cooperative Research and Development Agreement (CRDA) with STERIS Corporation to evaluate the potential of a vaporized hydrogen peroxide process to decontaminate an aircraft. This technology may support a decontamination/rehabilitation process allowing aircraft contaminated with chemical or biological agents to be returned to operational status. The threats of terrorist attack, intensified by the events of 9/11/2001, and contagious disease transmission, such as SARS, have magnified requirements for this research thrust. Other research efforts with industrial organizations involving new methods to enhance cabin environmental quality has been initiated.

- Provided advisory materials for enhancing human health relative to in-flight cosmic and solar radiation exposures and cabin air quality via the Web and through other widely available media for all human occupants of aerospace craft.

  The system provided a near real-time warning of several FY 2004-2005 solar events, with recommendations for reduced aircraft flight altitudes and potential diversions for polar routes.

- Developed cabin evacuation computer models.

  Transport aircraft are currently certified by manned testing to determine if the aircraft evacuation capability meets requirements. These certification tests are expensive, can injure test subjects, and generally evaluate specific scenarios that may not be representative of actual evacuation requirements. Advancements in bioinformatics, and the high monitoring and research costs of human subject testing have led to development of cabin evacuation models to replace and/or streamline portions of the manned tests. These modeling efforts are under development.

R&D Partnerships: The program collaborates and leverages its research activities with many government and non-government organizations and agencies. Program staff members also cooperate directly on research processes with airlines and aircraft and manufacturers equipment manufacturers responsible for safety products such as seats, restraint systems, oxygen masks, and evacuation slides. They are integral members of the Cabin Safety Harmonization Working Group, Seat Certification Streamlining Effort, Airbus 380 Cabin Safety Working Group, and the National Safety Council. Staff members also hold memberships, fellowships, and leadership positions in all scientific, medical, and bioengineering societies associated with aerospace medicine and safety.

FAA program staff 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 DoD and NASA on human research issues involving crashworthiness, in-flight turbulence, aerospace medicine, ocular injury from lasers, and exposure to cosmic radiation. The research team works with NATO aerospace medical advisory groups, the European Union, and many independent scientific organizations and academic institutions. Additionally, the program develops Cooperative Research and Development Agreements with industry to develop collaborative projects that benefit both the FAA and the aviation industry.

National Research Council postdoctoral associates have conducted research in molecular biology and space medicine research studies at CAMI. Academic collaboration, which involves ten or more students and faculty participating each year in aeromedical research, rounds out the full scope of medical and scientific partnerships of this world-renown program.

MAJOR ACTIVITIES AND ANTICIPATED FY 2006 ACCOMPLISHMENTS

The program expects to achieve the following results in FY 2006:

- Complete:
  - Biodynamic evaluations of alternative test devices to streamline seat certification; and
  - 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 that takes note of factors such as:
  - The time required to prepare a narrow-body aircraft for clear air turbulence,
  - The effects of passenger knowledge on aircraft evacuation and cabin safety, and
  - The effectiveness of an enhanced narrow body cabin egress test facility designed to allow simulation of more aircraft types and configurations.
- Develop:
  - Support for FAA and American Society of Heating, Refrigeration and Air-conditioning Engineers cabin air quality assessment programs;
  - Recommendations for life support equipment and medical requirements in civilian spacecraft;
  - Advisory circulars, medical screening procedures and recommended vision standards for non-destructive inspection and non-destructive testing;
  - Research recommendations for Aviation Rule-Making Advisory Committee reviews of cabin air quality and altitude safety rules;
  - Advanced database technology to provide statistical and graphical analysis to evaluate medical certification criteria and mechanisms of injury in aircraft accidents/incidents; and
  - Research on crew and passenger safety requirements for very high altitude air or spacecraft.

FY 2007 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. Cabin safety, health, and security for all human occupants of civilian aerospace craft require careful, cost-effective certification and regulation. The following research will improve human safety, security, and health by providing 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 bioinformatic 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; and
  - Risk posed by pilots with special medical issuances.

- Recommend:
  - Safer aircraft cabin evacuation certification guidelines/procedures;
  - Effective limits to radiation exposure (laser and ionizing); and
  - 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 Functional genomics technology to support accident investigation and aerospace stressor/response analysis in humans.

New Initiatives

- Implement molecular biological techniques in forensic toxicological investigations of aircraft accidents.
- Support development of a coordinated research effort to define cabin air quality and analyze requirements for occupant protection and aircraft decontamination.
- Collect data, and conduct analysis and modeling of passenger/crew injury patterns in accidents and incidents.
- Publish guidelines for maintaining aircraft cabin occupant health to include re-evaluation of the effectiveness of automatic external defibrillators in the flight environment.

KEY FY 2007 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;
  - Use of molecular biological laboratory methods to enhance forensic toxicological investigation of aircraft accidents or incidents;
  - The 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; and
  - Accident experience of sport category pilots relative to medical certification requirements.
- Enhance guidelines for maintaining aircraft cabin occupant health, including the CARI-6 radio-biological computer program covering large solar particle events.
- Develop a process to evaluate the use of component tests and mathematical modeling for improved aircraft seat certification criteria and anthropomorphic test devices to establish the correlation of occupant injury and measured impact dynamics.

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2005)	$108,826
FY 2006 Appropriated	8,800
FY 2007 Request	6,962
Out-Year Planning Levels (FY 2008-2011)	29,026
Total	153,614

Budget Authority ($000)	**FY 2003 Enacted**	**FY 2004 Enacted**	**FY 2005 Enacted**	**FY 2006 Enacted**	**FY 2007 Request**
Contracts:					
Aeromedical Research	385	2,801	3,776	3,569	1,504
Personnel Costs	4,451	4,611	4,761	5,091	5,313
Other In-house Costs	1,357	1,418	1,542	140	145
Total	**6,193**	**8,830**	**10,079**	**8,800**	**6,962**

OMB Circular A-11, Conduct of Research and Development ($000)	**FY 2003 Enacted**	**FY 2004 Enacted**	**FY 2005 Enacted**	**FY 2006 Enacted**	**FY 2007 Request**
Basic	0	0	0	0	0
Applied	6,193	8,830	10,079	8,800	6,962
Development (includes prototypes)	0	0	0	0	0
Total	**6,193**	**8,830**	**10,079**	**8,800**	**6,962**

A11j – Aeromedical Research Product and Activities	FY 2007 Request ($000)	Program Schedule					
		FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011
086-110 Aeromedical Research							
Cabin Health and Environmental Guidelines	**$76**						
Assess flight crew health risks during a flying career		♦	◊	◊	◊	◊	◊
Support research conducted by industrial organizations to develop / analyze methods to detect / mitigate aircraft cabin contamination		♦	◊	◊	◊	◊	
Human Survival and Protection in Civil Aviation	**$577**						
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	**$851**						
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		♦	◊				
Conduct advanced aeromedical accident and pilot certification data analyses		♦	◊	◊	◊	◊	◊
Personnel and Other In-House Costs	**$5,458**						
Total Budget Authority	**$6,962**	**$8,800**	**$6,962**	**$7,044**	**$7,180**	**$7,304**	**$7,498**

FAA Budget Appropriation	Budget Item	Program Title	Budget Request
R,E&D	A11.e.	Aging Aircraft	$18,621,000

Supports FAA Strategic Goal: Increased Safety.

Intended Outcomes: The Aging Aircraft Program conducts research and development on technologies, technical information, procedures, and practices that help to ensure the continued airworthiness of the civil aircraft fleet. The program is reducing the number of accidents and incidents associated with the failure of aircraft structures, components, and systems, and is developing the knowledge, inspection tools, and techniques needed to prevent or mitigate the effects of safety hazards associated with aging airframe structures, engine components, and mechanical and electrical systems.

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 aging civil aircraft. Aging aircraft and continued airworthiness research focuses on:

- Assessing causes and consequences of widespread fatigue damage on aging aircraft structures;
- Ensuring the continued safe operation and airworthiness of aircraft electrical and mechanical systems;
- Applying nondestructive inspection techniques to detect and quantify damage such as cracking, corrosion, disbonding, and material processing defects;
- Acquiring, analyzing, and publishing operational loads usage data to provide technical substantiation for airworthiness standards and advisories associated with aircraft loads;
- Establishing damage-tolerant design and maintenance criteria for rotorcraft and commuter airplanes; and
- Standardizing methods and data for aircraft certification and continued airworthiness.

By FY 2008, the program will develop new technologies and tools to ensure the continued airworthiness of aircraft structures, components, and systems. It will provide new inspection tools, for example, to find damage such as small cracks in aircraft structures before they reach a critical size.

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 technical and policy materials to its field personnel and an additional limited distribution.

Customer/Stakeholder Involvement: Program researchers coordinate with an extensive network of government and industry groups, including:

- Subcommittee on Aircraft Safety of the FAA Research, Engineering and Development Advisory Committee – representatives from industry, academia, and other government agencies annually review the program's activities.
- Technical Community Representative Groups – FAA representatives apply formal guidelines to ensure that the program's research projects support new rule making and the development of alternate means of compliance with existing rules.
- The Aviation Rulemaking Advisory Committee – proposes cost-effective rule making and research to address aging aircraft issues.
- The Aging Transport Systems Rulemaking Advisory Committee – members make 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: The program has:

- Developed and flight tested two aircraft arc-fault circuit breaker (AFCB) prototypes. These devices are now in limited production, and at least two operators have installed them in select circuits on their commercial aircraft. The use of AFCBs is expected to reduce the incidence of electrically ignited in-flight fires and multiple-system failures resulting from cascading arc-faults.
- Completed several test programs addressing aircraft structural integrity using the Full-Scale Aircraft Structural Test Evaluation and Research Facility. 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 (MSD). Several areas of aircraft structural integrity research have been undertaken, including the initiation and development of MSD, effects of MSD on the residual strength behavior, and methods to reduce fatigue-related problems.
- Published a final report evaluating and verifying advanced methods to assess MSD of airframe structure.
- Developed and tested new and enhanced inspection technologies, and structural repair techniques, in support of rule making. To date, this effort has:
  - Completed a study that assessed traditional and advanced inspection devices for their ability to inspect composite honeycomb structures for damage such as disbonds;
  - Completed the development of a second generation thermosonic inspection prototype that can image widespread fatigue cracking and kissing disbonds;
  - Assessed the efficacy of second and third-layer crack inspection procedures and suggested procedural changes to improve crack detectability;
  - Developed an improved inspection prototype using magneto-optic technology with a demonstrated ability to sort rivets made from different materials efficiently and to detect previously undetectable small cracks; and
  - Validated a bonded composite repair patch methodology that is 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, for two typical small aircraft, that demonstrate the feasibility and practicality of maintaining older aircraft to safer and more effective damage-tolerance standards.
- Acquired, analyzed, and published numerous technical reports containing flight, landing, and ground load, operational usage data for civil transports and firefighting aircraft.
- In collaboration with the engine industry, developed and tested new and enhanced inspection technologies for nickel and titanium billet and titanium forgings. Techniques developed under this program, including a multizone ultrasonic inspection systems and phased array ultrasonic inspection systems, have greatly improved sensitivity over more conventional inspection techniques.
- Developed a micro-energy high-voltage wire test system that identifies insulation breaches that are likely to result in short circuiting or sparking.
- Published a report on handling qualities and flight safety implications of rudder control strategies and systems in transport aircraft.
- Published a report on engineering studies of the cleaning and drying process for fluorescent penetrant inspection.

R&D Partnerships: Program activities are closely coordinated with industry, and NASA and DoD initiatives. The FAA maintains interagency agreements with NASA, the U.S. Navy, the U.S. Air Force, and DOE. The FAA, DoD, and NASA have co-sponsored eight joint Aging Aircraft Conferences.

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

- The Joint Council on Aging Aircraft – leverages resources and coordinate the efforts of all DoD service organizations for common aging aircraft issues.
- The Center for Aviation Systems Reliability – a consortium of Iowa State University, Northwestern University, and Wayne State (leads) and several adjunct institutions.
- The Airworthiness Assurance Nondestructive Inspection Validation Center – an FAA program that collaborates with Sandia National Laboratory to test and evaluate inspection techniques and to enhance technology transfer.
- The Engine Titanium Consortium – formed by Iowa State University, Pratt and Whitney, General Electric, and Honeywell, to develop methods for the inspection of engine components.
- The National Institute for Aviation Research – resident at Wichita State University.
- The FAA Airworthiness Assurance Center of Excellence – a consortium of university and industry partners who conduct R&D for the FAA on a cost-matching basis.
- The Center for Aviation Research and Aerospace Technology – comprised of Ohio State University and the University of Dayton Research Institute.
- The National Rotorcraft Technology Center – comprised of the U.S. Army, U.S. Navy, FAA, and NASA.

In addition, the FAA has a number of Cooperative Research and Development Agreements with domestic and international airline operators as part of the flight loads data collection program.

MAJOR ACTIVITIES AND ANTICIPATED FY 2006 ACCOMPLISHMENTS:

- Publish interim results from the destructive evaluation and extended fatigue testing of fuselage sections taken from a retired Boeing 727 transport aircraft. These results will help to formulate policy regarding the use and interpretation of the teardown data in applications for continued airworthiness certification.
- Validate a remote field eddy current inspection prototype that can inspect aircraft landing gear lugs without bushing removal. Use of this technology will facilitate inspection of this critical area without costly disassembly required under the current inspection method.
- Demonstrate a highly automated rivet inspection system for large transport aircraft.
- Complete a field prototype of a low cost, generic scanning and imaging system that can be readily coupled to existing aircraft inspection devices to improve flaw detection in both metals and composites.
- Complete a first-phase prototype of a magnetic carpet probe for rapid and wide-area inspection of aircraft engine critical rotating components and perform laboratory assessment of its capability. The prototype will be evaluated to determine if it accomplishes faster, more consistent and reliable inspections than the fluorescent penetrant inspection process currently used.
- Test nondestructive electrical wiring inspection technologies under operational conditions. These include the Indenter inspection system and the Micro-Energy/Pulse Arrested Spark Discharge inspection system.
- Publish:

- A capability report on emerging inspection technologies with application to detect cracks, disbonds and corrosion;
- A report on inspection development for titanium forgings;
- A report on inspection development for large diameter titanium billets used in forging critical rotating components in aircraft turbine engines;
- A report on the study of aircraft propeller corrosion processes and their effect on fatigue life;
- A report on updated default probability of detection curves used for life analyses of critical rotating components in aircraft turbine engines;
- An operational loads monitoring report for the A-340/300 and A-340/600 airplanes used in typical revenue operations;
- A report documenting failure risk analyses of the Boeing 757 elevator control system and the Airbus A320 rudder control system;
- The FAA Health and Usage Monitoring Systems (HUMS) R&D Strategic Plan;
- A report on the development of reliability-based damage tolerance methodology for rotorcraft structures;
- A report on the evaluation of nondestructive inspection and test systems for commercial-off-the-shelf electrical wiring interconnect systems;
- A report on the visual inspection results of Boeing 737 and 747 aircraft dual load path flight control components; and
- A report on certification standards and design issues for rudder control systems in transport aircraft.

FY 2007 PROGRAM REQUEST:

Ongoing Activities

The program will continue to focus on developing technologies, technical information, procedures, and practices that help ensure the continued airworthiness of aircraft structures and systems in the civil aircraft fleet. Rotorcraft research will continue in the areas of damage tolerance and health and usage monitoring systems. Researchers will also continue efforts on aging aircraft systems, structural integrity research, structural inspection research, commuters, and flight loads.

New Initiatives

New flight control system research will begin in FY 2007. The Agency will initiate research on in-service control force characteristics and responses of existing transport aircraft. Data and analysis will be used to assess and update control systems certification and operations standards in the Federal Aviation Regulations. Existing requirements may not adequately address present transport pilot demographics and associated abilities to apply necessary forces to the flight control system.

KEY FY 2007 PRODUCTS AND MILESTONES:

- Publish final results from the destructive evaluation and extended fatigue testing of fuselage sections taken from a retired Boeing 727. The results of this project will help formulate policy regarding the use and interpretation of the teardown data in applications for continued airworthiness certification.
- Complete the testing of second-generation (115Volt/3-phase and 28Volt DC) arc-fault circuit breakers. The circuit breakers will reduce the possibility electrically ignited fires on aircraft.
- Complete the development of the Pseudo Random Binary Sequence Reflectometry prototype for the inspection of aircraft wiring. This technique applies a random digital code to aircraft wire to analyze the signal distortion and assess the safety of the insulation.

- Complete research and development of the Advanced Risk Assessment Tool for Aircraft Electrical Systems.
- Complete a study to assess capabilities of traditional and advanced inspection devices to detect hidden flaws in thick composite laminates.
- Complete a second-phase prototype of magnetic carpet probe for rapid and wide area inspection of aircraft engine critical rotating components. Also perform a laboratory assessment of this capability and evaluate the prototype for field implementation.
- Complete an assessment study of variables affecting the performance of fluorescent penetrant inspection.
- Publish operational loads data reports for the Boeing B-737/700 and Embraer ERJ135/140/145 airplanes. Data from these reports will provide the data needed to assess the currency of certification and design assumptions used in aircraft certification.
- Publish a technical report on a landing loads survey conducted at Cincinnati International Airport. This report will contain regional jet landing data from over 500 landings captured with the FAA video landing data acquisition system.
- Publish findings of an emergency evacuation system study. The study will identify causes and solutions to the most critical failure modes of emergency escape slides and doors.
- Publish findings of a mechanical systems risk assessment study. This research will explore and develop methodologies for analyzing and locating areas of potentially catastrophic mechanical system failure.
- Complete destructive teardown evaluations to determine the airworthiness of two aged commuter-class airplanes – a Piper Navajo and a Beech 1900D.
- Complete assessment and validation of fatigue crack growth and threshold data test methodologies for propeller and rotorcraft. The results will be used to support revision of AC-29.2A and 27.1A.

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2005)	$336,581
FY 2006 Appropriated	19,807
FY 2007 Request	18,621
Out-Year Planning Levels (FY 2008-2011)	70,812
Total	445,821

Budget Authority ($000)	**FY 2003 Enacted**	**FY 2004 Enacted**	**FY 2005 Enacted**	**FY 2006 Enacted**	**FY 2007 Request**
Contracts:					
Aging Aircraft	25,000	15,633	13,852	14,881	14,211
Personnel Costs	4,100	4,478	4,609	4,631	4,159
Other In-house Costs	308	387	537	295	251
Total	**29,408**	**20,498**	**18,998**	**19,807**	**18,621**

OMB Circular A-11, Conduct of Research and Development ($000)	**FY 2003 Enacted**	**FY 2004 Enacted**	**FY 2005 Enacted**	**FY 2006 Enacted**	**FY 2006 Request**
Basic	0	0	0	0	0
Applied	29,408	20,498	18,998	19,807	18,621
Development (includes prototypes)	0	0	0	0	0
Total	**29,408**	**20,498**	**18,998**	**19,807**	**18,621**

A11e - Aging Aircraft Product and Activities	FY 2007 Request ($000)	Program Schedule					
		FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011
065-110 Aging Aircraft							
Structural Response Simulation And Modeling	**$1,026**						
Continue support for aging transport aircraft structural integrity and provide information for policy guidance		♦	◊	◊	◊	◊	
Inspection Systems Research And Development	**$1,974**						
Develop crack detection technologies including pulsed eddy current for aircraft lug inspection		♦	◊	◊			
Develop corrosion and disbond inspection systems		♦	◊	◊	◊		
Perform validation of inspection technologies		♦	◊	◊	◊	◊	
Conduct fluorescent penetrant inspection research		♦	◊	◊	◊		
Develop enhanced aircraft repair techniques for bonded repairs		♦	◊	◊			
Airborne Data Monitoring Systems	**$901**						
Publish reports on large transports and commuter loads surveys		♦	◊	◊	◊		
Structural Integrity Of Commuter Aircraft	**$737**						
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	**$5,093**						
Develop rotorcraft damage tolerance methodologies		♦	◊	◊	◊		
The FAA HUMS Research Strategic Plan		♦					
Conduct research on the installation of HUMS and its use for maintenance credit		♦	◊	◊	◊	◊	◊
Aging Mechanical Systems	**$2,053**						
Publish report on visual inspection of dual path flight control components		♦					
Publish report on risk assessment for aging mechanical systems			◊				
Aging Electrical Systems	**$2,427**						
Conduct wire degradation assessment		♦	◊	◊	◊		
Develop and test wire inspection equipment		♦	◊	◊			
Develop advanced circuit protection devices including second generation arc-fault circuit breaker		♦	◊	◊	◊		
Complete advanced risk assessment tool for aircraft electrical systems		♦					
Flight Controls Research							
Conduct study on in-service control force characteristics and responses of existing transport aircraft			◊	◊	◊	◊	
Personnel and Other In-House Costs	**$4,410**						
Total Budget Authority	**$18,621**	**$19,807**	**$18,621**	**$17,962**	**$17,765**	**$17,412**	**$17,673**

FAA Budget Appropriation	Budget Item	Program Title	Budget Request
R,E&D	A11.i.	Air Traffic Control/Technical Operations Human Factors	$9,654,000

Supports FAA Strategic Goals: Increased Safety, Greater Capacity, and Organizational Excellence.

Intended Outcomes: The Air Traffic Control/Technical Operations (ATC/TO) Human Factors Program develops research products that will help meet the demands of future air traffic loads and decrease the likelihood of operational errors. The Program is developing tools to reduce the risk of runway incursions, developing an improved reporting and analysis technique for operational errors, and enhancing the understanding of the role that ATC sector characteristics play in the probability of experiencing an operational error. The program is also providing material to reduce accidents associated with the performance of controllers, system maintainers, and others who fill important safety roles. In addition, researchers are determining effective methods to present weather information to air traffic specialists for severe weather avoidance, developing methods to select ATC training candidates so that the applicant screening process is valid, reliable, and fair, and improving human-system integration in a manner that allows controllers to manage an increased number of aircraft in the sector while reducing task loading.

By FY 2008, researchers will complete evaluations of the JANUS operational error and analysis tool, and will analyze data emerging from newly enhanced databases that allow the identification of causal factors of human error in Air Traffic Control operations. The JANUS evaluations will focus on identifying systemic problems to determine mitigation actions. The research team will develop and assess improved methods to select successful candidates for the ATC work force and measure their performance during training. Additionally, the program will support organizational excellence goals by analyzing data emerging from the web-based version of the FAA Employee Attitude Survey.

The ATC/TO research program works to improve system safety by:

- Developing:
  - System safety tools for human factors practitioners to proactively identify human error hazards during early stages of acquisition;
  - New safety reporting and investigative tools to mitigate ATC operational errors and TO incidents; and
  - Effective methods to present weather information to air traffic specialists for severe weather avoidance.
- Improving:
  - Effectiveness of safety programs by tracking the frequency of incidents at the facility level to determine if the interventions are having the desired effect; and
  - Methods to select ATC training candidates so that the applicant screening process is valid, reliable, and fair.

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

- Developing:
  - Integrated workstations ensuring interoperability of tools and information using human factors standards.
- Improving:
  - Human-system integration in a manner that allows controllers to manage an increased number of aircraft in the sector while reducing task loading; and

- Roles and responsibilities between air traffic service providers and pilots as technology evolves to meet future demands.

Agency Outputs: The 1995 National Plan for Civil Aviation Human Factors: An Initiative for Research and Application provides a technical framework 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 to improve operator performance and reduce errors; and
- Selection and Training – applying program-generated knowledge of human factors to improve selection and training of aviation system personnel.

The program provides customers with products that support the Administrator's Flight Plan and the Air Traffic Organization Business Plan. It also participates in broader planning efforts affecting the future National Airspace System, such as the Inter-Agency Joint Planning and Development Office's Next Generation Air Transportation System Integrated Plan. The Program focuses on the achievement of Agency goals and the role that humans play in their achievement. Improvements in how errors are investigated and reported will foster effective safety interventions.

Customer/Stakeholder Involvement: The ATC/TO Human Factors research program receives requirements from its internal FAA sponsoring organizations. The Human Factors program receives recommendations and guidance primarily from the following FAA Air Traffic Organization Air Traffic/Technical Operations research groups:

- Advanced Air Traffic Systems Research Group – ATC personnel and systems developers articulate human factors research requirements for measuring the benefits of proposed technologies to controllers and maintainers.
- Individual and Team Performance Research Group – identifies human factors/human performance research needs involving age, operational errors, runway incursion prevention, and employee attitudes.
- Technical Operations Research Group – recommends research for operation and maintenance of the NAS infrastructure including specification of displays, controls, and maintainability features of AT systems.
- Personnel Selection Research Group – addresses personnel selection and retention including the ability to successfully screen applicants for controller positions, and the need to reduce training cost and time.

Accomplishments: Program highlights include:

Advanced Air Traffic Systems

- Performed a series of human-in-the-loop simulations and assessments that better integrate the user into the en route controller workstation concepts proposed to manage the traffic load projected in the 2015 time frame.
- Performed analyses and simulations to reduce controller dependence on flight progress strips. Flight data were used in an integrated workstation to enable a more efficient flow of traffic on the airport surface, provide memory aids to prevent operational errors, and reduce controller communication workload.

- Performed a simulation to assess the benefits of improved weather product displays in the terminal environment for severe weather avoidance and capacity enhancement.

Individual and Team Performance

- Implemented a new method for the reporting and analysis of operational errors at an ATC facility using the web-based JANUS tool to improve the determination of causal factors.
- Developed a refined set of measures of employee attitudes to act as leading indicators of organizational performance and potential problem areas.

Technical Operations

- Completed an initial effort to transform safety culture in the TO work force.
- Continued data collection to update the anthropometric database to guide the ergonomic design of maintenance workstations.
- Developed and distributed a tool to aid in the mitigation of fatigue within the TO workforce.

Personnel Selection

- Continued the development of secure and equivalent forms of the Air Traffic Selection and Training (AT-SAT) test battery for controller selection.
- Developed the rapid and objective capability to evaluate the specific and changing technical knowledge, skills and abilities of job applicants for FAA TO positions.

R&D Partnerships: Collaborative research with EUROCONTROL addresses human error in the design and operation of ATC systems. This activity includes participation in semi-annual Air Traffic Management Seminars. In addition, program personnel play an active role in the Normal Operations Study Group of the International Civil Aviation Organization and routinely participate in the Interagency Integrated Product Team, which provides a framework for coordination with NASA and MITRE. An area of particular interest is ensuring that human factors considerations are integrated at the appropriate technology readiness levels.

MAJOR ACTIVITIES AND ANTICIPATED FY 2006 ACCOMPLISHMENTS:

Advanced Air Traffic Systems

- Establish human performance benefits in terms of safety and capacity when using enhanced weather products, such as storm movement and wind shear, at the terminal controller's workstation.
- Demonstrate candidate electronic flight data handling systems for the tower to reduce runway incursions and enhance human performance supporting increased airport throughput.
- Assess the effectiveness of automated methods to perform routine repetitive tasks at the controller workstation.

Individual and Team Performance

- Complete analysis of operational error causal factors related to time-on-position.
- Research causal factors feedback from controllers to facilitate operational error reduction.
- Analyze the initial set of ATC operational error data generated by the JANUS tool to determine if it should be nationally deployed.
- Evaluate the effectiveness of safety culture interventions in the TO work force.

Technical Operations

- Continue to update the database of anthropometric measurements of the TO work force.
- Complete a set of recommendations to improve the communications and coordination process in TO organizations.

Personnel Selection

- Complete an initial assessment of the impact of new technology on the screening for new controllers.
- Complete a parallel form to the AT-SAT test battery.
- Complete the longitudinal validation of screening and testing tools used to select job applicants.

FY 2007 PROGRAM REQUEST

The proposed program supports research that addresses human performance issues in the acquisition, design, operation, and maintenance of ATC systems over the next several years.

Ongoing Activities:

The proactive analysis of causal factors will help prevent human error during system operation and maintenance. Researchers developed a tool to analyze human error and are applying that tool to system design and proposed changes to ATC procedures. This tool can be applied to procedures, concepts of operation, and system design to identify the hazards associated with human error. The program will also continue its work in human error analysis and reporting by expanding the use of JANUS to prevent operational errors that contribute to runway incursions.

Program researchers will also continue to: develop displays for advanced flight data handling techniques; develop methods to assess the impact of autonomous flights versus radar positive control; evaluate candidate methods to reduce runway incursions; assess intra-team communications to reduce operational errors; and, assess the complexity of airspace and ATC displays. Research will also continue to refine air traffic selection processes using the results of the updated Job Task Analysis activities to derive measures of controller performance for use in selection, training, and system development.

New Initiative:

The lack of human performance data to guide investment decisions on workstation design has limited the ability to capitalize on opportunities for improved human-system performance. In FY 2007, researchers will develop a prototype workstation integration platform test bed to support development of FAA's Standard Automation Platform in the Enterprise Architecture. NASA, MITRE, and MIT Lincoln Laboratory reseachers will use this platform as part of the ATC research program. In FY 2008 and beyond, researchers will conduct human-in-the-loop simulations using this platform to generate human performance data. They will also conduct human systems integration analyses to determine productivity, capacity, and safety benefits associated with decision support tools, displays, and other concepts proposed by external organizations for inclusion in future controller workstations.

KEY FY 2007 PRODUCTS AND MILESTONES:

Advanced Air Traffic Systems

- Initiate development of a workstation integration platform test bed to provide early evaluations of proposed controller roles and responsibilities related to decision support tools, concepts of operation, and procedures and to determine the contribution of each concept.
- Conduct a simulation of a set of prototypes for the integrated display and control of flight data in towers to determine the benefits of such systems and to determine if any of the conceptual systems is effective.
- Conduct investigations of human factors concepts for standard automation platforms usable by controllers in converging TRACON and en route domains.

Individual and Team Performance

- Introduce the JANUS Flight Tool to enhance the reporting and analysis of runway incursions by pilots and controllers to provide data on underlying causal factors.

- Increase the number of facilities applying techniques to improve and transform safety culture in the TO work force.
- Expand use of proactive human error analysis techniques to include ATC tasks and procedures.

Technical Operations

- Deliver a database of anthropometric measures of the TO work force to be used in the design of workstations and systems.
- Develop criteria for TO system design to reduce the probability of human error.
- Complete the investigation of redundant activities in TO communication and coordination.

Personnel Selection

- Develop databases and analytical techniques to provide longitudinal validation of AT-SAT for future controller selection criteria.
- Deliver the Job Task Analysis for terminal controllers to be used in development of performance measures in the controller training and evaluation process.

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2005)	$142,894
FY 2006 Appropriated	9,558
FY 2007 Request	9,654
Out-Year Planning Levels (FY 2008-2011)	38,880
Total	200,986

Budget Authority ($000)	**FY 2003 Enacted**	**FY 2004 Enacted**	**FY 2005 Enacted**	**FY 2006 Enacted**	**FY 2007 Request**
Contracts:					
Air Traffic Control/Airway Facilities Human Factors	1,742	2,747	2,756	4,234	4,130
Personnel Costs	4,002	4,445	4,765	5,079	5,285
Other In-house Costs	1,646	1,654	1,870	245	239
Total	**7,390**	**8,846**	**9,391**	**9,558**	**9,654**

OMB Circular A-11, Conduct of Research and Development ($000)	**FY 2003 Enacted**	**FY 2004 Enacted**	**FY 2005 Enacted**	**FY 2006 Enacted**	**FY 2007 Request**
Basic	0	0	0	0	0
Applied	7,390	8,846	9,391	9,558	9,654
Development (includes prototypes)	0	0	0	0	0
Total	**7,390**	**8,846**	**9,391**	**9,558**	**9,654**

A11i – Air Traffic Control/Technical Operations Human Factors Product and Activities	FY 2007 Request ($000)	Program Schedule					
		FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011
082-110 Air Traffic Control/Technical Operations Human Factors							
Advanced Air Traffic Systems	**$1,383***						
Conduct an advanced integrated workstation assessment		♦	◊	◊	◊	◊	◊
Develop weather information requirements for en route		♦	◊	◊			
Assess HF aspects of tower electronic flight data handling		♦	◊	◊			
Develop HF concepts for converging en route and terminal		♦	◊	◊	◊	◊	◊
Individual and Team Performance	**$1,450**						
Expand the use of E-JANUS		♦	◊	◊	◊		
Introduce the JANUS tool to reporting/analysis of runway incursions by pilot/controllers		♦	◊	◊	◊	◊	◊
Increase the number of facilities applying techniques to transform safety cultures in the work force		♦	◊	◊	◊		
Technical Operations	**$800**						
Complete the review of communications/coordination with field services		♦	◊	◊	◊	◊	◊
Develop TO HF design specifications		♦	◊	◊			
Develop HF aspects of outage and human error reporting		♦	◊	◊	◊		
Personnel Selection	**$497**						
Develop successful ATCS applicant profile		♦	◊	◊	◊		
Conduct AT-SAT longitudinal validation		♦	◊	◊	◊	◊	◊
Assess impact of new technology on selection and training		♦	◊	◊	◊		
Personnel and Other In-House Costs	**$5,524**						
Total Budget Authority	**$9,654**	**$9,558**	**$9,654**	**$9,592**	**$9,667**	**$9,702**	**$9,919**

FAA Budget Appropriation	Budget Item	Program Title	Budget Request
R,E&D	A11.f.	Aircraft Catastrophic Failure Prevention Research	$1,512,000

Supports FAA Strategic Goal: Increased Safety.

Intended Outcomes: The Aircraft Catastrophic Failure Prevention Research Program develops technologies and methods to assess risk and prevent occurrence of potentially catastrophic defects, failures, and malfunctions in aircraft, aircraft components, and aircraft systems. Its researchers assess the use of advanced materials to protect aircraft critical systems and passengers in the event of catastrophic engine failures. The program also uses historical accident data and National Transportation Safety Board recommendations to examine and investigate:

- Turbine engine uncontainment events, including the mitigation and modeling of aircraft vulnerability at uncontainment parameters stated in Advisory Circular (AC) 20-128, Phase II; and
- Propulsion malfunction indications research in response to Aerospace Industries Association (AIA) recommendations and proposed solutions.

In FY 2008, the program will conduct research needed to develop and publish guidelines for the use of explicit finite element analysis for engine failure analysis.

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 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:

- Subcommittee on Aircraft Safety of the FAA Research, Engineering and Development Advisory Committee – representatives from industry, academia, and other government agencies annually review the program's activities.
- Technical Community Representative Groups – FAA representatives apply formal guidelines to ensure that the program's research projects support new rule making and development of alternate means of compliance with existing rules.
- The Aviation Rulemaking Advisory Committee (ARAC) – helps to ensure the effectiveness of the Agency's rule making. Members of the subcommittee and full committee identify research requirements and priorities, provide guidance for the update of documents such as AC20-128, and encourage 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 and academia under the Airworthiness Assurance Center of Excellence (AACE) to perform technology transition of armor technologies for engine containment and engine rotor burst protection.
- The AIA Transport Committee – with participation of the FAA and industry, has examined propulsion system malfunctions, identified inappropriate crew response, and recommended development of specific regulations and advisory materials to correct safety hazards. AIA

has completed some preliminary efforts on propulsion issues with implications for follow-on ARAC work on FAR 25.1305.

Accomplishments: Results of Aircraft Catastrophic Failure Prevention Program research provide the technical basis for FAA rule changes as well as new or modified ACs. Researcher 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 (UEDDAM), version 2.02 for evaluation of uncontained engine debris hazards to aircraft for ARAC evaluation and comment.
- Conducted a workshop for DoD and ARAC on UEDDAM.
- 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.
- Completed a mitigation test for uncontained engine failure damage to pressurized fuel lines.
- Completed research for the University California Berkeley (UCB) 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 research on the Arizona State University (ASU) AACE grant on "Explicit Finite Element Analysis Modeling of Multi-Layer Composite Fabric for Gas Turbine Engine Containment Systems, Phase I." A significant database of small and full-scale test data was developed to understand the interaction of multiple layers in containment systems.
- Completed work for the UCB AACE grant on "Statistical Testing of Aluminum, Titanium, Lexan, and Composites for Transport Airplane Rotor Burst Fragment Shielding, Phase I." Test data developed under the program was used to improve analytical modeling of fabric shielding.
- Conducted two workshops for engine certification engineers on non-linear finite element modeling of containment systems.
- Completed work on the UCB AACE grant on "Lightweight Ballistic Protection of Flight-Critical Components on Commercial Aircraft, Phase II." This effort developed fabric attachment data and designs for fuselage shielding.
- Completed full-scale fabric shielding demonstration test of various fabric attachment designs (developed under the AACE grant with UCB) at Naval Air Warfare Center (NAWC), China Lake.

Propulsion Malfunction

- Completed a report describing an in-depth analysis of 80 in-service propulsion system malfunctions and recommendations for propulsion indication improvement.
- Completed Phase II work on Propulsion System Malfunctions. Phase II performed detailed study of malfunctions classified as Sustained Thrust Anomalies.

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

- Interagency agreement with NAWC Weapons Division, China Lake – with industry, modifies tools for analyzing the vulnerability of commercial transport aircraft to turbine engine uncontainment events.

- AACE grant with 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 UCB – with Boeing and SRI International, develops "Lightweight Ballistic Protection of Flight-Critical Components on Commercial Aircraft."
- The Defense Advanced Research Projects Agency, NAVAIR, U.S. Air Force, and NASA Glenn Research Center partnership – develops and demonstrates engine disk crack detection technologies.
- AACE grant with George Washington University (GWU), National Crash Analysis Center for aviation users guidance on "Explicit Finite Element Analysis of Uncontained Aircraft Engine Failure."

MAJOR ACTIVITIES AND ANTICIPATED FY 2006 ACCOMPLISHMENTS:

Engine Uncontainment Research

- Continue NASA/FAA sponsored quality control program for modeling aircraft problems in the manufacturer's supported finite element code (LSDYNA).
- Complete AACE grant (ASU) – Phase II testing of fabric gas turbine engine containment system.
- Complete AACE grant (UCB) – "Modeling, Analysis and Testing of Metallic and Composite Shielding."
- Complete AACE grant (GWU) – "Explicit Finite Element Analysis of Uncontained Aircraft Engine Failure."
- Complete UEDDAM, version 3.0.

Propulsion Malfunction

- Continue Phase III effort on Propulsion Malfunction Indications to study engine mechanical damage.

FY 2007 PROGRAM REQUEST:

Ongoing Activities

Uncontained engine failure mitigation research will continue to develop vulnerability models. The current effort will evaluate improved penetration equations for composite structure and develop a tutorial for how to use the suite of tools developed for uncontained engine failure mitigation. Model development and conversion into geometry suitable for vulnerability analysis from computer aided design tools will be a primary focus based upon industry feedback.

Research will continue on the NASA/FAA quality control program for modeling aircraft engine failures in LSDYNA. The AACE grant to GWU will support development of guidelines and validated generic aerospace models that verify various portions of the code with sample problems. This effort is also developing a workshop series for aerospace users as part of the bi-annual LSDYNA users conference.

New Initiatives

No new initiatives are planned in FY 2007.

KEY FY 2007 PRODUCTS AND MILESTONES:

Engine Uncontained Research

- Improve material models for incorporation into the LSDYNA model.

- Complete uncontained engine crack detection demonstration.

Propulsion Malfunction

- Complete propulsion malfunction indication recommendations for engines with mechanical damage.

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2005)	$29,053
FY 2006 Appropriated	3,306
FY 2007 Request	1,512
Out-Year Planning Levels (FY 2008-2011)	5,888
Total	39,759

Budget Authority ($000)	**FY 2003 Enacted**	**FY 2004 Enacted**	**FY 2005 Enacted**	**FY 2006 Enacted**	**FY 2007 Request**
Contracts:					
Aircraft Catastrophic Failure Prevention Research	1,319	259	833	2,703	947
Personnel Costs	463	468	241	566	533
Other In-house Costs	27	31	33	37	32
Total	**1,809**	**758**	**1,107**	**3,306**	**1,512**

OMB Circular A-11, Conduct of Research and Development ($000)	**FY 2003 Enacted**	**FY 2004 Enacted**	**FY 2005 Enacted**	**FY 2006 Enacted**	**FY 2007 Request**
Basic	0	0	0	0	0
Applied	1,809	758	1,107	3,306	1,512
Development (includes prototypes)	0	0	0	0	0
Total	**1,809**	**758**	**1,107**	**3,306**	**1,512**

A11f - Aircraft Catastrophic Failure Prevention Research Product and Activities	FY 2007 Request ($000)	Program Schedule					
		FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011
066-110 Aircraft Catastrophic Failure Prevention Research							
Engine Uncontainment Research	**$947**						
Complete AACE grant (ASU) - Phase II testing of fabric gas turbine engine containment system		♦					
Complete AACE grant (UCB) – "Modeling, Analysis and Testing of Metallic and Composite Shielding"		♦					
Complete AACE grant (GWU) - "Explicit Finite Element Analysis of Uncontained Aircraft Engine Failure"		♦					
Complete version 3.0 of UEDDAM vulnerability code		♦					
Complete uncontained engine disk crack detection test			◊				
Improve material models for incorporation into the LSDYNA model			◊				
Complete AACE grant (GWU) - "Explicit Finite Element Analysis of Uncontained Aircraft Engine Failure, Phase II"				◊			
Publish guidelines for the use of explicit finite element analysis for engine failure analysis				◊			
Develop prototype engine crack detection system					◊		
Develop dry bay mitigation recommendations						◊	
Propulsion Malfunction	**$0**						
Continue Phase III on Propulsion Malfunction Indications to study engine mechanical damage		♦					
Develop propulsion malfunction indications for engines with mechanical damage			◊				
Develop recommendations for propulsion monitoring system					◊		
Conduct propulsion monitoring flight test							◊
Personnel and Other In-House Costs	**$565**						
Total Budget Authority	**$1,512**	**$3,306**	**$1,512**	**$1,476**	**$1,472**	**$1,457**	**$1,483**

FAA Budget Appropriation	Budget Item	Program Title	Budget Request
AIP	N/A	Airport Cooperative Research Program	$10,000,000

Supports FAA Strategic Goals: Increased Safety, Greater Capacity, and International Leadership.

Intended Outcomes: The Airport Cooperative Research Program (ACRP) was mandated by Congress in Vision 100-Century of Aviation Reauthorization Act. Its purpose is to carry out applied research on problems that are shared by airport operating agencies and that are not being adequately addressed by existing federal research programs.

The ACRP was authorized as a four-year pilot program. Research projects will be selected by an independent governing board of airport managers and others appointed by the Secretary of Transportation.. The program will be administered by the Transportation Research Board (TRB) through a Memorandum of Agreement (MOA) with the FAA.

Research projects will be solicited annually by the TRB. Research will be conducted in areas of significant interest to airports including their operations, management and planning, environmental concerns, and capacity issues.

The research will lead to improvements in airport safety, capacity, and efficiency as well as to reductions in environmental impact from airport noise and the runoff of airport deicing and anti-icing activities.

Agency Outputs:

ACRP research will be conducted as relatively low cost studies lasting one to two years and will result in reports published by the TRB for use by the airport community.

Customer/Stakeholder Involvement:

The TRB will annually solicit research topics from airports, educational institutions, and the aviation industry. Technical panels will review the proposals and make recommendations to the ACRP regarding which research projects to fund. Other federal agencies concerned with airport research, including NASA and the Environmental Protection Agency, will serve with the FAA on the ACRP Governing Board. The airport community will be represented on the Board by airport managers and representatives from the Airports Council International (ACI), the American Association of Airport Executives (AAAE).

Accomplishments:

An MOA has been drafted between the FAA and the TRB to implement the ACRP. This is a new program that was first funded by $3M in FY 2005. Actual research projects will not start until late in FY 2005.

R&D Partnerships:

ACRP is a cooperative partnership with airports and federal agencies to conduct airport research. The research will be conducted by universities, airports, and companies within the aviation industry.

MAJOR ACTIVITIES AND ANTICIPATED FY 2006 ACCOMPLISHMENTS:

The FAA has coordinated development of an MOA between itself and the TRB to implement the ACRP. The agreement has been coordinated with industry through the assistance of the ACI and the AAAE.

The TRB has solicited for research projects and received over 70 proposals.

FY 2007 PROGRAM REQUEST:

Vision 100 authorized $10M per year for the ACRP. $3M was appropriated in FY 2005. In FY 2006, the FAA has requested $10M for the ACRP as part of the Airport Improvement Program.

Technical panels administered by the TRB will review research proposals submitted by airports, universities, and the aviation industry to select the most promising projects for funding.

KEY FY 2007 PRODUCTS AND MILESTONES:

TRB published reports documenting the airport research to be conducted.

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2005)	$0
FY 2006 Appropriated	9,900
FY 2007 Request	10,000
Out-Year Planning Levels (FY 2008-2011)	40,000
Total	$59,900

Budget Authority ($000)	**FY 2003 Enacted**	**FY 2004 Enacted**	**FY 2005 Enacted**	**FY 2006 Enacted**	**FY 2007 Request**
Contracts:					
Airport Cooperative Research Programs					
Personnel Costs	0	0	0	9,900	10,000
Other In-house Costs	0	0	0	0	0
Total				**9,900**	**10,000**

OMB Circular A-11, Conduct of Research and Development ($000)	**FY 2003 Enacted**	**FY 2004 Enacted**	**FY 2005 Enacted**	**FY 2006 Enacted**	**FY 2007 Request**
Basic	0	0	0	0	0
Applied	0	0	0	0	0
Development (includes prototypes)				9,900	10,000
Total				**9,900**	**10,000**

Airport Cooperative Research Program Product and Activities	FY 2007 Request ($000)	Program Schedule					
		FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011
Airport Cooperative Research Program							
Safety-Related Research	**$5,000**						
Conduct research on selected proposals			◇	◇	◇	◇	◇
Other Subtask(s) (TBD)			◇	◇	◇	◇	◇
Capacity-Related Research	**$5,000**						
Conduct research on selected proposals			◇	◇	◇	◇	◇
Other Subtask(s) (TBD)			◇	◇	◇	◇	◇
Total Budget Authority	**$10,000**	**$9,900**	**$10,000**	**$10,000**	**$10,000**	**$10,000**	**$10,000**

◆ - 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 5, NOT THE PROGRAM BUDGET LINE ITEM.
* DETAILED TASKING STRUCTURE FOR THIS PROGRAM IS CURRENTLY UNDER DEVELOPMENT.

FAA Budget Appropriation	Budget Item	Program Title	Budget Request
AIP	N/A	Airports Technology Research – Capacity	$8,503,000

Supports FAA Strategic Goals: Increased Safety, Greater Capacity, and International Leadership.

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 (AC) 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, the FAA is 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 NAPTF and dedicated it on April 12, 1999; began testing at the facility on June 4, 1999.
- In FY2004, completed reconstruction and full-scale traffic testing of three concrete pavement test items at the NAPTF.
- In FY2005, completed overlay construction at the NAPTF and conducted full-scale traffic testing of three asphalt concrete overlay test sections (rubblized sections as well as conventional overlay).
- Issued Layered Elastic Design (LED)FAA version 1.3, a pavement design-standard software based on NAPTF-generated data, to allow the introduction of the Airbus A380 and other new aircraft into the fleet mix.
- Completed a beta test of the FEDFAA, a pavement design computer program that incorporatates 3D finite element models.
- Conducted technical workshops in airport pavement design using FEDFAA and LEDFAA version 1.3.
- Maintained an airport pavement data base containing full-scale test data collected at the NAPTF, and gave on-line access to international researchers.

- Established or expanded cooperative programs with non-profit research foundations, located at the Innovative Pavement Research Foundation (IPRF) and Auburn University, to conduct research into concrete and asphalt airport pavement technology. In FY 2005, completed an IPRF report on the use of stabilized and drainable bases in the design and construction of airport pavements.
- Established a new Interagency Agreement with the U.S. Army Engineer Research and Development Center (ERDC) to cooperate on research projects of interest to both military and civil aviation.
- In FY 2005, released DOT/FAA/AR-04/46, a technical report entitled "Operational Life of Airport Pavements," that addresses the extent to which current FAA thickness design standards for airport pavements conform to the Agency's 20-year life requirement.
- Released ProFAA, a software program that combines an inertial profiler with simulations of the standard outputs from other commonly used devices, to analyze runway smoothness.

R&D Partnerships:

- FAA-U.S. Army ERDC*
- FAA-U.S. Air Force, Tyndall Air Force Base*
- FAA-Center of Excellence for Airport Technology, University of Illinois/Northwestern University**
- FAA-Boeing Company, Cooperative Research and Development Agreement ($7 million Boeing/$21 million total for the NAPTF)***
- FAA-IPRF++
- FAA-Auburn University++
- FAA-Rowan University++

* Interagency agreement or Memorandum of Agreement ** Partnership through matching funds *** Cost Sharing ++ Cooperative Agreement

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

MAJOR ACTIVITIES AND ANTICIPATED FY 2006 ACCOMPLISHMENTS:

- Continue analyzing full-scale data from the NAPTF.
- Coordinate with IPRF on reconstruction of full-scale test items for concrete overlay full-scale traffic tests at the NAPTF.
- Deliver a completed airport pavement thickness design package, including 3D finite element structural models, using FAARFIELD, an analytical program developed for the Agency.
- Complete a final report on implementating the new 3D finite element models in sensitivity and calibration studies and the development of new design procedures.
- Support development of a web-based MicroPAVER application for airport pavement management.
- Design and fabricate modules for 8-10 wheel gear loading.
- Develop models for airport funding strategies and passenger surveys.

FY 2007 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 2007 PRODUCTS AND MILESTONES

- Continue analyzing full-scale data from the NAPTF.
- Publish new airport pavement design procedures based on data from the FAARFIELD computer program.
- Conduct technical workshops in pavement design using FAARFIELD.
- Develop conceptual guidelines and computer tools for terminal building design.
- Conduct full-scale traffic tests on flexible pavement test items at the NAPTF.

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2005)	$32,232
FY 2006 Appropriated	8,440
FY 2007 Request	8,503
Out-Year Planning Levels (FY 2008-2011)	34,012
Total	$83,187

Budget Authority ($000)	**FY 2003 Enacted**	**FY 2004 Enacted**	**FY 2005 Enacted**	**FY 2006 Enacted**	**FY 2007 Request**
Contracts:					
Airport Technology -Capacity	6,586	7,750	8,630	7,240	7,185
Personnel Costs	0	0	0	1,200	1,318
Other In-house Costs	0	0	0	0	0
Total	**6,586**	**7,750**	**8,630**	**8,440**	**8,503**

OMB Circular A-11, Conduct of Research and Development ($000)	**FY 2003 Enacted**	**FY 2004 Enacted**	**FY 2005 Enacted**	**FY 2006 Enacted**	**FY 2007 Request**
Basic	0	0	0	0	0
Applied	0	0	0	0	0
Development (includes prototypes)	6,586	7,750	8,630	8,440	8,778
Total	**6,586**	**7,750**	**8,630**	**8,440**	**8,503**

Airports Technology - Capacity Product and Activities	FY 2007 Request ($000)	Program Schedule					
		FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011
Airport Technology – Capacity Goal							
Airport Technology - Capacity	**$7,185**						
Continue full-scale testing at NAPTF		◆	◇	◇	◇	◇	◇
Continue analysis of full-scale data from NAPTF		◆	◇	◇	◇	◇	◇
Develop advanced airport pavement design procedures; conduct related workshops in development, programming and documentation		◆	◇	◇	◇	◇	◇
Develop design standards for general aviation airports		◆	◇	◇	◇		
Continue support of airport technology center of excellence		◆	◇	◇			
Conduct non-destructive pavement testing		◆	◇	◇			
Support development of MicroPaver software		◆	◇	◇	◇	◇	◇
Conduct pavement roughness research			◇	◇	◇		
Operate material testing lab			◇				
Modify test machine for 8-10 wheels			◇				
Improve paving materials			◇	◇			
Mix design for high-pressure tires			◇	◇	◇		
Test for high inflation pressure			◇	◇			
Research non-destructive testing methods			◇	◇	◇		
Develop gyratory test method for P-401			◇	◇	◇		
Develop conceptual guidelines and computer tools for terminal building design		◆	◇				
Develop models for airport funding strategies, and passenger surveys		◆					
Personnel and Other In-House Costs	**1,318**						
Total Budget Authority	**$8,503**	**$8,440**	**$8,503**	**$8,503**	**$8,503**	**$8,503**	**$8,503**

◆ - 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.

FAA Budget Appropriation	Budget Item	Program Title	Budget Request
AIP	N/A	Airports Technology Research – Safety	$9,367,000

Supports FAA Strategic Goals: Increased Safety, and Greater Capacity.

Intended Outcomes: The FAA conducts safety-related 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; and
- Reduce the negative impact of wildlife on airport safety.

Agency Outputs: Federal law requires the FAA to develop and publish standards and guidance material for airport design, construction, and maintenance. The Agency uses the airport advisory circular (AC) system as its principal means to communicate this guidance 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 and techniques that can improve airport lighting and marking to help reduce surface accidents and runway incursions; improve aircraft rescue and fire fighting to address double decked aircraft carrying up to 800 passengers; and 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: Projects funded under the AIP grants must conform to the FAA ACs or designated standards. AIP grants contribute about half of the approximately $2 billion spent each year to provide operationally safe and reliable airport pavements. 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 the completion of:

- Installation of the Engineered Materials Arresting System (EMAS) long-term durability test bed;
- Final report on anti-icing overlay at Chicago O'Hare during winter operations;
- Final report on a polyurea alternative marking material;
- Evaluation of a prototype foreign object debris (FOD) detection radar at a large airport;
- Report on installation criteria for taxiway centerline lights;
- Evaluation of small airport firefighting systems;
- Demonstrated use of aircraft lighting to make aircraft on the ground more conspicuous; and
- Synthetic turf studies.

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 - soft-ground arrestor materials) **

* 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 2006 ACCOMPLISHMENTS:

- Evaluate effectiveness of a prototype alternative runway groove shape
- Evaluate taxiway deviations to support updated risk factors for Design Group IV taxiway designs
- Completion of installation of Next Generation High Reach Extendible Turret
- Evaluate EMAS long-term durability
- Construction of A-380 Fire Test Mock Up

FY 2007 PROGRAM REQUEST:

The Airport Technology FY 2007 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 2007 PRODUCTS AND MILESTONES:

- Complete design criteria for an interior intervention vehicle.
- Evaluate a prototype radar-based airport advisory system.
- Complete trash transfer station studies.
- Complete taxiway deviation studies.

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2005)	$35,394
FY 2006 Appropriated	8,885
FY 2007 Request	9,367
Out-Year Planning Levels (FY 2008-2011)	37,468
Total	$91,114

Budget Authority ($000)	**FY 2003 Enacted**	**FY 2004 Enacted**	**FY 2005 Enacted**	**FY 2006 Enacted**	**FY 2007 Request**
Contracts:					
Airport-Safety	7,600	9,667	3,670	7,685	8,049
Personnel Costs	0	0	0	1,200	1,318
Other In-house Costs	0	0	0	0	0
Total	**7,600**	**9,667**	**3,670**	**8,885**	**9,367**

OMB Circular A-11, Conduct of Research and Development ($000)	**FY 2003 Enacted**	**FY 2004 Enacted**	**FY 2005 Enacted**	**FY 2006 Enacted**	**FY 2007 Request**
Basic	0	0	0	0	0
Applied	0	0	0	0	0
Development (includes prototypes)	7,600	9,667	3,670	8,885	9,367
Total	**7,600**	**9,667**	**3,670**	**8,885**	**9,367**

Airports Technology - Safety Product and Activities	FY 2007 Request ($000)	Program Schedule					
		FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011
Airport Technology – Safety Goal							
Airport Technology - Safety	**$8,049**						
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 prototype radar-based airport advisory system			◇	◇	◇		
Conduct trash transfer station studies and continue wildlife hazard abatement studies			◇	◇			
Conduct taxiway deviation studies			◇				
Continue development of improved visual guidance systems to reduce runway incursions		◆	◇	◇	◇	◇	◇
Continue development of improved rescue and firefighting methods		◆	◇	◇	◇	◇	◇
Continue development of improved airport design methods and improve runway friction		◆	◇	◇	◇	◇	◇
Continue development of improved methods for handling the NLA		◆	◇	◇	◇	◇	◇
Continue development of improved standards for frangibility		◆	◇	◇			
Continue development of improved standards for airport planning		◆	◇	◇	◇	◇	◇
Personnel and Other In-House Costs	**$1,318**						
Total Budget Authority	**$9,367**	**$8,885**	**$9,367**	**$9,367**	**$9,367**	**$9,367**	**$9,367**

◆ - Activities Accomplished ◇ - Activities Planned

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

FAA Budget Appropriation	Budget Item	Program Title	Budget Request
F&E	1A01J	Airspace Management Laboratory	$4,000,000

Supports FAA Strategic Goals: Increased Safety, Greater Capacity, and International Leadership.

Intended Outcomes: The mission of the FAA's Air Traffic Organization (ATO) System Operations – Safety division is to meet air transportation's demand for increased capacity, efficiency and predictability in the airspace, routes, and airports of the National Airspace System (NAS) while ensuring that safety factors and environmental regulations are diligently satisfied.

To aide the ATO in achieving its mission, the Airspace Management Laboratory provides decision support capabilities to national, regional and local airspace system management specialists. The Laboratory also develops and manages information management systems to improve the end-to-end integrity of NAS support and post-operational data.

Major categories of activities carried out by the Laboratory include:

- Identifying issues and performing analyses, with appropriate attention to potential environmental impact, in support of FAA airspace assessment and redesign activities – this activity includes the continuing development of data management and simulation tools for the evaluation of airspace design alternatives by FAA field personnel and analysts at the Federally Funded Research and Development Center.
- Developing information system and decision support tools to support other FAA lines of business dependent on extensive operational data such as foreign overflight "fee for service" assessments, obstruction evaluation analyses, advanced air traffic control (ATC) tool benefits evaluation (e.g., former Free Flight Office), and Daily Measurement of Air Traffic Services.
- Streamlining input, storage and output for FAA aeronautical information management systems used to create end-user products, like charts and publications as well as internal FAA products such as NAS modernization/improvement plans, obstruction analyses, environmental analyses and performance metrics.

Airspace Management Laboratory outcomes during the past year include:

- Acquired, stored, and distributed air traffic operational data for use in NAS performance metrics calculations and local and national NAS improvement analyses; this work included the full phase-in of a new high fidelity air traffic operational data source for all centers and large terminals.
- Performed quantitative analyses of current air traffic activity, including performance measures such as reported cancellations, diversions, and delays.
- Analyzed environmental factors (noise).
- Helped to develop international aeronautical data standards designed to improve the quality and timeliness of FAA aeronautical data.
- Demonstrated new computer-based methodologies for constructing and publishing Temporary Flight Restrictions (TFR) and Notices to Airmen (NOTAM); the prototype improved NOTAM safety and high end user acceptance by improving standardization, readability and accuracy of TFR NOTAMs.
- Deployed new obstruction evaluation capabilities allowing proposed obstructions to be submitted digitally.
- Continued support and fielding of:

- Overflight "fee for service" assessments;
- The Consolidated Operations and Delay Analysis System
- Airspace Metrics;
- Sector Design and Analysis Tool (SDAT); and
- Enhanced Traffic Management System repository.

Customer/Stakeholder Involvement: The Airspace Management Laboratory continues to focus on providing value to the FAA and its external customers. The laboratory has supported the missions of Finance and Cost Accounting, the Office of Financial Services, the Office of Aviation Policy, and the Operational Evolution Plan. Products and tools produced by the lab are continually used by several lines of business throughout the agency, including several ATO organizations like System Operations – Safety, System Architecture and Investment Analysis, System Capacity, Air Traffic Planning and Procedures, and Air Traffic System Management. The Laboratory also has provided ongoing support for many NAS improvement projects involving staffing field analyses, performing analytical work, enabling daily access to operational data, and continuing technical support for database query programming.

Accomplishments:

Obstruction Evaluation and Airport Airspace Analysis

- Deployed national infrastructure to support paper-less processing of obstruction evaluation cases.
- Provided mechanism for Airports to submit airport and runway data directly to national Flight Data Center.
- Deployed a new interface allowing proponents to submit proposed obstructions electronically.

Airspace system issue identification and operations research

- Visualized and analyzed past and current traffic patterns.
- Analyzed system performance such as work done for ATO Financial System and Performance Reporting to develop future forecasts of ATO Performance and Cost metrics.
- Calculated facility utilization rates using historical and current air traffic.
- Provided airspace and traffic analyses to support special requests such as the 9/11 Commission.
- Developed models and scenarios to evaluate and improve NAS response to convective weather events.
- Evaluated traffic volume levels for system performance and capacity studies such as a traffic volume evaluation at Standard Terminal Automation Replacement System facilities to estimate bandwidth requirements.

Airspace and airport design and environmental evaluation

- Developed alternative airspace designs and images used in examining flight track data and in evaluating airspace classification changes at major airports like Minneapolis and Detroit.
- Analyzed changes to airspace design on flow, capacity, delay, workload, and other metrics as required.
- Developed data needed to evaluate noise and consider pollution impacts as a part of airspace design analysis.
- Enhanced the SDAT to provide advanced airspace design capabilities.

Aeronautical Information Management

- Demonstrated proof of concept that the accuracy, consistency and readability of NOTAMs could be improved through use of information engineering techniques to digitally encode, transmit and distribute the notices.
- Led an effort to adopt international standards for aeronautical data; the resulting adoption will lead to cost savings in aeronautical data collection, management and distribution as well as safety improvements resulting from enhanced data quality.

MAJOR ACTIVITIES AND ANTICIPATED FY 2006 ACCOMPLISHMENTS:

- Integrate Aviation System Standards obstruction evaluation processes into the paper-less obstruction evaluation system.
- Provide analytical, decision support and operations research support to the FAA lines of business and external customers.
- Continue improving aeronautical information system quality by automating and digitizing system inputs and outputs.
- Leverage international aeronautical data standards and automation tools to improve aeronautical data quality, completeness and timeliness.
- Add design and analysis capability into the SDAT, especially critically needed capability to automate and improve Minimum Vector Altitude sector analysis at terminals and centers.
- At ATC operational data repositories with improved fidelity, focus on generating next-day reports that can be used by field facilities to refresh the web metrics system.
- Continue traffic data repository collection and enhancement of high-precision aircraft position reports to support National Airspace Redesign and Environmental analysis.

KEY FY 2007 PRODUCTS AND MILESTONES:

- Maintain decision and analytical capabilities to support FAA lines of business and external customers.
- Begin a fully integrated aeronautical information management system that leverages automation and workflow systems to provide end-to-end data integrity.
- Develop additional automation systems to improve the operation of facility airspace offices.
- Develop an operational concept and begin implementing new capabilities to manage temporary changes to aeronautical data (e.g., the aeronautical data content contained within a NOTAM) with the goal of improving aeronautical data accuracy and consistency for NAS users.
- Deliver a new web metrics capability that utilizes high fidelity traffic data. Deploy a metrics system suitable for daily use within the air traffic facility offices
- Support the examination of technologies being acquired or alternative procedures with respect to potential for ATC efficiency and other performance-related improvements.
- Continue collecting and distributing NAS support and NAS post-operational data for use by the FAA lines of business.

FY 2006 PROGRAM REQUEST:

Continued investments in the Airspace Management Laboratory are needed to provide the data, tools and processes required for the FAA to meet the demands of a continually change NAS. New technologies and NAS modernization efforts (such as En Route Automation Modernization) require significant improvements in aeronautical data quality to achieve desired cost, efficiency and safety improvements. The Airspace Management Laboratory program plans reflect the goals of providing high quality information systems,

analytical support and tool capabilities necessary for the FAA to meet performance, safety and efficiency targets.

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2005)	$16,061
FY 2006 Appropriated	6,930
FY 2007 Request	4,000
Out-Year Planning Levels (FY 2008-2011)	16,000
Total	$42,991

Budget Authority ($000)	**FY 2003 Enacted**	**FY 2004 Enacted**	**FY 2005 Enacted**	**FY 2006 Enacted**	**FY 2007 Request**
Contracts:					
Airspace Management Lab	4,570	0	0	6,930	4,000
Personnel Costs	0	0	0	0	0
Other In-house Costs	0	0	0	0	0
Total	**4,570**	**0**	**0**	**6,930**	**4,000**

OMB Circular A-11, Conduct of Research and Development ($000)	**FY 2003 Enacted**	**FY 2004 Enacted**	**FY 2005 Enacted**	**FY 2006 Enacted**	**FY 2007 Request**
Basic	0	0	0	0	0
Applied	0	0	0	0	0
Development (includes prototypes)	4,570	0	0	6,930	4,000
Total	**4,570**	**0**	**0**	**6,930**	**4,000**

Airspace Management Laboratory Product and Activities	FY 2007 Request ($000)	Program Schedule					
		FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011
Airspace Management Laboratory	**$4,000**						
Analyze, Deploy, and Enhance Traffic Data & Metrics Products and Projects							
Enhance and augment ATC data collection and distribution system		◆	◇	◇	◇	◇	◇
Deliver high fidelity next-day performance metrics for field use		◆	◇	◇	◇	◇	◇
Provide analytical and operations research support to internal and external customers		◆	◇	◇	◇	◇	◇
Analyze, Enhance, and Support Analysis and Decision Support Tools							
Maintain and enhance environmental noise analysis tool capability		◆	◇	◇	◇	◇	◇
Deliver airspace office automation capabilities, including minimum vector analysis capabilities		◆	◇	◇	◇	◇	◇
Integrate terminal procedures component of obstruction evaluation into the obstruction evaluation workflow system		◆	◇	◇	◇	◇	◇
Aeronautical Information Management							
Create fully integrated aeronautical information management system							
Automate and standardize aeronautical data inputs		◆	◇	◇	◇	◇	◇
Develop transformation engines to automate aeronautical data products and provide data access to internal and external clients		◆	◇	◇	◇	◇	◇
Implement process improvement strategies to improve end-to-end data integrity, timeliness and quality		◆	◇	◇	◇	◇	◇
Integrate international aeronautical data standards and processes		◆	◇	◇	◇	◇	◇
Develop operational concept and implement processes to support aeronautical data temporality		◆	◇	◇	◇	◇	◇
Total Budget Authority	**$4,000**	**$6,930**	**$4,000**	**$4,000**	**$4,000**	**$4,000**	**$4,000**

◆ - 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 5, NOT THE PROGRAM BUDGET LINE ITEM.

FAA Budget Appropriation	Budget ItemS	Program Title	Budget Request
F&E	**1A01**	**Airspace Redesign**	**$2,800,000**

Supports FAA Strategic Goals: Increased Safety, Greater Capacity, and International Leadership.

FAA Air Traffic Control Facilities Cited in This Program Description:

Acronym	Facility Name
DFW	Dallas Ft. Worth International Airport
HAATS	Houston Area Air Traffic System
IAH	George Bush Intercontinental Airport; Houston, Texas
LAS	McCarran International Airport; Las Vegas, Nevada
NCT	Northern California Terminal Radar Approach Control
PHX	Sky Harbor International Airport; Phoenix, Arizona
ZAB	Albuquerque Air Route Traffic Control Center
ZHU	Houston Air Route Traffic Control Center
ZJX	Jacksonville Air Route Traffic Control Center
ZKC	Kansas City Air Route Traffic Control Center
ZLA	Los Angeles Air Route Traffic Control Center
ZMA	Miami Air Route Traffic Control Center
ZME	Memphis Air Route Traffic Control Center
ZOA	Oakland Air Route Traffic Control Center

Intended Outcomes: The Airspace Management Program (formerly National Airspace Redesign) directly supports all four objects of the "Greater Capacity" goal of the FAA's Flight Plan 2006-2010. Airspace redesign accomplished through the Airspace Management Program will create a modern and effectively managed national airspace redesign that:

- Increases system capacity and efficiency by removing as many airspace constraints as possible;
- Manages complexity and congestion without continuously increasing sector splitting and growth in the number of sectors;
- Increases flexibility and predictability for the benefit of air traffic controllers and aviation system users;
- Balances the access needs of the diverse set of aviation system users;
- Maintains the highest levels of system safety and security; and
- Reduces expected delays and inefficient routing over the next ten years in New York, Philadelphia, Chicago, Los Angeles Basin, San Francisco Bay Area, and South Florida metropolitan areas.

Agency Outputs: The Airspace Management Program serves as the FAA's primary effort to modernize the nation's airspace. The purpose of this national initiative is to review, redesign and restructure airspace. The program has four components: Regional Optimization, Regional Redesign, High Altitude Redesign and Oceanic Redesign.

- Regional Optimization projects involve airspace changes that are smaller in scale, utilizing available resources.

- Regional Redesign projects are much larger in scale than optimization projects and can encompass multiple facilities that cross several Service Areas or FAA Regions.
- High Altitude Redesign is a multi-phased project targeting large scale redesign of the nation's high altitude airspace. High Altitude Redesign is the mechanism for influencing future infrastructure system requirements and the introduction of advanced concepts into airspace design.
- Oceanic Redesign capitalizes on the oceanic infrastructure and automation improvements across all oceanic and offshore facilities.

Customer/Stakeholder Involvement: The Airspace Management Program utilizes both formal and informal methods to solicit and include customer/stakeholder perspectives. Since the inception of the FAA's national focus on airspace redesign, the program has worked with RTCA to communicate plans and receive appropriate feedback from the aviation customer community. Since 2001, the Airspace Working Group has been the main body to aid in understanding the operational views and perspectives of the diverse airspace customers and stakeholders. Airspace Working Group members represent major carriers, regional carriers, general and business aviation, and the military. Regarding environmental concerns, the Airspace Management Program communicates with communities through various forums and processes as prescribed by the National Environmental Policy Act.

Accomplishments: Through the Airspace Management Program (and its predecessor, National Airspace Redesign), the FAA has implemented many airspace changes that have resulted in significant operational improvements. These accomplishments include:

- Las Vegas Redesign & Phoenix/Northwest 2000 – redesigned terminal/en route airspace and random navigation/area navigation (RNAV) procedures.
- Honolulu Redesign – improved departure coordination procedures for flights; reduced departure times.
- Great Lakes Integrated Design Plan – implemented new routes and improved procedures; reduced delays and restrictions.
- Choke Points – implemented new sectors and route changes; reduced delays, miles in trail, and other restrictions.
- High Altitude Redesign Phase 1 Initial – improved information about Special Use Airspace (SUA) availability and usage, implemented waypoints to circumnavigate SUA supporting improved flight planning information; reduced flying distance around SUA.
- Oakland Oceanic Gateway – created new oceanic route access points; allowed Pacific bound aircraft to achieve desired altitudes quicker, saving fuel and time.
- Denver South – created new routings for Denver satellite airports; reduced complexity.
- Anchorage Center Redesign – created an oceanic specialty, added a new sector, and revised other sector boundaries; improved controller workload balance.
- ZHU/ZMA/ZJX Boundary Realignment – revised the boundaries that divide control of Gulf airspace; improved safety for Gulf flights.
- High Altitude Redesign Phase 1 – instituted non-restrictive routing, Navigational Reference System, and Q-Routes.
- Denver Redesign – developed Ski Country procedures; better managed delays and demand at key airports.
- NY/NJ/PHL Redesign – instituted "Dual Modena" departure routes; increased departure throughput, reduced departure restrictions, and reduced taxi-out delays.

- Atlantic Oceanic Redesign – instituted Coded Caribbean Routes; reduced coordination and communication errors, increased use of shorter distance access routes, and saved 11-35 miles for flights from Philadelphia and Boston to the Caribbean.
- ZME 5th Area Redesign and ZKC East End – realigned sectors; balanced workload and reduce complexity.
- HAATS Airspace and DFW RNAV – instituted new RNAV departures for DFW; tripled arrivals for IAH and expected to increase throughput.
- LAS Redesign – intituted RNAV procedures; reduced flight distances.
- Bay to Basin Redesign and ZAB Redesign – instituted new sectors in ZLA and ZAB; reduced restrictions upon LAS and PHX.
- Southern CA Redesign – instituted new departure routes; allowed for more fuel efficient departures and reduced the number of leveled-off departures by over 70%.
- Northern California Terminal Airspace Redesign – realigned airspace between NCT and ZOA; reduced FAA operational costs and reduced flight distances for customers.
- Florida Airspace Optimization – added new sectors and routes; reduced delays and restrictions in the busy east coast corridor.

R&D Partnerships: The Airspace Management Program works closely with the FAA's Federally Funded Research and Development Center, MITRE's Center for Advanced Aviation Development (CAASD). MITRE-CAASD's work includes investigating, innovating, and developing modeling, simulation, and analysis capabilities facilitating airspace design. MITRE-CAASD will also research and explore issues that influence strategic policy in airspace management and design, such as sectorization concepts.

MAJOR ACTIVITIES AND ANTICIPATED FY 2006 ACCOMPLISHMENTS:

- Northern California Redesign (ZOA)
- ZTL North-South Routes
- Midwest AirSpace Enhancement
- High Altitude Redesign Q-Routes
- Minneapolis Runway sectors
- Cincinnati 3rd Parallel Runway Airspace
- Atlanta 5th Runway Airspace
- Central California Terminal Airspace

FY 2007 PROGRAM REQUEST:

The requested funding will allow the Airspace Management Program to implement airspace design projects associated with:

- Regional optimization and redesign: includes NY/NJ/PHL Metropolitan Airspace Redesign, Chicago Airspace Project, Houston Area Airspace, and the Southern California Redesign.
- High Altitude Redesign: includes redesign of airspace above Flight Level 290.
- Oceanic Redesign: includes work in all oceanic (New York, Oakland, and Anchorage) airspace and offshore airspace.

KEY FY 2007 PRODUCTS AND MILESTONES:

- NY/NJ/PHL Metropolitan Area Airspace Redesign (initial phases)
- Chicago Airspace Project (initial phases)
- Northern Utah Airspace Initiative (complete FEIS)
- Southern California Redesign (SAN Arrival Enhancement)

- Las Vegas Terminal Airspace Redesign
- Houston Area Air Traffic System Airspace (initial phases)

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2005)	$0
FY 2006 Appropriated	0
FY 2007 Request	2,800
Out-Year Planning Levels (FY 2008-2011)	12,000
Total	$14,800

Budget Authority ($000)	**FY 2003 Enacted**	**FY 2004 Enacted**	**FY 2005 Enacted**	**FY 2006 Enacted**	**FY 2007 Request**
Contracts:					
Airspace Redesign					2,800
Personnel Costs	0	0	0	0	0
Other In-house Costs	0	0	0	0	0
Total					**2,800**

OMB Circular A-11, Conduct of Research and Development ($000)	**FY 2003 Enacted**	**FY 2004 Enacted**	**FY 2005 Enacted**	**FY 2006 Enacted**	**FY 2007 Request**
Basic	0	0	0	0	0
Applied	0	0	0	0	0
Development (includes prototypes)					2,800
Total					**2,800**

Airspace Redesign Product and Activities	FY 2007 Rquest ($000)	Program Schedule					
		FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011
Airspace Design							
Equipment and other F&E expenditures to support Airspace Management Program projects	**$ 2,800**						
Develop/Initiate regional optimization and redesign			◇	◇	◇	◇	◇
Develop/Initiate high altitude redesign			◇	◇	◇	◇	◇
Develop/Initiate oceanic redesign			◇	◇	◇	◇	◇
Total Budget Authority	**$2,800**	**$0**	**$2,800**	**$3,000**	**$3,000**	**$3,000**	**$3,000**

◆ - 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 5, NOT THE PROGRAM BUDGET LINE ITEM.

FAA Budget Appropriation	Budget Item	Program Title	Budget Request
R,E&D	A11.d.	Atmospheric Hazards/Digital System Safety	$3,848,000

Supports FAA Strategic Goals: Increased Safety, Greater Capacity, and International Leadership.

Intended Outcomes: The Atmospheric Hazards/Digital System Safety Research Program develops and tests digital system safety technologies that detect frozen contamination, predict anti-icing fluid failure, and ensure safe operations both during and after flight in atmospheric icing conditions. The program develops technologies, and related advisory and guidance materials, that ensure safe aircraft operation in spite of electromagnetic hazards resulting from electromagentic interference, cosmic radiation, high intensity radiated fields (HIRF), and lightning. Its researchers are also working to ensure the safe operation of emerging, highly complex software-based digital flight controls and avionics systems.

A major goal of the program is to reduce aviation's vulnerability to all in-flight icing hazards through the application of its research to improve certification criteria. Commercial airplanes are not yet certified to fly in icing conditions to an icing envelope that includes supercooled large droplet (SLD) icing conditions. The program's researchers plan to develop technical data and advisory materials to correct this omission. They also will create the research basis for guidance to mitigate electromagnetic hazards to aircraft electrical and avionic systems from lightning, HIRF, and portable electronic devices. Additionally, they will develop new guidelines for testing, evaluating, and certifying digital flight controls and avionics systems.

Agency Outputs: The FAA establishes rules for the operation of aircraft that encounter icing conditions and electromagnetic hazards – as well as rules for the use of software, digital flight controls, and on-board avionics systems. The Agency provides Advisory Circulars (AC), and various other forms of technical information detailing acceptable means for meeting requirements, to guide government and industrial certification and airworthiness specialists and inspectors.

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, including:

- Subcommittee on Aircraft Safety of the FAA Research, Engineering and Development Advisory Committee – representatives from industry, academia, and other government agencies annually review the program's activities.
- Technical Community Representative Groups – FAA representatives apply formal guidelines to ensure that the program's R&D projects support new rule making and the development of alternate means of compliance with existing rules.
- Ice Protection Harmonization Working Group of the FAA Aviation Rulemaking Advisory Committee (ARAC) – helps to ensure the effectiveness of the Agency's rule making. Members of the working group and full committee identify research requirements and priorities, and they provide guidance for including SLD within the icing environment and installing ice detectors to warn flight crews of ice accumulation on critical surfaces.
- Electromagnetic Effects Harmonization Working Group of the ARAC – helps to ensure the effectiveness of the Agency's rule making. Members of the working group and full committee identify research requirements and priorities, and they provide guidance for the update of ACs and other documents.
- G-12 Aircraft Ground Deicing Committee of the Society of Automotive Engineers (SAE) – assists in updating holdover time guidelines and establishing standards for de/anti-icing methodologies, deicing fluids, and ground ice detection.

- SAE AC-9C Aircraft Icing (In-flight) Subcommittee – assists in updating the Aircraft Icing Handbook, including the Icing Bibliography, and in establishing standards for icing simulation methods.
- SAE Aircraft Lightning Protection (AE-2) Committee – assists in developing ACs, test standards, and related users manuals to improve flight safety.
- RTCA – helps to ensure the effectiveness of the Agency's rule making. Members of the full organization and is special committees identify research requirements and priorities and the provide guidance for the update of documents in areas such as avionics software and electromagnetic hazards.

Accomplishments: The most recent accomplishments of the Atmospheric Hazards/Digital System Safety Research Program include:

- Developed technical data to support the issuance of several ACs and technical information bulletins, and published the third update of the Aircraft Icing Handbook.
- Held international conferences on aircraft ground deicing and aircraft in-flight icing.
- Developed technical data for the holdover time guidelines followed by many of the world's airlines in their use of aircraft anti-icing fluids.
- Developed technical data to support the issuance of advisory material on lightning strike characterization.
- Completed research on the effects of aging on the continued protection integrity of aircraft due to degradation of wiring and connectors.
- Identified issues that make commercial off-the-shelf software (COTS) ground processing systems for aircraft maintenance trustworthy and secure.

R&D Partnerships: The program maintains a number of cooperative relationships:

- National Aeronautics and Space Administration (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.
- NASA Langley Research Center – assesses software-based digital flight controls and avionics systems and electromagnetic hazards research.
- Aerospace Vehicle Systems Institute – cooperative industry and government venture for investigation of aircraft semiconductor wear out and cosmic radiation effects on avionics systems.

MAJOR ACTIVITIES AND ANTICIPATED FY 2006 ACCOMPLISHMENTS:

Aircraft Icing

- Determine and substantiate the time of effectiveness and aerodynamic performance of modern de/anti-icing fluids.
- Complete a report on facility simulation development for SLD icing testing.
- Complete a report on the testing and analysis of runback icing for hot air ice protection systems.
- Complete a report on new test procedures for Type II, II, and IV anti-icing fluids and non-glycol based Type I fluids for snow conditions.

- Conduct icing test capability for in-flight conditions at the U.S. Air Force McKinley Climatic Laboratory.
- Investigate and assess ground ice detectors.
- Initiate research on characterization and simulation of high ice water content environments for engines.
- Continue equivalent pressure altitude testing, analysis and scaling of hot-air ice protection systems.

Electromagnetic Hazards to Aircraft Systems

- Assess aircraft continued protection integrity due to degradation of wiring, connectors, and insulation on transport category aircraft.
- Conduct a risk assessment of neutron particle effects (single event effects) on flight critical systems.
- Complete final testing to determine methodology to measure HIRF compliance.

Software and Digital Systems Safety

- Complete a report analyzing how the integration of COTS components into a generic aviation platform is verified.
- Complete an evaluation of the use of object-oriented technology in aviation – address how language and tool-specific software issues are identified and addressed at the source code and object code levels.
- Identify objectives, design requirements, and desired features needed to meet operational, safety, and certification requirements for integrated flight guidance and control (FG&C) systems.
- Complete a handbook and guidelines for the design of future avionics systems using semiconductor devices.
- Complete assessment criteria and safety concerns on the use of microprocessors in aviation.
- Identify and address tool qualification issues for developing complex electronic hardware and verification tools – include the development of software tool qualification criteria.
- Determine aircraft system level impacts on software design assurance level determination.

FY 2007 PROGRAM REQUEST:

Ongoing Activities

Researchers will continue to refine laboratory methods for determining de-icing fluid holdover times. They will continue to study the enhancement and validation of icing simulation methods, with an emphasis on engine testing in high ice water content conditions. They will also investigate the possibility of using ground ice detectors to demonstrate compliance with FAA requirements.

The program will continue to assess the effects of lightning on aircraft structures and systems and issues affecting the continued protection integrity of transport aircraft. In addition, researchers will continue databus evaluation criteria for airworthiness of newly proposed databuses and local area networks (LAN) in aircraft and the protection of sensitive information on these LANs. Research will also continue on methods for successful management, control, integration, verification, and validation of system and software requirements.

New Initiatives

The program will begin research on augmented manual control (fly-by-wire/light) and flight critical systems design assurance.

KEY FY 2007 PRODUCTS AND MILESTONES:

Aircraft Icing

- Determine and substantiate time of effectiveness and aerodynamic performance of modern de/anti-icing fluids.
- Complete a report on use of ground ice detectors to demonstrate compliance with FAA requirements.
- Complete a report on residual and inter-cycle ice for pneumatic boots at low airspeeds.
- Complete a report on propeller icing.
- Assess instrumentation for measurement of high ice water content environments.
- Release technical data on characterization and simulation of high ice water content environments for engines.
- Release technical data on equivalent pressure altitude testing, analysis, and scaling of hot-air ice protection systems.
- Complete an investigation and assessment of ground ice detectors.

Electromagnetic Hazards to Aircraft System.

- Publish a final report on risk assessment of emissions from wireless devices.
- Update results on risk assessment of cosmic radiation (single event effects) on flight critical systems.
- Release results on methodology and recommended practices for HIRF compliance.

Software and Digital Systems Safety

- Develop operational objectives, certification requirements, and guidelines for FG&C safety functions to prevent loss of control.
- Continue to evaluate tool qualification issues for complex electronic hardware development and verification tools, as well as to develop software tool qualification criteria from previous research.
- Report on aircraft system level impacts on software design assurance level determination.
- Assess control algorithms for performance and minimum standards and guidelines for control inceptors in the augmented manual control (fly-by-wire/light) task.
- Develop reference materials for updating certification regulations for availability, integrity, failure effects, failure propagation, and fault monitoring and identification in flight critical systems design assurance.

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APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2005)	$79,564
FY 2006 Appropriated	3,407
FY 2007 Request	3,848
Out-Year Planning Levels (FY 2008-2011)	15,154
Total	$101,973

Budget Authority ($000)	**FY 2003 Enacted**	**FY 2004 Enacted**	**FY 2005 Enacted**	**FY 2006 Enacted**	**FY 2007 Request**
Contracts:					
Digital System Safety	748	1,306	440	232	842
Atmospheric Hazards	3,816	1,408	1,864	1,287	1,316
Personnel Costs	1,417	1,707	1,621	1,786	1,614
Other In-house Costs	106	147	161	102	76
Total	**6,087**	**4,568**	**4,086**	**3,407**	**3,848**

OMB Circular A-11, Conduct of Research and Development ($000)	**FY 2003 Enacted**	**FY 2004 Enacted**	**FY 2005 Enacted**	**FY 2006 Enacted**	**FY 2007 Request**
Basic	0	0	0	0	0
Applied	6,087	4,568	4,086	3,407	3,848
Development (includes prototypes)	0	0	0	0	0
Total	**6,087**	**4,568**	**4,086**	**3,407**	**3,848**

A11d – Atmospheric Hazards/Digital System Safety Product and Activities	FY 2007 Request ($000)	Program Schedule					
		FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011
064-110 Digital System Safety							
Software and Digital Systems Safety	**$842**						
Publish report on COTS component integration		♦					
Evaluate object oriented technology in aviation		♦					
Evaluate integrated flight guidance and control systems		♦	◊	◊	◊		
Evaluate the criteria and use of microprocessors in aviation		♦					
Identify and evaluate tool qualification issues for complex electronic hardware		♦	◊	◊			
Determine and report on aircraft system level impacts on software design assurance level		♦	◊				
Evaluate augmented manual control (fly-by-wire/light)			◊	◊	◊	◊	◊
Develop reference materials for updating regulations on flight critical systems design assurance			◊	◊			
Evaluate model-based development criteria				◊	◊		
Evaluate modified condition/decision coverage (MC/DC) of software				◊	◊		
Evaluate environmental qualification of electronic components						◊	◊
064-111 Atmospheric Hazards							
Aircraft Icing	**$1,316**						
Characterize and simulate high ice water content environments for engines		♦	◊	◊	◊	◊	◊
Substantiate time of effectiveness and aerodynamic performance of modern fluids		♦	◊	◊			
Complete report on runback icing for thermal ice protection systems – testing and analysis		♦					
Complete report on new test procedures for Type II, III, IV and non-glycol Type I fluids for snow		♦					
Complete report on facility simulation development for SLD icing testing		♦					
Conduct icing test capability for inflight conditions at McKinley Environmental Laboratory		♦					
Investigate and assess ground ice detectors		♦	◊				
Report on equivalent pressure altitude testing, analysis and scaling of hot-air ice protection systems.		♦	◊	◊	◊	◊	
Electromagnetic Hazards to Aircraft Systems	**$0**						
Publish reports on characterization of aircraft lightning				◊	◊		
Publish report on risk assessment on emissions from wireless devices			◊				
Assess aircraft continued protection integrity due to degradation of wiring, connectors and insulation of transport category aircraft		♦	◊	◊	◊	◊	◊
Assess risk of single event effects		♦	◊	◊	◊	◊	◊
Complete testing on methodology to measure HIRF compliance		♦					
Release reports on methodology to measure HIRF compliance			◊	◊	◊		
Personnel and Other In-House Costs	**$1,690**						
Total Budget Authority	**$3,848**	**$3,407**	**$3,848**	**$3,779**	**$3,781**	**$3,760**	**$3,834**

.

FAA Budget Appropriation	Budget Item	Program Title	Budget Request
R,E&D	A11.h.	Aviation Safety Risk Analysis	$5,292,000

Supports FAA Strategic Goals: Increased Safety, Greater Capacity, and International Leadership.

Intended Outcomes: The Aviation Safety Risk Analysis Program develops risk management methodologies, prototype tools, technical information, procedures, and practices that will improve aviation safety. The Program collaborates with industry to ensure that risk management decision support tools are properly defined, developed, tested, and evaluated prior to implementation and to ensure changes to the regulations, advisory materials, and procedures are smoothly implemented.

By 2008, researchers will develop prototypes for enhanced risk management decision support systems to make the aviation oversight processes (certification, surveillance, investigation, and certification management) more effective, efficient, and systematic.

Agency Outputs: The program is developing and testing new risk management decision support tools. It also supports the development and modification of Agency rules and advisory material related to aircraft design, certification and maintenance. The program provides guidance material to identify a range of landing distances needed by aircraft to safely conduct land and hold short operations (LAHSO) under normal approach procedures.

Customer/Stakeholder Involvement: The program encourages broad industry and government participation across all projects.

- Subcommittee on Aircraft Safety of the FAA Research, Engineering and Development Advisory Committee – representatives from industry, academia, and other government agencies annually review the program's activities.
- Technical Community Representative Groups – FAA representatives apply formal guidelines to ensure that the program's research projects support new rule making and the development of alternate means of compliance with existing rules.
- The System Approach for Safety Oversight – the primary goal of this Flight Standards Service program is to apply a systems approach, cooperative problem solving, and proactive risk management principles to operations affecting aviation safety.
- The Safety Management Focus Group – safety directors from various major and regional carriers review and evaluate the products of the Risk Management Decision Support project.

Accomplishments: Recent program accomplishments include:

- A patent award to the University of Maryland for FAA-funded research on the "Hybrid Causal Logic Model." The methodology facilitates the integration of fault trees that assess aircraft-associated risks with causal models that assess risks associated with processes and organizations. This integrated assessment model makes risk evaluation possible across the entire aviation system.
- Research results and recommendations for an Approved Training Program for Repair Stations (Title XIV CFR 145.163) used to develop the (draft) Advisory Circular (AC) 145-RSTP, "Repair Station Training Program."
- A Usability Tool Kit, comprising a standardized set of evaluation tools that can be used to evaluate and develop maintenance technical documents.
- Technical reports, "Assessment of Standard Probabilities in Support of FAA AC 25.1309 Phase One, Phase Two, and Phase Three," which provide standard estimated probabilities and

recommended values for environmental and operating conditions such as lightning strike, high energy rejected takeoff, and engine fire.

- Technical reports, "Flight Crew Intervention Credit Phase One, and Phase Two and Three." The Phase One Study examines flight crew response to aircraft malfunctions. The combined Phase Two and Three studies establish a list of key design characteristics that influence the ability of the flight crew to intervene in case of a system failure.
- Research results and recommendations included in AC 70-1, "Outdoor Laser Operations, and AC 70-2, Reporting of Laser Illumination of Aircraft."

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

- The Safety Management Focus Group, composed of directors of safety from various major and regional carriers, to review and evaluate the products of the Risk Management Decision Support project;
- NASA, under a cost sharing agreement, to develop a process for the FAA and the commercial aviation industry to share safety-related information and to use that information to proactively identify, analyze and correct safety issues that affect commercial aviation;
- The Civil Aviation Authority of the Netherlands to conduct joint research on aviation system safety initiatives via a Memorandum of Cooperation; and
- Wichita State University, under a cost-sharing grant, to develop techniques that will evaluate and improve the usability and reliability of aviation technical manuals.

MAJOR ACTIVITIES AND ANTICIPATED FY 2006 ACCOMPLISHMENTS:

Risk Management Decision Support

- Continue to:
  - Develop an integrated risk management tool;
  - Develop an integrated framework for the identification, classification, and assessment of hazards;
  - Develop a methodology to design performance measures and risk indicators based on an integrated hazards framework; and
  - Develop the conceptual design of a decision support system.

Aircraft Maintenance - Maintainability and Reliability

- Continue to:
  - Develop a tool calibration program for repair stations;
  - Develop standards for carbon monoxide detections devices including the development of inspection methods to determine the integrity of exhaust systems;
  - Conduct a series of safety review studies that examine several aspects of outsourced maintenance; and
  - Develop and refine techniques to evaluate and improve the usability and reliability of aviation technical manuals.

Safety Analysis Methodology

- Continue to:
  - Develop a methodology to determine an appropriate certification credit level for design features intended to reduce the effect of system errors;

- Develop methods for sorting and evaluating certification and continued airworthiness data sets to identify technical areas posing fleet-wide safety risks; and
- Determine the outcome ratio for a limited number of well-defined unsafe conditions.

Runway Capacity Analysis

- Start to:
  - Develop evaluation plan to identify constraints to Required Navigation Performance (RNP).
- Continue to:
  - Conduct analysis for operational landing distance performance of selected aircraft make/model/series;
  - Conduct evaluations on the use of pilot-in-the-loop flight simulators for training of advanced maneuvers related to terminal area operations;
  - Conduct evaluations on air traffic and flight procedures for terminal area operations by using pilot-in-the-loop flight simulator; and
  - Develop tools to model the safety hazards of rejected landing procedure and to identify possible training solutions.
- Complete:
  - Evaluation of the automatic LAHSO light system for safety of terminal area operations.

FY 2007 PROGRAM REQUEST:

Ongoing Activities

Research will continue to ensure that risk management decision support tools are properly defined, developed, tested, and evaluated prior to implementation and that changes to the regulations, advisory materials, and procedures are smoothly implemented. Government, industry, and academia aviation safety subject matter experts will be invited to participate in the research efforts 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. The participation of these subject matter experts will ensure the smooth transition of new regulations and advisory materials. The program will 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 2007.

KEY FY 2007 PRODUCTS AND MILESTONES:

Risk Management Decision Support

- Develop a risk mitigation model that uses results from past risk mitigation actions to recommend future risk mitigation action.
- Develop an integrated framework for the identification, classification, and assessment of aviation maintenance and flight operations hazards using technology developed for NASA's space shuttle program.
- Develop a set of performance measures and risk indicators based on an integrated hazards framework.
- Develop a methodology to identify the information requirements needed to support a decision support system that will provide FAA with improved certificate management and oversight capabilities.

- Develop the conceptual design of a decision support system.

Aircraft Maintenance - Maintainability and Reliability

- Develop standards for carbon monoxide detections devices, including the development of inspection methods to determine the integrity of exhaust systems.
- Conduct a series of safety review studies that examine several aspects of outsourced maintenance.
- Complete a tool calibration program for aircraft maintenance.
- Complete a technical report that contains recommendations regarding outsourced maintenance issues and certification of returned-to-service inspectors of U.S.-registered aircraft at foreign repair stations.

Safety Analysis Methodology

- Determine the outcome ratio for a limited number of well-defined unsafe conditions.
- Complete a methodology to determine an appropriate certification credit level for design features intended to reduce the effects of system errors.
- Complete methods for sorting and evaluating certification and continued airworthiness data sets to identify technical areas posing fleet-wide safety risks.

Runway Capacity Analysis

- Conduct evaluations on the use of pilot-in-the-loop flight simulators for training of advanced maneuvers related to terminal area operations.
- Develop evaluation plan to identify RNP constraints.
- Conduct evaluations on air traffic and flight procedures for terminal area operations by using the pilot-in-the-loop flight simulator.
- Develop tools to model the safety hazards of rejected landing procedure and to identify possible training solutions.
- Complete a study of operational landing distance performance of selected aircraft make/model/series.

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2005)	$59,223
FY 2006 Appropriated	4,883
FY 2007 Request	5,292
Out-Year Planning Levels (FY 2008-2011)	20,663
Total	90,061

Budget Authority ($000)	**FY 2003 Enacted**	**FY 2004 Enacted**	**FY 2005 Enacted**	**FY 2006 Enacted**	**FY 2007 Request**
Contracts:					
Aviation Safety Risk Analysis	5,124	6,194	6,260	3,303	3,232
Personnel Costs	1,317	1,528	2,091	1,494	1,947
Other In-house Costs	98	129	220	86	113
Total	**6,539**	**7,851**	**8,571**	**4,883**	**5,292**

OMB Circular A-11, Conduct of Research and Development ($000)	**FY 2003 Enacted**	**FY 2004 Enacted**	**FY 2005 Enacted**	**FY 2006 Enacted**	**FY 2007 Request**
Basic	0	0	0	0	0
Applied	6,539	7,851	8,571	4,883	5,292
Development (includes prototypes)	0	0	0	0	0
Total	**6,539**	**7,851**	**8,571**	**4,883**	**5,292**

A11h - Aviation Safety Risk Analysis Product and Activities	FY 2007 Request ($000)	Program Schedule					
		FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011
060-110 Aviation Safety Risk Analysis							
Risk Management Decision Support	**$1,868**						
Develop a methodology to identify the information requirements needed to support a decision support system		♦	◊	◊			
Develop an integrated framework for the identification, classification, and assessment of hazards		♦	◊				
Develop a set of performance measures and risk indicators based on system engineering models and an integrated hazard framework		♦	◊				
Develop the conceptual design of a decision support system		♦	◊				
Develop a risk mitigation model that uses results from past risk mitigation actions to recommend future risk mitigation actions			◊	◊			
Aircraft Maintenance – Maintainability & Reliability	**$632**						
Conduct a series of safety review studies that examine several aspects of outsourced maintenance		♦	◊				
Develop a tool calibration program for aircraft maintenance		♦	◊				
Develop and refine techniques to evaluate and improve the usability and reliability of aviation technical manuals		♦					
Develop standards for carbon monoxide detection devices including the development of inspection methods to determine the integrity of exhaust systems		♦	◊	◊			
Safety Analysis Methodology	**$0**						
Determine the outcome ratio for a limited number of well-defined unsafe conditions		♦	◊	◊			
Develop a methodology to determine an appropriate certification credit level for design features intended to reduce the effect of system errors		♦	◊				
Develop methods for sorting and evaluating certification and continued airworthiness data sets to identify technical problem areas posing fleet-wide safety risk		♦	◊				
Runway Capacity Analysis	**$732**						
Conduct evaluation on the use of pilot-in-the-loop flight simulators for training of advanced maneuvers related to terminal area operations		♦	◊	◊			
Develop evaluation plan to identify RNP constraints		♦	◊	◊	◊		
Conduct analysis for operational landing distance performance of selected aircraft make/model/series		♦	◊				
Conduct evaluations on air traffic and flight procedures for terminal area operations by using pilot-in-the-loop flight simulator		♦	◊	◊	◊	◊	◊
Develop tools to model the safety hazards of rejected landing procedures and to identify possible training solutions		♦	◊	◊			
Evaluate the automatic LAHSO light system for safety of terminal area operations		♦					
Personnel and Other In-House Costs	**$2,060**						
Total Budget Authority	**$5,292**	**$4,883**	**$5,292**	**$5,174**	**$5,162**	**$5,116**	**$5,211**

FAA Budget Appropriation	Budget Item	Program Title	Budget Request
F&E	4A10	Center for Advanced Aviation Systems Development	$30,100,000

Supports FAA Strategic Goals: Increased Safety, Greater Capacity, International Leadership, and Organizational Excellence.

Program Goals and 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 initiative.
- 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 United Parcel Service.
- Performed research that is leading to initial implementation of Traffic Information Services – Broadcast (TIS-B) 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 Adviso;
- 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; and
- 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 2006 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 Local Area Augmentation System 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 1982-2005)	$168,737
FY 2006 Appropriated	37,895
FY 2007 Request	31,100
Out-Year Planning Levels (FY 2008-2011)	158,670
Total	$395,402

Budget Authority ($000)	**FY 2003 Enacted**	**FY 2004 Enacted**	**FY 2005 Enacted**	**FY 2006 Enacted**	**FY 2007 Request**
Contracts:					
Center for Advanced Aviation System	45,268	47,108	46,794	37,895	30,100
Personnel Costs	0	0	0	0	0
Other In-house Costs	0	0	0	0	0
Total	**45,268**	**47,108**	**46,794**	**37,895**	**30,100**

OMB Circular A-11, Conduct of Research and Development ($000)	**FY 2003 Enacted**	**FY 2004 Enacted**	**FY 2005 Enacted**	**FY 2006 Enacted**	**FY 2007 Request**
Basic	0	0	0	0	0
Applied	45,268	47,108	46,794	37,895	30,100
Development (includes prototypes)	0	0	0	0	0
Total	**45,268**	**47,108**	**46,794**	**37,895**	**30,100**

Center for Advanced Aviation System Development (CAASD) Product and Activities	FY 2007 Request ($000)	Program Schedule					
		FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011
Center for Advanced Aviation System Development (CAASD)							
Research, Engineering and Development	**$11,700**						
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	**$11,200**						
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	**$7,200**						
Define and develop requirements for advanced free flight concepts and capabilities that will be needed beyond Free Flight Phase 1		◆	◇	◇	◇	◇	◇
Deliver and evaluate a 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	**$30,100**	**$37,895**	**$30,100**	**$34,400**	**$36,550**	**$38,700**	**$49,020**

◆ - 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 5, NOT THE PROGRAM BUDGET LINE ITEM.

FAA Budget Appropriation	Budget Item	Program Title	Budget Request
Ops	N/A	Commercial Space Transportation Safety	$125,000

Supports FAA Strategic Goals: Increased Safety, Greater Capacity, International Leadership, and Organizational Excellence.

Program Goals and Intended Outcomes: The mission of the Commercial Space Transportation Safety Program is to ensure protection of the public, property, national security and foreign policy interests of the United States during a commercial launch or re-entry activity and to encourage, facilitate, and promote U.S. commercial space transportation. To achieve its mission, the program undertakes research projects intended to:

- Evaluate the results of the human consequence models used by the Office of the FAA's Associate Administrator for Commercial Space Transportation (AST) to base assessments of public risk from launch and re-entry debris on the best available empirical data.
- Determine initial requirements for the development of separation standards for aircraft and space vehicles.
- Prepare for the future collection of biomedical data to assess the physiological effects of short duration space flight to promote the continuous improvement of the safety of launch vehicles designed to carry humans.

Agency Outputs:

The research program completes or provides inputs for the development of regulations, advisory circulars, and/or guidelines that identify the requirements for the safe operation expendable as well as reusable launch vehicles (ELV/RLV). These outputs include:

- A comparison, performed with AST computational models, of empirical test results and historical events involving explosions to determine the vulnerability of humans in buildings to being injured by launch and re-entry debris.
- A report on initial requirements in the development of separation standards in order to integrate aviation and space traffic into the National Airspace System.
- A report recommending the type of data and equipment required to characterize medical and biological effects upon the human body during short-duration spaceflight.

Customer/Stakeholder Involvement:

The research on debris risk analysis was recommended by the Reusable Launch Vehicle Working Group (RLVWG) of the FAA Commercial Space Transportation Advisory Committee (COMSTAC). The results of this research will be presented to the RLVWG for comments and suggestions for further investigations.

The research performed in the development of initial requirements for separation standards between aircraft and space vehicles will enable the FAA to develop a corporate approach in managing and maintaining an efficient National Airspace System.

The concept of short duration space physiology research was suggested by a reusable launch vehicle developer who wants to collect data on their flights for the good of the industry to fill the gap of knowledge that exists. The results of this research will be presented to the COMSTAC RLV Working Group for comments and suggestions for further investigations.

Accomplishments:

In FY 2005, as part of the Debris Risk Analysis research, a draft report on the Khobar Towers data analysis was delivered to AST. This document initially validated the program's empirical evaluations, and provided recommendations to enhance the validity of computational vulnerability models for humans in buildings.

FY 2006 is the first year of funding for new activities known as "Initial Requirements for Development of Separation Standards of Aircraft and Space Vehicles," and "Biomedical Data Collection R&D."

R&D Partnerships:

AST will partner with several launch ranges engaged in debris risk analysis research that compares data from tests and historical accidents as part of an evaluation of computational vulnerability models for humans in buildings. The project will be carried out by AST and its contractor, ACTA Inc.

AST will partner with various FAA Lines of Business and the William J. Hughes Technical Center (WJHTC) to report on initial requirements for the development of separation standards affecting aircraft and space vehicles.

AST will partner with the FAA Civil Aerospace Medical Institute (CAMI) to recommend the type of biomedical data collection needed to characterize the physiological effects experienced by the human body during short duration spaceflight. The project will be carried out by AST, its support contractor Aerospace Corporation, and CAMI.

MAJOR ACTIVITIES AND ANTICIPATED FY 2006 ACCOMPLISHMENTS:

For the debris risk analysis project, the AST contractor will continue the comparison of test with historical event data to complete their evaluation of computational vulnerability models for humans in buildings. The contractor will compare and document sub-model results from AST tools for explosion-induced casualties with data from historical events, such as the Oklahoma City and Khobar Towers bombings, the Scud missile attacks on Israel in 1995, and the bombings of London in WWII. The contractor will also compare and document AST sub-model results for building penetration from empirical data such as tests conducted by the DoD. The contractor will draft and submit a report that details the specifics of the evaluation, including a discussion of the issues that arose during these comparisons and the methods by which those issues were resolved.

For the project on initial development of separation standards for aircraft and space vehicles, AST will collaborate with other FAA Lines of Business and the WJHTC to establish the initial requirements for separation standards in order to develop a corporate FAA approach to managing and maintaining an efficient National Airspace System.

The U.S. Government has collected data over the years on a very narrow anthropometric group of young, healthy individuals exposed to long-duration spaceflight. With its growth potential for space tourism, the emerging suborbital industry provides an opportunity to collect data on a wider range of subjects in short-duration spaceflight, an area that currently has little data. The AST contractor will identify in-flight and ground biomedical parameters that will allow for characterization of medical and biological effects experienced by the human body during spaceflight and identify in-flight and ground biomedical equipment and requirements necessary to monitor, measure, and record the recommended parameters.

FY 2007 PROGRAM REQUEST:

For all projects, authorized commercial space transportation research is currently included in the Operations budget.

KEY FY 2007 PRODUCTS AND MILESTONES:

None identified as yet. However, as research is conducted during the year, there may be indications of additional research efforts required during FY 2007, with appropriate products and milestones determined at that time.

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2005)	$
FY 2006 Appropriated	75
FY 2007 Request	125
Out-Year Planning Levels (FY 2008-2011)	500
Total	$

Budget Authority ($000)	**FY 2003 Enacted**	**FY 2004 Enacted**	**FY 2005 Enacted**	**FY 2006 Enacted**	**FY 2007 Request**
Contracts:					
Commercial Space Transporation Safety				75	125
Personnel Costs	0	0	0	0	0
Other In-house Costs	0	0	0	0	0
Total				**75**	**125**

OMB Circular A-11, Conduct of Research and Development ($000)	**FY 2003 Enacted**	**FY 2004 Enacted**	**FY 2005 Enacted**	**FY 2006 Enacted**	**FY 2007 Request**
Basic	0	0	0	0	0
Applied	0	0	0	0	0
Development (includes prototypes)				75	125
Total				**75**	**125**

Commercial Space Transportation Safety Product and Activities	FY 2007 Request ($000)	Program Schedule					
		FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011
Commercial Space Transportation Safety	**$125**						
Debris Risk Analysis							
Report on comparison study of human vulnerability to launch/re-entry debris		◆	◇	◇	◇	◇	◇
Initial Requirements for Development of Separation Standards for Aircraft and Space Vehicles							
Report on initial requirements in the development of separation standards in order to integrate space and aviation traffic into the NAS		◆	◇	◇	◇	◇	◇
Biomedical Data Collection R&D							
Report recommending data and equipment requirements for characterizing medical and biological effects on humans during short duration spaceflights		◆	◇	◇	◇	◇	◇
Total Budget Authority	**$125**	**$75**	**$125**	**$125**	**$125**	**$125**	**$125**

◆ - 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 5, NOT THE PROGRAM BUDGET LINE ITEM.

FAA Budget Appropriation	Budget Item	Program Title	Budget Request
R,E&D	A13.a.	Environment and Energy	$16,008,000

Supports FAA Strategic Goals: Increased Safety, Greater Capacity, International Leadership, and Organizational Excellence.

Intended Outcomes: The Environment and Energy Program helps achieve FAA's environmental compatibility goal and supports the FAA Flight Plan and the Joint Planning and Development Office (JPDO) Next Generation Air Transportation System (NGATS) plan. The Program:

- Improves analytic and planning tools that reveal aviation's impacts upon the environment (alone and as compared to pollutants from other sources) and the consequences of alternative courses of action – actions include developing comprehensive environmental analytical tools that address the interrelationships between noise and emissions and among environmentally beneficial actions affecting various emissions;
- Works with the international aviation community to reduce aircraft noise – actions include: improving aircraft certification standards and operational procedures; promoting compatible land use; and applying abatement technologies around populations exposed to aircraft operations;
- Minimizes the impact of aviation 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;
- Develops better science-based understanding of impacts of aircraft noise and aviation emissions on local air quality and climate change to enable the NGATS goal of three-fold growth in capacity by 2025, while reducing noise and emissions in absolute terms; and

The program is developing and validating methodologies, models, metrics, and tools to assess and mitigate the effect of aircraft noise and aviation emissions in a manner that balances the interrelationships between emissions and noise and includes economic consequences. To achieve this goal the program will:

- By FY 2007, develop and distribute a first generation of integrated noise and emission prediction and modeling tools;
- By FY 2008, develop airline and technology environmental cost module;
- By FY 2010, develop and disseminate a preliminary planning version of Aviation Environmental Design Tool that will allow integrated assessment of noise and emissions impact at the local and global levels; and
- By FY 2013, develop and field a fully validated suite of tools, including the Aviation Environmental Design and Aviation Environmental Portfolio Management tools, which will allow cost benefit analyses.

The program is also developing, applying, and disseminating knowledge and tools to support international harmonization and optimization of emissions and noise related aircraft certification standards, operational procedures and abatement technology. To achieve this goal, the program is:

- Developing data, requirements, standards, rules, and technical guidance addressing certification of new and modified designs for reduction of aircraft noise and emissions. By FY 2009, develop new technical guidance for certification;
- Conducting government-industry sponsored research through the Partnership for AiR Transportation Noise and Emissions Reduction (PARTNER) Center of Excellence (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;

Specifics of these cooperative research efforts include:

- By FY 2008, develop and disseminate new standards and methodologies to quantify and assess the impact of aircraft noise and aviation emissions for use by industry, government, and the public – also suggest a new metric to assess the acceptability of supersonic aircraft;
- By 2008, develop methodologies to quantify and assess the impact of Particulate Matter and Hazardous Air Pollutants (HAP);
- By 2010, assess the impacts of aviation on regional air quality including the effects of oxides of nitrogen (NOx) emissions that result when aircraft climb and cruise; and
- By 2011, assess the level of certainty of aviation's impact on climate change, with special emphasis on the effects of contrails.

- Preparing technical documentation and training materials for use by aircraft manufacturers and others. By FY 2007, develop methods and models to analyze aircraft and ground support equipment emissions and their impact on air quality. By FY 2010, develop noise and emissions exposure models for airspace management activities; and
- Providing computer models and impact criteria for use by civil aviation authorities in environmental assessments. By FY 2013, use hazardous air pollutants and particulate matter direct measurements from engines to replace factors used in modeling tools.

The program is also developing tools and data to support development of flight procedures and airspace design that reduce environmental impacts. By FY 2008, researchers will implement a new continuous-descent approach noise and emission abatement procedure at low-traffic airports during nighttime operations. Researchers will also identify advances required to adopt the procedure at medium and high capacity airports during all operations.

The program intends to provide an Internet capability to educate and inform the public about aviation and the environment and to enable the community to participate actively in public processes. By FY 2010, the program will test and deploy first elements of the website.

Agency Outputs: Aviation environmental research outputs include:

- Computer models and impact criteria for use by civil aviation authorities in assessing proposed actions;
- Better science-based understanding of impacts of aviation emissions on local air quality and climate change;
- Standards for the certification of new and modified aircraft and engine designs to reduce aircraft noise and engine exhaust emissions; and
- 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 that can 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 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 rule making activities, and its

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.

The FAA and other government agencies, industry, academia, and the public have developed an aviation Particulate Matter (PM) Roadmap to coordinate research and regulatory activities. The objective of this long-range action plan is to gain the necessary understanding of particle formation, composition, and growth and transport mechanisms for assessing aviation's particulate emissions, understanding their impact on human health and the environment. Ultimately, if warranted, this activity will guide the development of aviation related technology that results in reduced particulate emissions.

NGATS required a new level of collaboration. Under the NGATS, the FAA is leading an Integrated Product Team (IPT) responsible for all environmental dimensions of the JPDO. The IPT comprises FAA, NASA, the Environmental Protection Agency (EPA), DoD, Department of Commerce, Council on Environmental Quality, Department of the Interior, and Office of the Secretary of Transportation, as well as industry, academia, local government, and community groups. The efforts of the IPT are centered on advancing the national vision and recommendations for aviation in the NGATS and in the congressionally mandated study on "Aviation and the Environment."

Accomplishments: The number of people exposed to significant noise levels was reduced by about 90 percent between 1975 and 2005. Today's aircraft are also 70 percent more fuel-efficient-per-passenger-mile than jet aircraft of the 1960s. Reduced fuel consumption has also led to a 90 percent reduction in carbon monoxide, smoke, and other aircraft emissions. Other accomplishments include:

- Reported to Congress regarding:
  - A comprehensive national study of ways to reduce aircraft noise and emissions;
  - Quiet technology for air tour aircraft operating in Grand Canyon National Park; and
  - The annual progress of the FAA/NASA subsonic jet noise research program from FY 1994 to FY 2005.
- Established the PARTNER COE to allow partnerships with universities, research institutions, and industry to conduct exploratory research 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.
- Developed a long-term strategic plan for PARTNER.
- In collaboration with NASA, initiated a long-term, strategic effort to develop analytical tools to address the relationship between noise and emissions and different types of emissions. The long-term aim is a comprehensive approach to addressing all aspects of noise and emissions. The tools will facilitate better informed decisions which can cost in excess of 10 billion dollars to government and industry.
- Developed highly influential advanced computer models for airport and heliport noise analysis – users number over 850 in over 40 countries. The models are used in over 160 U.S. airport studies involving more than $1.8 billion in airport noise compatibility grants, and they

have provided the basis for an aircraft overflight noise exposure prediction model for Grand Canyon National Park.

- 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 awakening, (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 airline and airport operators.
- Developed and enhanced the computer model that is used extensively by over 300 domestic and international users in airport air quality analyses and has won the EPA's highest endorsement.
- Developed a first order approximation to help airports assess aircraft particulate emissions and demonstrate compliance with the National Environmental Policy Act and the Clean Air Act.
- Developed a methodology for assessing noise, local air quality emissions, and aviation climate impacts using a common currency.
- 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.
- The JPDO IPT instituted a framework for establishing national goals for aviation and the environment and completed a "gap analysis" of environmental R&D programs necessary to meet NGATS goals.

R&D Partnerships: Through a series of Memorandums of Agreement (MOA), 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. In FY 2005, the FAA signed an MOA with DoD to pursue joint activities to understand and mitigate aviation noise and emissions. The FAA is also pursuing collaborative agreements with DoE, and EPA to leverage resources to address aviation's environmental impact.

Through the JPDO NGATS, the program established an IPT comprising the FAA, NASA, EPA, DoD, Department of Commerce, Council on Environmental Quality, Department of the Interior, and Office of the Secretary of Transportation, as well as industry, academia, local government, and community groups. The IPT is pursuing an intensive, balanced approach, emphasizing alignment across stakeholders in developing needed business and technology architectures, as well as other relevant tools, metrics, and products to address aviation's environmental impact.

The Volpe National Transportation Systems Center 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 2006 ACCOMPLISHMENTS:

Noise and Emissions Analyses and inter-relationships

- Complete annual assessment of noise exposure and fuel burn.
- Deliver Aviation Environmental Design Tool (AEDT), Version 1.0 for the CAEP/7 Introduction).
- Deliver Environmental Design Space (EDS), Version 1.0 for CAEP/7 Introduction.
- Deliver Aviation environmental Portfolio Management Tool (APMT), Version 0.0 for CAEP/7 Introduction.
- Through the PARTNER COE, continue assessment and uncertainty analysis of the total environmental costs of aviation noise, local air quality, and climate change impact.
- Continue upgrades to the Integrated Noise Model (INM), Emissions Dispersion Modeling System (EDMS), Modeling System for Assessing Global Noise Exposure (MAGENTA), and System for Assessing Aviation Global Emissions (SAGE) modules for incorporation into AEDT and, as necessary, to support existing customers.
- Refine CDA benefits analyses.
- Work with candidate airports for appropriate implementation of CDA.
- Initiate assessment of CDA Applicability to airports with greater traffic levels, general mixed fleet, and mixed operations.

Aircraft noise

- Promulgate new procedures and technical guidance for noise certification for aircraft (subsonic jet and large transport airplanes, small propeller airplanes, and rotorcraft) that are both harmonized and simplified.
- Continue developing methods and techniques to improve use of supplemental noise metrics through the COE, including:
  - Correlate objective metrics with subjective perception of low frequency noise; and
  - Develop preliminary sonic boom acceptance metrics.
- With the "Aviation emissions activity," conduct a COE noise and emissions focused session at national and international conferences.
- Complete scoping the development of a prototype interactive website/software to communicate complex noise technical information in a manner suitable for public distribution (NoiseQuest).
- Continue evaluating the effectiveness of sound insulation, assessing encroachment issues, and examining land use versus airport controls to provide information to enhance land use practices around airports through the COE.
- Continue to assess potential benefits of using newly-developed noise reduction technologies; identify technology goals for long term reduction of aircraft emissions.

Aviation emissions

- Develop and publish:
  - Procedures and technical guidance materials for affordable engine exhaust emissions testing and certification that are both harmonized and simplified; and
  - Protocol for assessing hazardous air pollutants in the aviation environment.
- Continue to:

  - Assess potential benefits of using newly-developed emissions reduction technologies; identify technology goals for long term reduction of aircraft engine emissions; and
  - 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 recommended practices and methodologies for impact assessment.
- With the "Aircraft noise activity", conduct a Center of Excellence noise and emissions focused session at national and international conferences.
- Advance measurement technologies, develop aviation emissions metrics, and assess aviation emissions contributions to health impacts through the COE.
- Address uncertainties in understanding aviation's impact's on climate change.

FY 2007 PROGRAM REQUEST:

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.

The FAA will continue to work with NASA in research efforts identifying noise and emissions 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.

Ongoing Activities

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. However, aviation noise and emissions are highly interdependent phenomena. Future environmentally responsible aviation policy and rule making must 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 is developing 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 this framework include:

- EDS capability to provide integrated analysis of noise and emissions at the aircraft level;
- AEDT comprises EDS and other integrated aviation noise and emissions modules – will provide integrated capability of generating interrelationships between noise and emissions and among emissions at the local and global levels;
- 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 AEDT and APMT tools will allow:
  - Government agencies to understand how proposed actions and policy decisions affect and noise and emissions;
  - Industry to understand how operational decisions affect proposed projects affecting aviation noise and emissions; and
  - The public to understand how actions by government and industry affect aviation noise and emissions.

Anticipated benefits of this initiative include the ability to:

- Optimize environmental benefits of proposed actions and investments;
- Improve data and analysis on airport/airspace capacity projects;
- Increase capability to address noise and emissions interdependencies in the resolution of community concerns;
- Aid in more effective R&D portfolio management;
- Remove environmental roadblocks to capacity growth; and
- Continue global leadership for the United States in environmentally responsible aviation.

Other activities include:

- 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;
- Continue updating and enhancing existing analytical tool modules (e.g., INM, EDMS, SAGE, MAGENTA), as necessary, to support existing customers and transition to AEDT;
- 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; and
- Continue efforts to maintain the currency of the regulation and technical guidance materials concerning aircraft noise and engine exhaust emissions certification requirements.

KEY FY 2007 PRODUCTS AND MILESTONES:

Noise and Emissions Analyses and interrelationships

- Complete an annual assessment of noise exposure and fuel burn.
- Deliver AEDT Version 1.1, including EDS, capability for CAEP/8 Application.
- Deliver APMT Version 1.0 for CAEP/8 Application.
- Assess noise and emissions for various technology and operational scenarios.
- Demonstrate the benefit of assessing interdependencies through a significant example problem.
- Continue upgrades to INM, EDMS, MAGENTA, and SAGE modules for incorporation into AEDT and to support existing customers as necessary.
- Develop business case and cost allocation for implementation of CDA.
- Work with candidate airports for appropriate implementation of CDA.
- Include provisions for CDA usage in airspace redesign projects.
- Develop cockpit and controller tools to enable CDA implementation at higher traffic levels.

Aircraft noise

- Promulgate new procedures and technical guidance for noise certification for aircraft (subsonic jet and large transport airplanes, small propeller airplanes, and rotorcraft) that are both harmonized and simplified.
- Develop low frequency noise impact metrics and assess mitigation techniques; complete low frequency noise metrics assessment and publish a report.
- Complete aircraft low frequency noise study and publish report; obtain measurements, annoyance data, develop impact metrics and mitigation techniques.
- Investigate how average Day-Night-Level (DNL) performs compared to other noise impact metrics;

- Complete Land Use metrics study and publish a report.
- Conduct a study to analyze the four elements of the Balanced Approach to noise abatement and their relationships.
- Continue to assess potential benefits of using newly-developed noise reduction technologies; identify technology goals for long term reduction of aircraft noise;
- Based on scoping study results, develop interactive website/software to communicate complex noise technical information in a manner suitable for public distribution (NoiseQuest) and complete educational component of NoiseQuest.
- Advance the sonic boom metric definition and continue to assess the applicability of existing noise metrics to sonic boom and determine annoyance of low boom waveforms to inform future decision making regarding supersonic flight over land.
- With the "Aviation emissions activity," conduct two COE focused sessions at a national and an international conference.

Aviation emissions

- Continue to develop and publish:
  - Procedures and technical guidance materials for affordable engine exhaust emissions testing and certification that are both harmonized and simplified; and
  - Develop and disseminate standards and methodologies to quantify and assess the impact of Particulate Matter and Hazardous Air Pollutants Protocol for assessing hazardous air pollutants in the aviation environment.
- Continue to:
  - Assess potential benefits of using newly-developed emissions reduction technologies, and identify technology goals for long term reduction of aircraft engine emissions;
  - Assess the atmospheric and health effects of aviation related emissions through the COE; and
  - Test and analyze particulate matter emissions from aircraft engines under the PM Roadmap.
- Complete study to collect particulate matter data using light detection and ranging technology to enhance dispersion analytical models.
- Develop preliminary agreed upon methods to measure PM from commercial aircraft.
- Develop a model of near field plume expansion to feed local air quality models.
- Assess whether there are unique health effects, particularly for NGATS scenarios, associated with particulates and hazardous air pollutants from aviation sources.
- Initiate assessment of uncertainty of impact of aviation on climate change with special emphasis on the effects of contrails.
- Initiate an assessment of the impacts of aviation on regional air quality including the effects of NOx emissions attributable to aircraft climb and cruise activities.
- With the "Aircraft noise activity," conduct two COE focused sessions at a national and an international conference.

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2005)	$121,143
FY 2006 Appropriated	15,840
FY 2007 Request	16,008
Out-Year Planning Levels (FY 2008-2011)	59,791
Total	$212,782

Budget Authority ($000)	**FY 2003 Enacted**	**FY 2004 Enacted**	**FY 2005 Enacted**	**FY 2006 Enacted**	**FY 2007 Request**
Contracts:					
Aircraft Noise	18,192	3,921	1,164	1,366	1,367
Engine Emissions	1,941	2,340	467	1,596	1,766
Noise & Emissions Analyses			8,436	10,748	10,700
Personnel Costs	1,383	1,580	1,575	1,985	2,005
Other In-house Costs	97	87	153	145	170
Total	**21,613**	**7,928**	**11,795**	**15,840**	**16,008**

OMB Circular A-11, Conduct of Research and Development ($000)	**FY 2003 Enacted**	**FY 2004 Enacted**	**FY 2005 Enacted**	**FY 2006 Enacted**	**FY 2007 Request**
Basic	0	0	0	0	0
Applied	21,613	7,928	11,795	15,840	16,008
Development (includes prototypes)	0	0	0	0	0
Total	**21,613**	**7,928**	**11,795**	**15,840**	**16,008**

A13.a- Environment and Energy Product and Activities	FY 2007 Request ($000)	Program Schedule					
		FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011
091-016 Noise and Emissions Analysis	**$10,700**						
Develop 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 INM updates			◊		◊		
Enhance aircraft noise and emissions modeling for airspace management activities					◊		◊
Release EDMS updates		♦		◊			
Forecast future global emissions and complete updates to the SAGE model		♦		◊			
Release screening model for airport air quality, version 1, and updates		♦			◊		
Validate methodologies used to assess aviation emissions and their impact on air quality		♦	◊	◊			
Develop 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 AEDT			◊	◊	◊	◊	
Develop AEPMT			◊	◊		◊	
Harmonize AEDT and APMT databases and code management protocols			◊		◊		◊
Integrate cost and socioeconomic data			◊		◊		◊
091-110 Aircraft Noise	**$1,367**						
Assess FAA/NASA aircraft noise reduction technology research		♦	◊	◊	◊	◊	◊
Prepare noise COE reports, conferences, findings, and other publications		♦	◊	◊	◊	◊	◊
Publish Advisory Circular 36-4 (and updates)		♦		◊		◊	
Develop a new international noise standard for subsonic jets and large airplanes			◊			◊	
Develop a new national noise standard for helicopters					◊		
Validate the methodologies used to assess aircraft noise exposure and impact (INM, AEM)		♦		◊		◊	
091-111 Engine Emissions	**$1,766**						
Assess technological and scientific bases to support future ICAO engine emission standards		♦		◊		◊	
Develop alternative, simplified engine exhaust emissions certification test procedures				◊	◊		◊
Update Advisory Circular 34-1		♦			◊		◊
Develop measurement/sampling protocol for PM emissions from aircraft engines		♦		◊	◊		◊
Develop science/metrics and reduce uncertainties to assess impact of aviation on climate change			◊	◊	◊	◊	
Prepare COE reports, findings, and other activities			◊	◊	◊	◊	◊
Personnel and Other In-House Costs	**$2,175**						
Total Budget Authority	**$16,008**	**$15,840**	**$16,008**	**$15,302**	**$15,043**	**$14,631**	**$14,815**

FAA Budget Appropriation	Budget Item	Program Title	Budget Request
R,E&D	A11.a.	Fire Research and Safety	$6,638,000

Supports FAA Strategic Goals: Increased Safety, Greater Capacity, International Leadership, and Organizational Excellence.

Intended Outcomes: The Fire Research and Safety Program develops technologies, procedures, test methods, and criteria that can prevent accidents caused by hidden in-flight fires and fuel tank explosions and factors that can improve survivability during a post-crash fire. This research focuses on interior materials fire test methods and criteria; on near-term improvements in aircraft fuel tank explosion protection, fire detection and suppression systems; and on the long-range development of ultra-fire resistant cabin materials.

To reduce the number and severity of accidents associated with in-flight aircraft fires, the program develops and assesses ways to prevent ignition and flame propagation of cabin materials. By FY 2008, researchers will develop improved criteria for fire testing hidden materials, such as insulation, wiring, and heating, ventilation, and air conditioning (HVAC) ducting. The program also is developing and assessing means to extinguish in-flight fires. By FY 2008, researchers will develop criteria for the effective use of hand-held or fixed systems to put out hidden fires.

To prevent accidents caused by fuel tank explosions, the program is developing a practical, cost-effective inerting system. By FY 2008, researchers will conduct research and tests in support of the FAA's new rule establishing reduced flammability limits for fuel tanks.

The program also conducts tests to determine if composite transport aircraft, such as the Boeing 787, can provide the same level of in-flight and post-crash fire safety as current aircraft constructed of metallic materials. By FY 2008, researchers will develop fire test criteria for structural composites to ensure the same level of fire safety as currently exists in aircraft with metallic structures.

Agency Outputs: The FAA issues aircraft fire safety rules that improve material selection, design criteria, and operational procedures. The 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. Through this research, which is resulting in new materials and government-owned patents, the FAA provides industry with critical new safety products and information.

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

- Aircraft Safety Subcommittee of the FAA Research, Engineering and Development Advisory Committee – representatives from industry, academia, and other government agencies annually review the program's activities.
- Technical Community Representative Groups – FAA representatives apply formal guidelines to ensure that the program's research projects support new rule making and development of alternate means of compliance for existing rules.
- Aircraft manufacturers (U.S. and foreign), airlines, foreign airworthiness authorities, chemical companies, material suppliers, and aircraft fire safety equipment manufacturers – focuses on interior material fire tests and improvement of fire detection and suppression systems.
- National Transportation Safety Board (NTSB) – focuses 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 over two-dozen reports and papers highlighting research results that have lead to major improvements in aircraft safety.

Outstanding program accomplishments include:

- Demonstrated the effectiveness of the FAA-developed fuel tank inerting system during flight tests in an Airbus 320 operated by Airbus and in a Boeing 747 operated by NASA.
- Developed thermal protection test criteria for oxygen container carrying cases designed to prevent the release of oxygen from cargo fire heating causing over pressurization – in 2004 the Department of Transportation Research and Special Projects Administration proposed a regulation requiring the use of this test criteria.
- Designed, built, and demonstrated an on-board inerting system to prevent fuel tank explosions, and persuaded Boeing to seek FAA certification of this system for its 737 and 747 aircraft.
- Determined the minimum concentration of oxygen required to inert a fuel tank to prevent explosions.
- Developed the fire test guidance for thermal acoustic insulation, including in-flight fire resistance and post-crash fire burn-through resistance – published in two 2005 Advisory Circulars.
- Completed tests leading to a proposed 2005 FAA airworthiness directive, requiring the removal of AN-26 insulation in over 800 U.S. operated aircraft because of its vulnerability to ignition by an electrical arc.
- Characterized the hazards of primary lithium battery fires, leading to the issuance of a 2004 interim final rule that banned the shipment of primary lithium batteries in passenger carrying aircraft.
- Developed and published minimum performance standards for halon replacement fire extinguishing agents in cargo compartments, lavatories, and hand-held extinguishers.
- In 2005, licensed the FAA-patented Microscale Combustion Calorimeter technology to two companies that will sell this unique and versatile fire test method.
- Developed and patented a hand-held extinguisher nozzle that discharges carbon dioxide as dry ice, increasing the agent effectiveness.

R&D Partnerships: Fire Research and Safety Program R&D partners include:

- FAA-sponsored International Systems Fire Protection Working Group – R&D involves fuel tank protection, hidden fire safety, fire/smoke detectors, halon replacement, and lithium battery fire hazards.
- FAA-sponsored International Aircraft Materials Fire Test Working Group – R&D involves development and standardization of improved material fire tests.
- Integrated FAA and NASA program – R&D involves research on gas generation systems for fuel tank protection, advanced fire/smoke detectors, and explosion/fire resistant composite structure.
- Interagency working group on fire and materials – promotes technology exchange among U.S. Government agencies and prevents unwarranted duplication of work.
- Interagency agreement with the National Institute of Standards and Technology – develops fire retardant mechanisms and rapid screening tools for flammability.

- Memorandum of cooperation with the British Civil Aviation Administration – R&D involves a variety of fire safety research efforts.
- Cabin safety research technical group – cooperates in and coordinates cabin safety research conducted and/or sponsored by the international regulatory authorities.
- Grant programs with educational institutions and consortia.
- Arrangements with Fortune 100 companies to share development costs for new fire resistant materials.

MAJOR ACTIVITIES AND ANTICIPATED FY 2006 ACCOMPLISHMENTS:

Fire Safety Improvements

- Develop an improved fire test method for HVAC ducting.
- Evaluate the effectiveness and safety of nitrogen-enriched air (NEA) in extinguishing hidden fires above a cabin ceiling.
- Evaluate the cabin hazards caused by outgassing from a composite fuselage subjected to a postcrash fuel fire (intermediate scale tests).
- Determine the aircraft hazards caused by cargo fires involving lithium ion batteries.
- Evaluate the reproducibility of the FAA-required seat cushion flammability test method.

Fire Resistant Materials

- Develop and demonstrate an elastomer for use in seat cushions, pillows, and flexible sealants with an order of magnitude reduction in heat release rate.
- Characterize the fire performance of ultra-fire resistant chlorinated bisphenol polymers for aircraft interior applications.

FY 2007 PROGRAM REQUEST:

Ongoing Activities

Research will continue to prevent uncontrollable in-flight fires originating in hidden areas, and will include improved fire test methods for materials and for fire extinguishment. Previously developed improved fire test methods for HVAC ducting and electrical wiring will be standardized. The adaption of an On Board Inert Gas Generator System (OBIGGS), for fuel tank explosion protection will be evaluated for hidden fire extinguishment. Researchers will determine OBIGGS' effectiveness for both the attic space above the cabin ceiling and the electrical bay. They will also assess OBIGGS to determine if any modifications are needed to ensure the system achieves the desired level of protection. In addition, researchers will conduct cost benefit analyses for both the current OBIGGS and the modified system.

Because the unprecedented use of composite structures in the fuselage and wings of the new Boeing 787 transport airplane may potentially affect postcrash and in-flight fire safety, researchers will study the effects of an external fuel fire on survivability for both an intact and a damaged fuselage. When the fuselage is intact, the major hazards affecting survivability are toxic gases and smoke. Fire spread is an additional concern when the fuselage is damaged. In-flight fire safety concerns relate to both composite flammablity and heat transfer characteristics. Researchers will develop a test method to determine the effects of combustion and flame spread on the fuselage skin during an in-flight fire. Similarly, researchers will determine the difference in heat losses between a composite and aluminum skin to understand how aluminum and composite materials react during an in-flight fire.

Research to prevent fuel tank explosions will primarily address those issues raised in response to a 2005 proposed FAA regulation requiring reduced flammability for fuel tanks in large transport aircraft with vulnerable heated center wing tanks. Researchers will also address the safety of aviation mechanics in the event of a catastrophic leak of nitrogen enriched air and will recommend possible protective measures.

Researchers will conduct other tests and studies, as required, to support FAA regulatory activities, improving the reproducibility and simplicity of existing fire test requirements, and responding to NTSB recommendations. In some cases, industry and foreign regulatory authority participation will be obtained through the activities of the International Material Fire Tests and Systems Fire Protection Working Groups, chaired and administered by the FAA. One of the major products of these groups is the Aircraft Material Fire Tests Handbook, which is periodically updated.

The FAA will continue to conduct long-term, applied research to develop the enabling techology for ultra-fire resistant aircraft interior materials. In FY 2007, researchers will demonstrate a fiber for use in seat upholstery fabric, carpet, decorative murals and drapery that will provide an order of magnitude reduction in heat release rate compared to current requirements. Also, they will fabricate previously demonstrated low heat release elastomers into small samples and test them for in-service requirements such as durability, resiliency, mechanical strength, and sealing ability.

New Initiatives

No new initiatives are planned in FY 2007.

KEY FY 2007 PRODUCTS AND MILESTONES:

Fire Safety Improvements

- Standardize the improved fire test methods previously developed for HVAC ducting and electrical wiring.
- Determine the effectiveness of NEA provided by OBIGGS technology in extinguishing a fire hidden in the attic area above the cabin ceiling or in the electrical bay.
- Determine the impact of an external fuel fire impinging on an intact or ruptured composite fuselage on postcrash fire survivability.
- Assess the safety impact of the expected different heat transfer characteristics of a composite fuselage skin exposed to a hidden in-flight fire, compared to a conventional aluminum skin.
- Evaluate the risk to mechanics working in the vicinity of a catastrophic leak of nitrogen enriched air from a fuel tank inerting system.
- Update the Aircraft Materials Fire Tests Handbook.

Fire Resistant Materials

- Develop and demonstrate a fiber for use in seat upholstery, carpet, decorative murals, and drapery with an order of magnitude reduction in heat release rate.
- Fabricate and test samples of low heat release elastomers for resiliency, durability, mechanical strength, and sealing ability.

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2005)	$128,178
FY 2006 Appropriated	6,182
FY 2007 Request	6,638
Out-Year Planning Levels (FY 2008-2011)	26,750
Total	$167,748

Budget Authority ($000)	**FY 2003 Enacted**	**FY 2004 Enacted**	**FY 2005 Enacted**	**FY 2006 Enacted**	**FY 2007 Request**
Contracts:					
Fire Research and Safety	2,903	6,311	3,263	2,570	2,816
Personnel Costs	2,796	3,043	2,890	3,379	3,588
Other In-house Costs	252	314	372	233	234
Total	**5,951**	**9,668**	**6,525**	**6,182**	**6,638**

OMB Circular A-11, Conduct of Research and Development ($000)	**FY 2003 Enacted**	**FY 2004 Enacted**	**FY 2005 Enacted**	**FY 2006 Enacted**	**FY 2007 Request**
Basic	0	0	0	0	0
Applied	5,951	9,668	6,525	6,182	6,638
Development (includes prototypes)	0	0	0	0	0
Total	**5,951**	**9,668**	**6,525**	**6,182**	**6,638**

A11a - Fire Research and Safety Product and Activities	FY 2007 Request ($000)	Program Schedule					
		FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011
061-110 Fire Research & Safety							
Fire Resistant Materials	**$475**						
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		♦	◊	◊			
Evaluate improvement in post-crash fire survivability provided by ultra-fire resistant materials during full-scale fire tests						◊	
Fire Safety Improvement	**$2,341**						
Develop an improved fire test method for HVAC ducting		♦					
Standardize the improved fire tests previously developed for ducting and wiring			◊				
Evaluate the effectiveness and safety of NEA in extinguishing a fire in the cabin attic		♦					
Determine the effectiveness of NEA from an OBIGGS in extinguishing attic and electrical bay fires			◊				
Evaluate cabin hazards by outgassing from a composite fuselage exposed to a postcrash fuel fire		♦					
Determine survivability impact of fuel fire on intact or ruptured fuselage			◊				
Assess safety impact of reduced heat losses from composite fuselage skin exposed to hidden in-flight			◊				
Develop fire test method for composite fuselage				◊			
Evaluate risk to mechanics from catastrophic NEA leak			◊				
Determine hazards caused by lithium ion cargo fires		♦					
Evaluate reproducibility of seat cushion flammability test method		♦					
Update Aircraft Material Fire Tests Handbook			◊				
Characterized cabin and fuselage fires in very large transport aircraft (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	**$3,822**						
Total Budget Authority	**$6,638**	**$6,182**	**$6,638**	**$6,597**	**$6,651**	**$6,676**	**$6,826**

FAA Budget Appropriation	Budget Item	Program Title	Budget Request
R,E&D	A11.g.	Flightdeck/Maintenance/System Integration Human Factors	$7,999,000

Supports FAA Strategic Goals: Increased Safety, Greater Capacity, International Leadership, and Organizational Excellence.

Intended Outcomes: The Flightdeck/Maintenance/System Integration Human Factors Program helps achieve the FAA's Flight Plan strategic safety goal by:

- Developing more effective methods for pilot, 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 pilot, inspector, and maintenance technician task performance;
- Developing methodologies to identify and mitigate risk factors in automation-related operator errors; and
- Developing requirements, knowledge, guidance, and standards for design, certification, and use of automation-based technologies, tools, and support systems.

By FY 2007, researchers will evaluate methods to mitigate the potential for incidents and accidents by assessing and removing causal factors of human error from flight deck operations and aviation maintenance. Researchers will begin developing guidance on how advanced technology can be used for inspection training and reducing errors in general aviation maintenance. The research team will also complete development of the Human Factors Certification Job Aid, Version 8 for Parts 25 (Airworthiness Standards for Transport Category Airplanes) and 23 (Airworthiness Standards including Commuter Category Airplanes). This tool will support FAA certification personnel, aircraft designers, and researchers in addressing possible human factors concerns related to displays, controls, flight deck systems, pilot tasks, and procedures. It will also address equipment and testing assumptions.

By FY 2008, researchers will develop a system safety approach to understand error patterns of pilots, maintenance personnel, and inspectors, and identify intervention strategies. They will develop certification guidelines and human factors standards for integrating advanced technologies. They will also develop training guidelines for flight deck error management.

Agency Outputs: The Human Factors Research and Engineering program provides the research foundation for FAA guidelines, handbooks, advisory circulars, rules, and regulations that help to ensure the safety and efficiency of aircraft operations. It 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 framework 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 to improve operator performance and reduce errors; and
- Selection and Training – applying program-generated knowledge of human factors to improve selection and training of aviation system personnel.

Customer/Stakeholder Involvement: Program researchers work directly with colleagues in the FAA, other government agencies, academia, 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); and
- 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 accomplishments include:

Information Management and Display

- Developed a manual, adopted for use by the International Civil Aviation Organization (ICAO), that addresses appropriate human factors considerations in designing flight deck operating documents.
- 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 the use of automation in air carrier cockpits.

Human Performance Assessment

- Developed an inexpensive, reliable method to measure night vision goggle cockpit lighting compatibility.
- Provided guidance for precision visual flight rules and simultaneous non-interfering routes that will allow rotorcraft with global positioning system navigation capabilities to stay within narrow, defined horizontal airspace limits while operating under visual flight rules.
- Completed detailed general aviation fatal accident human error analysis by using the Human Factors Analysis and Classification System to determine how often each error type is in the causal chain of events and finding the exact types of errors committed that lead to a fatal accident.
- Completed initial mapping of flight data parameters onto AQP qualification standards.

Selection and Training

- Developed an industry-wide benchmark for aviation maintenance inspection. This computer based inspection training program will standardize inspection training processes in the general aviation industry.
- Provided guidance on an acceptable vision standard for personnel involved in nondestructive inspection and testing and visual inspection of aircraft and aircraft components.
- Developed educational materials that will help reduce general aviation accidents.
- Developed and validated a proceduralized pilot crew resource management (CRM) training and assessment system.

- Improved a line operations safety audit (LOSA) methodology that has been adopted by ICAO to help air carriers identify human-centered safety vulnerabilities.
- Completed a Flight Plan Target automation report specifying pilot proficiency standards for Technically Advanced Aircraft.

R&D Partnerships: The Flightdeck/Maintenance/System Integration Human Factors Program collaborates with industry and other government programs through:

- Joint Safety Analysis Teams and Joint Safety Implementation Teams 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 industry partners like Boeing, Continental Airlines, British Airways, and the International Association of Machinists– 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.
- 19 FAA grants to universities supporting 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 2006 ACCOMPLISHMENTS:

Information Management and Display

- Identify human factors issues in instrument procedures design.
- Provide an understanding of how broadband technology may aid maintenance personnel in their tasks and improve the work environment.
- Develop guidance for proficiency standards for advanced avionics.

Human-Centered Automation

- Distribute training guidelines for effective automation performance.
- Distribute an advanced knowledge assessment software tool to air carriers.
- Continue development of human factors Certification Job Aid for FAR Parts 25 and 23 flight decks.

Human Performance Assessment

- Develop guidance stipulating the minimum see-and-avoid optical system needed for an unmanned aerial vehicle ground station operator to detect an approaching airborne object.
- Develop guidance on the extent to which test criteria used by Designated Pilot Examiners conforms to the pilot certification requirements of 14 CFR Part 61 and the Practical Test Standards.
- Develop educational materials that will help reduce accidents caused by problems of visibility in the aviation air and ground environments.
- Validate analysis methods for simulator and flight data to arrive at a common platform to determine the effectiveness of training safety interventions.
- Validate methods to improve air carrier pilot assessment in an air carrier training curriculum by examining reliability, sensitivity and sampling techniques for pilot training and checks.

- Distribute analytical methods that link FOQA, ASAP and AQP data.
- Distribute a report on challenges facing implementation of ASAP programs.

Selection and Training

- Validate methods to trend ASAP data.
- Distribute training guidelines for unexpected flight deck events.
- Develop a report on enhanced LOSA methodology.
- Develop a "best practices" document to inform the aviation community of potential problems associated with fatigue in combination with environment when performing Liquid Penetrant and Fluorescent Magnetic Particle Inspection.
- Develop guidance for maintenance and operator training and qualification requirements related to the operation of unmanned aerial vehicles within the NAS.
- Flight Plan Target – Develop reference manual describing awareness, knowledge and skill elements for Technically Advanced Aircraft.
- Flight Plan Target – Design a prototype inspection training system for general aviation inspectors.

FY 2007 PROGRAM REQUEST:

The program will continue to focus on providing technical information and advice to improve pilot, 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

- Continue research on automation knowledge assessment, diagnosis and remediation.
- Establish human factors guidelines for electronic flight bag use in the cockpit.
- Validate an advanced knowledge assessment software tool for automated aircraft.
- Develop the human factors Certification Job Aid for FAR Parts 25 and 23 flight decks.

Human Performance Assessment

- Identify intervention strategies to either prevent or mitigate general aviation accidents.
- Develop methods to assess the financial cost of FOQA events.
- Explore best methods to analyze the LOSA archive data base in order that findings can be reported to the FAA and industry in a meaningful manner.
- Develop human factors recommendations for effective decision-making among voluntary safety program teams.
- Develop methods to expand air carrier internal evaluations.

Selection and Training

- Develop pilot proficiency recommendations for current-generation technically advanced aircraft (TAA).

- Investigate methods to prepare low-time pilots for high-density operations.
- Validate simulator training requirements for low-time regional pilots.
- Investigate methods to prepare low-time pilots for effective and prudent operational decision-making.
- Develop training for commercial pilot critical skills retention.
- Investigate the theoretical underpinnings of historical CRM versus newer models.
- Link threat and error management ASAP classification schemes to LOSA and AQP data.

New Initiatives

- Develop and evaluate off-the-shelf advanced technologies, like virtual reality, for training and evaluation in maintenance.
- Measure the status and impact of regulatory change related to human factors maintenance in Canada and Europe and other regulatory domains.
- Implement and evaluate a risk assessment system for maintenance equipment and procedure design in pre- and post certification scenarios.
- Identify criteria that influence pilot decision-making and what influences pilots to make either a good or bad decision based on those criteria.
- Develop guidance on the types of perceptual cues a helicopter pilot uses during transition from forward to hover flight.
- Develop guidelines for manufacturers to use when designing cockpit instrument panel layouts for rotorcraft.

KEY FY 2007 PRODUCTS AND MILESTONES:

Information Management and Display

Complete development of:

- Guidance on communicating maintenance ASAP derived actions and recommendations using the web-based ASAP safety-information and program-tracking tool;
- Human factors guidelines for instrument procedure design; and
- Guidelines regarding multiple weather sources on a multi-function display.

Human-Centered Automation

- Complete development of Certification Job Aid for FAR Parts 25 and 23 flight decks.
- Develop a risk assessment tool applicable to pre-certification of maintenance procedures and equipment.
- Complete phase one report on advanced methods to assess automation knowledge, diagnosis of shortcomings and their causes, and develop remediation techniques.
- Report on the validation study of the advanced knowledge assessment tool.

Human Performance Assessment

- Revise the Human Factors Guide for Aviation Maintenance and Inspection.
- Complete a report on methods to assess the financial cost of FOQA events.
- Complete a report on analysis of LOSA Archive database.
- Develop recommendations for effective decision-making among voluntary safety program teams.
- Complete a report on methods to expand air carrier internal evaluations.

Selection and Training

- Develop pilot proficiency recommendations for very-light jets.
- Test the application of advanced training technology, like virtual reality, for maintenance.
- Provide ASAP enhancements for reporting factors contributing to aviation incidents.
- Complete a report on new training requirements for low-time regional pilots.
- Complete a report on critical skill retention.
- Complete a report on theoretical underpinnings of CRM.
- Complete a report on threat and error management model encompassing ASAP, LOSA and AQP.

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2005)	$187,765
FY 2006 Appropriated	8,099
FY 2007 Request	7,999
Out-Year Planning Levels (FY 2008-2011)	31,189
Total	235,052

Budget Authority ($000)	**FY 2003 Enacted**	**FY 2004 Enacted**	**FY 2005 Enacted**	**FY 2006 Enacted**	**FY 2007 Request**
Contracts:					
Flightdeck/Maintenance/System Integration Human Factors	6,330	4,647	8,157	5,338	4,954
Personnel Costs	2,582	2,856	2,664	2,626	2,902
Other In-house Costs	845	841	879	135	143
Total	**9,757**	**8,344**	**11,700**	**8,099**	**7,999**

OMB Circular A-11, Conduct of Research and Development ($000)	**FY 2003 Enacted**	**FY 2004 Enacted**	**FY 2005 Enacted**	**FY 2006 Enacted**	**FY 2007 Request**
Basic	0	0	0	0	0
Applied	9,757	8,344	11,700	8,099	7,999
Development (includes prototypes)	0	0	0	0	0
Total	**9,757**	**8,344**	**11,700**	**8,099**	**7,999**

A11g – Flight Deck/Maintenance/System Integration Human Factors Product and Activities	FY 2007 Request ($000)	Program Schedule					
		FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011
081-110 Flightdeck/Maintenance/System Integration Human Factors							
Selection and Training	**$2,007**						
Investigate methods to prepare low-time pilots for high-density operations			◊	◊	◊		
Validate simulator training requirements for low-time regional pilots			◊	◊	◊	◊	
Develop training for critical skill retention		♦	◊	◊	◊		
Link threat and error management ASAP classification themes to LOSA and AQP data		♦	◊	◊	◊	◊	◊
Provide guidance and develop educational tools for the FAA/Industry Training Standards program that will integrate different technologies into any aircraft platform		♦	◊	◊	◊	◊	
Develop and evaluate off-the-shelf advanced technologies, such as virtual reality, for training and evaluation in aviation maintenance			◊	◊	◊		
Develop guidance on how advanced technology can be used for inspection training and reducing errors in general aviation maintenance		♦	◊				
Human Performance Assessment	**$335**						
Develop methods to assess the financial cost of FOQA events		♦	◊	◊	◊	◊	
Develop human factors recommendations for effective decision-making among voluntary safety program teams		♦	◊	◊	◊		
Provide human factors guidance for the operation of unmanned aerial vehicles within the NAS		♦	◊	◊	◊		
Develop guidance on the extent to which test criteria used by Designated Pilot Examiners conform to the pilot certification requirements of 14 CFR Part 61 and the Practical Test Standards		♦	◊	◊			
Human-Centered Automation	**$1,472**						
Complete Certification Job Aid for FAR Part 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	**1,140**						
Develop guidelines for instrument procedures design		♦	◊	◊	◊	◊	◊
Develop guidelines for the display of weather on multi-function displays		♦	◊	◊			
Provide guidelines for manufacturers to use when designing cockpit instrument panel layouts for rotorcraft			◊	◊	◊		
Develop maintenance human factors "best practices" documents, practical tools, and surveillance tools to aid industry		♦	◊	◊	◊		
Identify factors that can maximize the likelihood of successful implementation of ASAP for aircraft maintenance programs		♦	◊				
Personnel and Other In-House Costs	**$3,045**						
Total Budget Authority	**$7,999**	**$8,099**	**$7,999**	**$7,815**	**$7,794**	**$7,719**	**$7,861**

FAA Budget Appropriation	Budget Item	Program Title	Budget Request
F&E	1A01E	General Aviation and Vertical Flight Technology (GA&VF)	$2,000,000

Supports FAA Strategic Goals: Increased Safety, Greater Capacity, International Leadership, and Organizational Excellence.

Program Goals and Intended Outcomes: The General Aviation and Vertical Flight (GA&VF) Technology Program directly supports goals and programs delineated in the FAA's *Flight Plan 2006-2010*, the *Aviation Safety Action Plan*, the RTCA *Free Flight Action Plan*, the *Operational Evolution Plan*, the Performance-Based Operations Aviation Rulemaking Committee, and the ongoing National Airspace System architecture development effort. The program emphasizes the 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 2006-2010*. 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 GA aircraft. The program's initiatives to add new routes and improve landing and departure capabilities for helicopters during low visibility weather conditions also increase GA access to high-demand metropolitan areas in support of the strategic goal of *Greater Capacity*. And the program supports the strategic goal of *International Leadership* through recommendations to incorporate some of its own standards and procedures into the standards and practices of the International Civil Aviation Organization.

The program's applied research and development activities 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 use by Air Traffic Management, but it also enables these services at locations where they 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 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 program's new terminal instrumentation 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 improved aviation services 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 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 and situational awareness 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 all 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 and Safer Skies initiatives.

Low Altitude CNS Infrastructure and Pilot Situational Awareness Capability– route system guidelines, cockpit display guidelines, noise abatement procedures, and terminal and en route system integration plans for low altitude CNS operations. Establishment of test beds to foster efficient use of airspace and improved situational awareness for GA pilots.

Homeland Security – Feasibility assessments of concepts and procedures related to GA aircraft operations, related avionics and security equipment requirements. This program emphasis encourages the use of test beds established in high security areas as elements of comprehensive homeland security initiatives.

Customer/Stakeholder Involvement:

Customers Include:

- Helicopter Association International
- Eastern Region Helicopter Council
- 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 an 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.
- Established criteria to publish mountain pass waypoints on VFR charts.
- Completed a report on a simulation working with industry pilots to determine the adequacy of Instrument Landing System (ILS) Category I lighting systems to support helicopter instrument landing system approaches during lower minimum weather conditions.

- Reported on procedures for providing enhanced services for time-critical (e.g., law enforcement or emergency medical services) VFR vertical flight operations.
- Amended the Aeronautical Information Manual to provide guidance on special practices and techniques for helicopters in off-shore environments, and developed information to describe the overall capability of Automatic Dependent Surveillance-Broadcast (ADS-B), Traffic Information Service-Broadcast (TIS-B) and Flight Information Service-Broadcast (FIS-B).
- Completed a first phase report on maximum safe descent angle for helicopters during the visual segment of an instrument approach to a heliport.
- Completed a report, with recommendations for new research, on current and developing heliport lighting and marking technologies.
- Conducted tests, collected data, and initiated work on reports on how human factors affect the determination of precision VFR (PVFR) routes and the precision that pilots can maintain on these routes.
- Completed work to enable ILS Category I equipped helicopters to utilize ILS Category II facilities and thus provide them a safe approach in lower than their presently allowable minimal weather conditions.
- Completed a simulation report on potential helicopter routes that could be operated with minimal interference to fixed-wing traffic in the New York Metropolitan Area.
- Established a test bed in the New York Metropolitan Area to test and estimate the benefits and costs of SNI routes, improved heliport instrument approaches, and improved situational awareness services.
- Completed testing and data collection for GPS Wide Area Augmentation System (WAAS) lateral guidance for point-in-space (PINS) approaches and departures at airports and heliports.
- Completed helicopter holding pattern TERPS data analysis.

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 2006 ACCOMPLISHMENTS:

- Report on human factors issues affecting how PVFR routes are flown and the precision that pilots can maintain on the routes.
- Initiate research on new lighting concepts and technology for IFR and VFR operations at heliports.
- Complete final flight testing (utilizing industry pilots) and data analysis on maximum safe descent angle for helicopters during the visual segment of an instrument approach to a heliport.
- New York Metropolitan Area Test Bed – provide four new point-in-space approaches to heliports, install and commission three ADS-B ground stations. Commission FIS and TIS services, and revise design of SNI route structure. Establish Industry/FAA partnership with Eastern Region Helicopter Council for SNI routes and improved situational awareness capability in the New York terminal area.

- Initiate flight testing and data collection for WAAS vertically guided point-in-space approaches to heliports.
- Initiate a Small Business Innovative Research project for low cost voice recognition avionics.
- Initiate research into the helicopter instrument approach decision point annunciator.

FY 2007 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 reduce the incidence of Controlled Flight into Terrain (CFIT) involving light general aviation aircraft and vertical flight aircraft.

KEY FY 2007 PRODUCTS AND MILESTONES:

- Begin testing and demonstrating select technologies involving vertical flight and light general aviation at the New York Metropolitan Area (NYMA) Test Bed. Include: the study of SNI routes utilizing GPS Wide Area Augmentation System (WAAS) navigation capabilities and non-precision approaches to New York City heliports; and data collection on the benefits of SNI routes and TIS and FIS services. Initiate the design of improved SNI routes based on optimized CNS capabilities, the results of simulation, and air traffic controller feedback.
- Conduct flight tests and data collection for operations criteria for PVFR operations.
- Conduct flight tests and data collection for heliport IFR steep angle approach, missed approach, and departure standards for helicopters utilizing GPS WAAS capabilities.
- Initiate design of tiltrotor IFR approaches to heliports.
- Complete research on new lighting technologies for IFR and VFR operations.
- Evaluate operations procedures and technology requirements for reduced controlled flight into terrain for helicopters.
- Complete research into the helicopter instrument approach decision point annunciator.

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2005)	$9,190
FY 2006 Appropriated	1,490
FY 2007 Request	2,000
Out-Year Planning Levels (FY 2008-2011)	8,000
Total	$20,680

Budget Authority ($000)	**FY 2003 Enacted**	**FY 2004 Enacted**	**FY 2005 Enacted**	**FY 2006 Enacted**	**FY 2007 Request**
Contracts:					
Geneeral Aviation And Vertical Flight	1,000	1,400	1,488	1,490	2,000
Personnel Costs	0	0	0	0	0
Other In-house Costs	0	0	0	0	0
Total	**1,000**	**1,400**	**1,488**	**1,490**	**2,000**

OMB Circular A-11, Conduct of Research and Development ($000)	**FY 2003 Enacted**	**FY 2004 Enacted**	**FY 2005 Enacted**	**FY 2006 Enacted**	**FY 2007 Request**
Basic	0	0	0	0	0
Applied	0	0	0	0	0
Development (includes prototypes)	0	1,400	1,488	1,490	2,000
Total	**1,000**	**1,400**	**1,488**	**1,490**	**2,000**

General Aviation and Vertical Flight Technology Product and Activities	FY 2007 Request ($000)	Program Schedule					
		FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011
General Aviation and Vertical Flight Technology							
Simultaneous Non Interfering Operations	**$900**						
Conduct precision VFR route testing and analysis		◆	◇	◇			
Conduct SNI/GPS/ADS-B and TIS/FIS services studies at the NYMA test bed using existing standards		◆	◇	◇			
Continue the FAA/Industry Partnership for the New York Thruway Authority test bed		◆	◇	◇	◇		
Initiate NYMA Simulation/Modeling for improved SNI routes utilizing WAAS and ADS-B			◇	◇			
Initiate NYMA Simulation/Modeling for LAAS Standards				◇	◇		
Conduct NYMA demonstration with WAAS/LAAS standards					◇	◇	◇
Develop recommendation for WAAS/LAAS SNI national development					◇		
Instrument Operations at Heliports/Vertiports	**$600**						
Study maximum helicopter instrument approach angle		◆	◇				
Design, test and demonstrate heliport IFR/VFR lighting		◆	◇	◇	◇		
Study helicopter performance/instrumentation for application to heliport approaches		◆	◇				
Develop helicopter WAAS vertical guidance for PINS heliport approaches		◆	◇				
Develop helicopter/Tiltrotor criteria for complex approaches to heliports				◇	◇	◇	◇
Advanced Technology and Procedures Applications	**$500**						
Conduct SBIR voice activated avionics research		◆	◇				
Conduct research with the Helicopter decision point annunciator		◆	◇				
Determine operations procedures and technology requirements for helicopter CFIT			◇	◇			
Develop enhanced vision for light GA aircraft pilot and inspector guidance				◇	◇		
Develop copter/light GA synthetic vision displays pilot and inspector guidance				◇	◇	◇	
Improve weather distribution in the Gulf of Mexico					◇	◇	
Analyze options for GAVF support of Homeland Security				◇	◇	◇	◇
Total Budget Authority	**$2,000**	**$1,490**	**$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 5, NOT THE PROGRAM BUDGET LINE ITEM.

FAA Budget Appropriation	Budget Item	Program Title	Budget Request
R,E&D	A12.a.	Joint Program and Development Office	$18,100,000

Supports FAA Strategic Goals: Increased Safety, Greater Capacity, International Leadership, and Organizational Excellence.

Intended Outcomes: The Joint Program and Development Office (JPDO) is leading the development and implementation of the Next Generation Air Transportation System (NGATS) to increase the security, safety, capacity, and efficiency of the United States air transportation system. By 2025, this effort will allow the tripling of current capacity to meet new demands, reduce curb-to-curb transit time by 30 percent, reduce the cost of operating the system by 25 percent, and minimize the impact of weather and other disruptions to provide for 95 percent on-time arrivals and departures. The program will integrate capabilities across federal agencies to meet defense, commerce, and homeland security requirements. Network-enabled operations will provide a shared situational picture of aircraft and will help to prevent a recurrence of a 9/11 type terrorist attack.

Working in close collaboration with the private sector, the JPDO is ensuring that NGATS planning and execution are coordinated across government and industry. Eight Integrated Product Teams (IPT) are developing strategies and action plans to implement the NGATS.

The IPTs are initially refining the options for future solutions and assessing existing programs and plans to leverage what is available, and are identifying gaps and key questions for further research and development. System engineering/integration work will support architecture and IPT planning. These more detailed plans are referenced in the Annual Progress Report delivered to Congress in January 2006 and will be contained in subsequent updates to the Integrated National Plan. The JPDO is conducting the following activities and produce the indicated outputs/deliverables for the eight transformation strategies:

- Develop airport infrastructure to meet future needs – assess regional and national needs;
- Establish an effective security system – explore threat assessment and devise policies;
- Establish an agile air traffic system – develop system performance standards, communications, navigation, surveillance/air traffic management concept of operations and architecture;
- Establish user-specific situational awareness – develop policies and decision architecture; network enabled operations demonstration project with FAA, NASA, DOD, and DHS;
- Establish a comprehensive proactive safety management program – create safety doctrine, standards and framework;
- Develop environmental protection that allows sustained economic growth – establish environmental doctrine and draft environmental research plan;
- Develop a system-wide capability to reduce weather impacts – R&D alignment, R&D requirements and Weather Applied Research Center; and
- Harmonize equipage and operations globally – identify needs, streamline efforts, unify U.S. positions and partner with industry.

Customer/Stakeholder Involvement:

In their authorization legislation, Congress stressed the need for collaboration between all interested parties in creating the NGATS. The interested federal agencies have established a collective enterprise among the themselves and key stakeholders. The agencies, however, retain statutory responsibility to manage their programs, making use of acquisition strategies that provide the government the best value and ensure the implementation of the solutions developed through their efforts. As appropriate, federal advisory committees

will be used to ensure all plans and decisions receive broad review and public comment. These committees will include senior-level executives from across industry empowered to provide advice on strategy and transition issues. Furthermore, they will be able to gauge industry reaction and support for system developments and to develop and gain industry support for major decisions. In addition, each Integrated Product Team will identify specific means for private sector involvement through formal advisory committees, working groups, collaborative research agreements, and other available appropriate means.

JPDO has also established mechanisms for direct input and participation from experts in the private sector. It has already employed a series of workshops designed for gathering input on future planning scenarios, and will continue this means for direct expert involvement.

In addition, the NGATS Institute is an alliance among organizations representing major aviation stakeholder communities. The Institute operates under guidelines set forth in the funding agreement between the FAA/JPDO and the host organization, the National Center for Advanced Technologies. The agreement provides that the NGATS Institute will be governed by a sixteen member Institute Management Council that is broadly representative of the aviation stakeholder community. The Institute will support the NGATS mission by recruiting, selecting, and assigning private sector experts and technical resources to participate on IPTs, and perform technical work for the IPTs/JPDO.

Accomplishments: Major accomplishments and associated benefits of the JPDO efforts include:

- Aligned resources within the Federal Government and U.S. industry to develop and implement the NGATS in the most expedient and cost-effective manner possible.
- Produced, and updated as necessary, the Integrated National Plan as the long-term strategic business plan for NGATS that lays out goals and objectives and requirements for transformation in eight specific areas, each individually significant yet interdependent on the others.
- Established eight integrated product teams to work collaboratively with government and industry to plan for and develop strategies for the NGATS.
- Examined complimentary and competing ideas and suggestions resulting in the development of the NGATS Operational Vision.
- Evaluated the Operational Vision to validate the ability to deliver two to three times today's capacity.
- Established the NGATS Roadmap to guide the transition from today's system to the Next Generation System.
- Developed an initial NGATS Portfolio of needed policy, research and modernization efforts based on the NGATS Roadmap.
- Conducted a financial analysis of the airspace portion of the Operational Vision resulting in the NGATS Preliminary Cost Analysis statement.

R&D Partnerships:

The Integrated National Plan is premised on the belief that Government cannot solve all the problems facing aviation. The goal is not to pick winning technologies, but instead to provide a framework to use the creative forces of the market. Of great importance, the government's role under this plan will shift to allow industry to provide the most cost-effective solutions within a performance-based set of security and environmental rules. To succeed, the JPDO must maximize and leverage scarce public/private resources and align research resources and synchronize capital investments.

The Integrated National Plan includes a coordinated R&D plan across DOT/FAA, NASA, DHS/TSA, DOD, OST, OSTP and DOC for those elements required for defining and transforming the future air transportation system. The IPTs are:

- Analyzing changes currently underway, identifying gaps, and establishes the government and/or industry R&D activities to close them;
- Coordinating with government and private industry on R&D resources; and
- Collaborating with industry on research and implementation of the initiatives.

MAJOR ACTIVITIES AND ANTICIPATED FY 2006 ACCOMPLISHMENTS:

- Deliver the first Annual Progress Report describing the JPDO's progress in carrying out the Integrated National Plan to Congress along with any changes to the Integrated National Plan.
- Continue the JPDO's Senior Policy Committee for the purpose of addressing legislative and policy issues.
- Continue use of federal advisory committees, the NGATS Institute, and other mechanisms (e.g., seminars and working groups) to solicit and coordinate industry and stakeholder inputs.
- Conduct detailed planning for several demonstrations that will test potential operational concepts and protocols; demonstrated how technologies can be applied to address the major technical challenges; and provided alternatives for communications/navigation and surveillance architecture tradeoffs.
- Establish the framework to guide the operational, systems and technical architecture development process. The Enterprise Architecture was further developed to capture the major decisions represented in the Transformation Roadmap.
  - Air Traffic Management where service is delivered independent of geography; automation simplifies operations such as sequencing; noise management of arrivals and departures; migration to control of specific exception cases; decisions are distributed between the public and private sectors, air and ground; and procedures are tailored to an aircraft's capabilities and performance.
  - Security is embedded and seamless with multi-layered measures for prevention, detection and resolution that go well beyond airport boundaries; measures are interwoven throughout the system; established command and control protocols are backed with real time data (e.g. Auto-land); and there is a real-time threat analysis.
  - Airports have a balanced use of capacity with a greater use of inherent capacity, including expanded capacity for new operations.
  - Aircraft operations have performance-based services tailored to the more diverse range operations enabled through introduction of advanced capabilities.
- Refine operational concepts and establish the NGATS system characteristics so that NGATS will:
  - Be adaptable to new and unanticipated changes in transport needs, evolving safety and security concerns and a more information-driven national and global economy;
  - Be flexible and able to adapt quickly to changes by leveraging new technologies and procedures;
  - Be heavily reliant on automation for routine tasks enabling people to focus on higher-priority tasks;
  - Use increased automation with procedures to help boost system capacity. Automation aids will augment the role of decision makers and new operational procedures will leverage aircraft performance with fewer ties to geographical airspace;
  - Rely on human performance and efficiency enhancements that enable decision makers to accommodate a larger and more diverse number of operations;

  - Ensure threats to the system are mitigated by an integrated multi-layered approach and that there is access to operational information to provide for shared situational awareness and immediate responses;
  - Support new business models that increase flight options for travelers and shippers; and
  - Coordinate aviation and aeronautics research programs to achieve the goal of more effective and directed programs that result in applicable research and identification of specific R&D requirements that are not currently being addressed.
- Continue system-of-system modeling, simulation, and evaluation to ensure benefits, costs, and trade-offs are understood across the full range of Integrated National Plan goals and metrics.
- Establish the systems engineering process that will ensure an integrated approach to implementing the future system.

KEY FY 2007 ACTIVITIES AND MILESTONES:

Planning and Agency/Industry Alignment

- Update, validate, coordinate, and begin implementing the Integrated National Plan for the Next Generation Air Transportation System.
  - Coordinate aviation and aeronautics research programs to achieve the goal of more effective and directed programs that will result in applicable research.
  - Set goals and priorities and coordinate research activities within JPDO member agencies and with U.S. aviation and aeronautical firms.
- Facilitate the transfer of technology from research programs (e.g., NASA and DoD Advanced Research Projects Agency program) to the Federal agencies with operational responsibilities and to the private sector, as appropriate.

Systems Integration and Transformation Analysis

- Continue to refine the Integrated Product Team Action Plans and integrate them into the NGATS Action Plan, which will describe the research leading to the implementation decisions to achieve the desired changes to the current air transportation system.
- Continue to refine the overarching Transformation Roadmap along with the Research Portfolio and the Segment (implementation) Portfolio derived from the Roadmap, and coordinate them with the implementing agencies, the user community and industry.
- Begin to execute the IPT Action Plans by conducting the analysis, trade studies, and/or demonstrations identified in the plan.
- Develop lower levels of the enterprise architecture to facilitate the development, management and implementation of the Next Generation Air Transformation System.
- Model the planned system improvements called for in the Transformation Roadmap to validate their efficacy in accomplishing the goals identified in the Integrated National Plan.
- Conduct the analysis, trade studies, and demonstrations to select the best approaches/alternatives for transforming the current air transportation system;

This will allow transformation analysis beginning in FY 2007 to:

- Develop integrated transformation approach for defense, homeland security, and civil aviation based on IPT plans.
- Refine the NGATS roadmap that integrates IPT activities. The roadmap will include development of an avionics roadmap and policy decisions implementation with a focus on FAA National Airspace System architecture, FAA modernization plans (including the Flight

Plan and Operational Evolution Plan), homeland security plans, and DoD impact. This activity will be closely coordinated through the IPTs with planners in DHS, DoD, U.S industry, and international partners.

- Analyze the transition strategies, to include the development of alternative transition strategies for potential transformational changes and analysis of transition implications (including costs, equipage, safety, training, labor issues, and international harmonization). The transition strategies will represent an integration of individual IPT plans.
- Integrate budget/schedule analysis of IPT plans.

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2005)	$8,059
FY 2006 Appropriated	17,919
FY 2007 Request	18,100
Out-Year Planning Levels (FY 2008-2011)	67,291
Total	$111,369

Budget Authority ($000)	**FY 2003 Enacted**	**FY 2004 Enacted**	**FY 2005 Enacted**	**FY 2006 Enacted**	**FY 2007 Request**
Contracts:					
Joint Program & Development Office		3,000	3,659	16,539	16,112
Personnel Costs	0	0	1,200	1,313	1,867
Other In-house Costs	0	0	200	67	121
Total	**0**	**3,000**	**5,059**	**17,919**	**18,100**

OMB Circular A-11, Conduct of Research and Development ($000)	**FY 2003 Enacted**	**FY 2004 Enacted**	**FY 2005 Enacted**	**FY 2006 Enacted**	**FY 2007 Request**
Basic	0	0	0	0	0
Applied	0	3,000	5,059	17,919	18,100
Development (includes prototypes)	0	0	0	0	0
Total	**0**	**3,000**	**5,059**	**17,919**	**18,100**

A12.a - Joint Program & Development Office Product and Activities	FY 2007 Request ($000)	Program Schedule					
		FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011
Joint Planning & Development Office	**$16,112**						
Planning and Agency/Industry Alignment:		♦	◊	◊	◊	◊	◊
Update and carry out an integrated plan for a Next Generation Air Transportation System.							
Coordinate aviation and aeronautics research programs to achieve the goal of more effective and directed programs that will result in applicable research							
Coordinate goals and priorities and coordinate research activities within the FAA with US aviation and Aeronautical firms							
Systems Integration and Transformation Analysis:			◊	◊	◊	◊	◊
To accomplish the coordination necessary to create and carry out the plan in a way that would achieve more directed programs through more applicable research the JPDO must establish the basis for system integration.							
Develop Enterprise Architecture as a tool for a robust systems-of systems engineering process							
Evaluate and validate cross IPT, integrated system-wide concepts (including defense and homeland security needs), procedures, policies, business cases, etc. to assure potential alternatives exist that could meet all the National Plan Objectives simultaneously							
Conduct policy analyses that focus on early decisions to establish guiding principles for the transformation							
Personnel and Other In-House Costs	**$1,988**						
Total Budget Authority	**$18,100**	**$17,919**	**$18,100**	**$17,262**	**$16,943**	**$16,445**	**$16,641**

FAA Budget Appropriation	Budget Item	Program Title	Budget Request
F&E	1A01H	NAS Requirements	$800,000

Supports FAA Strategic Goals: Increased Safety, Greater Capacity, and International Leadership.

Intended Outcomes: Weather has a significant impact on safety and efficiency and affects activities across all domains. Avoidable weather delays are estimated to cost airlines, air cargo operators and other users approximately $4B annually. Accidents and injuries from icing and turbulence cost approximately $300M per year. FAA's Air Traffic Organization, Operations Planning, National Airspace System (NAS) Weather Office manages aviation weather requirements at the NAS level and aims to decrease avoidable weather delays plus reduce accidents caused by weather. The staff manages mostly non-capital requirements met by both the FAA and the National Weather Service (NWS), principally through: strategic planning; aviation weather requirements development; research & development management and technology transfer; U.S. representation to the International Civil Aviation Organization (ICAO); industry and inter-agency outreach; policy and standards-setting; and weather impacts analysis.

This budget line item provides an established but flexible means for the FAA to direct attention and resources to concerns affecting system efficiency and safety of the present and future NAS. Its focus changes as needs develop, and it operates independently of vendor to provide timely evaluations of selected services or technologies. The program's continuing goal is to ensure that the most effective technical strategies are being pursued to ensure the success of the Agency's mission: to provide a safe, secure and efficient aerospace system. The thrust of the program for the near future is to ensure the ongoing success of projects intended to decrease avoidable weather delays and reduce accidents caused by adverse weather through implementation of new R&D weather products.

Deliverables supported by the NAS Requirements line item will provide a near-term means to off-set decreases in decreased in-house resources. These deliverables will help: (1) pilots avoid areas of current and forecast icing; (2) pilots and dispatchers to select more efficient, safer routes around convective weather, including the oceanic environment; (3) forecasters to better predict areas of convection, turbulence and low ceilings and visibilities in the Continental U.S. (CONUS) and Alaska; (4) meteorologists to better forecast volcanic ash dispersion, and (5) users to select routes that take advantage of forecast winds. The deliverables will replace four labor-intensive textual weather products with equivalent graphics and will establish a baseline for how all future graphical products may be developed.

Agency Outputs: This line item enables the development of technical requirements documents affecting:

- Continued implementation of weather solutions developed collaboratively by the FAA and the NWS;
- Reconciliation of aviation weather domestic practices with International Standards and Recommended Practices;
- Management of the technical transfer of aviation weather products from research & development into operational use; and
- Ongoing liaison with FAA's internal and external customers of weather products to ensure their requirements and priorities are reflected in the evolution of weather products and services.

This documentation is accomplished through a combination of analysis and staff work resulting in:

- Formal Requirements Statements,
- Impact Assessments,
- Concepts of Use for various new products and services,

- Performance Assessments and Business Case development, and
- Strategy formulations.

Customer/Stakeholder Involvement:

This program's customers and stakeholders include:

- External FAA users including pilots, dispatchers, airline operations centers, airport operators, and aviation meteorologists, all of whom are represented by entities that include ATA, NBAA, AOPA, ALPA, APA, RAA, SAMA, GAMA, IATA as well as individual airlines and others (see attached acronym list for clarification of unfamiliar acronyms);
- Internal FAA Service units representing controllers service providers in Terminal, En route/Oceanic, Flight Service, Systems Operations, Operations Planning, and Technical Operations Services;
- FAA Regulatory arm (aircraft certification and flight standards personnel);
- The weather and satellite services in the Department of Commerce, National Oceanic and Atmospheric Administration;
- ICAO and the World Meteorological Organization;
- The Office of the Federal Coordinator for Meteorology; and
- The National Aeronautics and Space Administration.

Accomplishments:

The following summarizes major accomplishments to date:

- Completed technology transfer into NAS operations of several new R&D products including the Current and Forecast Icing Potential Products, Graphical Turbulence Guidance Products, and National Convective Weather Forecast (1 Hour).
- Transferred other products into the final R&D phase (experimental): Ceiling and Visibility, Oceanic weather products, and improved capabilities associated with icing and turbulence products.
- Implemented Collaborative Convective Forecast Product.
- Completed the Turbulence Joint Safety Implementation Team (JSIT) final report detailing strategies to mitigate accidents and incidents caused by turbulence.
- Identified accident causes and developed standard interventions to avoid icing related accidents and incidents as part of the Joint Safety Analysis Team (JSAT) and JSIT Residual Risk activity.
- Represented U.S. aviation interest at ICAO to minimize operating costs for U.S. carriers.
- Provided requirements of service as contracting state to support the operation of Washington World Area Forecast Center and Anchorage/Washington Volcanic Ash Advisory Centers.

Partnerships:

The Weather Policy and Standards Office, Operations Planning, Air Traffic Organization (ATO), partners with the Agency's Aviation Weather Research program, other Air Traffic Organization offices, Flight Standards, Aircraft Certification, and NWS offices as a part of the technology transfer process. The office partners with the Flight Standards and NWS personnel on a full range of aviation weather development activities. In the international arena, the office closely partners with ICAO and its contracting members.

MAJOR ACTIVITIES AND ANTICIPATED FY 2007 ACCOMPLISHMENTS:

- Continue and expand the technology transfer process to include aviation weather policy development, prioritization of weather requirements, establishment of metrics, development of business cases and strategies to develop global harmonization. It is anticipated that an

enhancement to the forecast icing product that depicts severity and large water droplets, a product that depicts cloud top heights and a national ceiling and visibility analysis product will be implemented in the NAS this year, and several products will enter their last R&D phase (experimental).

- Initiate the development of international standards for graphic products for icing and turbulence.
- Develop guidance material for an international standard for in-situ aircraft turbulence reporting.
- Develop a comprehensive set of FAA weather requirements for products and services, and support NWS implementation team to fulfill these requirements.
- Assess development of a Quality Assurance scheme for Automatic Dependent Surveillance Meteorological messages for the World Area Forecast System.
- Evaluate the effectiveness of FAA and NWS weather information in reducing weather delays (this is a three year FAA Flight Plan Initiative under Capacity Goal – first year FY 2005).
- Initiate proof-of-concept experiments on utility of Probability Forecasts in reducing airline fuel carriage related to alternate airport requirements.
- Implement a weather impact analysis capability.
- Develop a quantitative depiction of how weather patterns differ from one time period to another on any national, regional, or local scale.
- Obtain corporate NWS agreement on a subset of the five year overall aviation weather requirements that can be delivered within FAA/NWS budgetary and technological constraints.
- Develop a strategy to promote U.S. strategic positons for adoption by ICAO member states.
- Draft international guidance material for cockpit display of meteorological data.
- Provide U.S. position to ICAO on Amendment 74 to Annex 3, Meteorological service for international air navigation.
- Provide U.S. position to ICAO on operational requirements for World Area Forecast System.

FY 2007 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 areas will include continued activities associated with the Aviation Weather Technology Transfer (AWTT) process, ICAO representation, and weather impact assessments.

KEY FY 2007 PRODUCTS AND MILESTONES:

- Continue the AWTT process to implement the Current Icing Potential for Alaska and National Convective Weather Forecast (Two Hour) and promote several other products into last R&D phase (experimental) including Forecast Icing Potential and Severity, Convective Cloud Top Height product associated with Oceanic environment, and a National Ceiling and Visibility product for CONUS.
- Continue the second year effort on evaluation of the effectiveness of FAA and NWS weather information in reducing weather delays.
- Complete proof-of-concept experiments on utility of Probability Forecasts in reducing airline fuel costs related to alternate airport requirements.
- Represent U.S. aviation interests at ICAO Regional Air Navigation meteorological Group Meetings.
- Complete a Plan for the Broadcast of Aeronautical Information Services on the World Area Forecast System.

- Provide support to NWS in the design of aviation weather products and services in response to FAA requirements.

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2005)	$10,388
FY 2006 Appropriated	790
FY 2007 Request	800
Out-Year Planning Levels (FY 2008-2011)	10,500
Total	22,478

Budget Authority ($000)	**FY 2003 Enacted**	**FY 2004 Enacted**	**FY 2005 Enacted**	**FY 2006 Enacted**	**FY 2007 Request**
Contracts:					
NAS Requirements	0	3,000	1,488	790	800
Personnel Costs	0	0	0	0	0
Other In-house Costs	0	0	0	0	0
Total	**0**	**3,000**	**1,488**	**790**	**800**

OMB Circular A-11, Conduct of Research and Development ($000)	**FY 2003 Enacted**	**FY 2004 Enacted**	**FY 2005 Enacted**	**FY 2006 Enacted**	**FY 2007 Request**
Basic	0	0	0	0	0
Applied	0	0	0	0	0
Development (includes prototypes)	0	3,000	1,488	790	800
Total	**0**	**3,000**	**1,488**	**790**	**800**

NAS Requirements Product and Activities	FY 2007 Request ($000)	Program Schedule					
		FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011
NAS Requirements (Office of Weather Policy and Standards, NAS Weather Office, ATO-P)	**$800**						
AWTT Process							
Implement Graphical Turbulence Guidance FL100-200		◆					
Implement Forecast Icing Potential – Severity and Supercooled Large Water Droplets		◆					
Implement NCWF-2		◆					
Continue implementation of R&D products			◇	◇	◇	◇	◇
JSIT/JSAT							
Complete the JSIT final report detailing strategies to mitigate accidents and incidents caused by icing.		◆					
ICAO							
Initiate the development of International standards for graphic products for icing and turbulence		◆					
Develop guidance material for International standard for in-situ aircraft turbulence reporting		◆					
Initiate development of Quality Assurance scheme for Automatic Dependent Surveillence Meteoro-logical messages for the World Area Forecast System		◆					
Represent US at Regional Air Navigation meteorological Group Meetings as a part of the International activities			◇				
Complete a Plan for the Broadcast of Aeronautical Information Services on the World Area Forecast System			◇				
Provide US policy positions to 12 ICAO operations, study and planning groups				◇	◇	◇	◇
FAA Flight Plan Initiative							
Evaluate effectiveness of FAA and NWS weather information in reducing weather delays		◆	◇	◇			
Aviation Weather Requirements Development							
Develop a comprehensive set of FAA weather requirements for NWS products and services and support to NWS implementation team on strategies to fulfill these requirements		◆	◇	◇	◇	◇	◇
Proof-of-concept experiments on utility of Probability Forecasts in reducing airline fuel costs related to alternate airport requirements		◆	◇				
Total Budget Authority	**$800**	**$790**	**$800**	**$2,000**	**$2,000**	**$3,200**	**$3,300**

◆ - 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 5, NOT THE PROGRAM BUDGET LINE ITEM.

FAA Budget Appropriation	Budget Item	Program Title	Budget Request
F&E	1A01D	Operations Concept Validation	$3,000,000

Supports FAA Strategic Goals: Increased Safety, Greater Capacity, and International Leadership.

Intended Outcomes: Operational concept validation challenges and tests the validity of common situational awareness assumptions behind new mechanized systems for distributing weather and traffic information, and provides the high-quality performance requirements needed to ensure that the next generation of National Airspace System (NAS) ground and airborne support systems succeed. This process brings tactical and strategic assumptions behind controller roles and responsibilities, and decision support tools in general – as well as requirements affecting information type, update rate, and display within the systems –under strict scrutiny and redirects them, as 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 that 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; and
- 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 upon 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 designed 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* (released by the RTCA, August 1997), *A Concept of Operations for the NAS Airspace System in 2005* (released by Air Traffic Services, September 1997), and the RTCA *NAS Concept of Operations and Vision of Future Aviation* (released by the RTCA, December 2002). These documents have provided guidance to the development of the NAS Architecture Version 5. Additional details appear in the appendices to the NAS Architecture document itself.

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, and 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

- 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.
- Validated user concepts for joint FAA/NASA activities, including human-in-the-loop simulations.
- Validated information requirements for flight object management.
- Analyzed the concept of de-emphasizing geographic dependency when assigning facilities for airspace use.

Concept system design

- Analyzed core factors related to common trajectory.
- Assessed controller workload in various U.S. traffic situations – results will help to validate density concepts and alerts used with collaborative decision-making and traffic flow management products.
- Developed and analyzed the separation normalization concept referred to as “three miles everywhere.”
- Evaluated the impact on cross-facility coordination of splitting front and back rooms, and centralizing the core automation functions apart from the controller facilities.

R&D Partnerships: This work directly relates to the FAA/NASA Memorandum of Understanding on ATM research and development and to the objectives of the Next Generation Air Transportation System objectives advanced by the Joint Planning and Development Office. 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 flight deck 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 2006 ACCOMPLISHMENTS:

Operational concept development

- Deliver the concept of operations for the multi sector planner – including the role of an area flow planner and/or the multi-sector data controller, the information needs of each position, and the associated training requirements.
- Expand the concept of moving the current sector and area concepts in en route operations into a high airspace/low airspace split for productivity and training efficiency.
- Deliver an end-to-end concept of use for the utilization of datalink in strategic NAS operations.
- Deliver a Concept of Use for Future Flight Data Management in a System Wide Information Environment that includes the flight object.
- Develop initial modernization concept of use for Business Continuity Planning for NAS operations.

Concept validation

- Conduct human in the loop analysis on the concept of a multi sector planner – reflect the roles and information needs for an area flow planner and multi data controller.
- Conduct initial end-to-end analysis of datalink and the changes in the provider roles and responsibilities for increased productivity and system efficiency.
- Deliver guidance on team size and dynamics for changes in controller roles and responsibilities and facility size.
- Conduct high-level concept validation for restructuring en route operations into a high airspace/low airspace split for productivity and training efficiency – include the analysis of cognitive and situational awareness issues, such as the local knowledge requirements and decision support.

Concept system design

- Populate the information model of advanced concepts into NAS interface requirements.
- Support the development of flight plan information requirements for next generation flight plan advanced by the International Civil Aviation Organization (ICAO) and a transition design to the flight object.
- Develop initial system design requirements for the common trajectory service in the new en route automation system.
- Deliver the initial ICAO Performance framework.

FY 2007 PROGRAM REQUEST:

The FY 2007 request continues to evolve the NAS operations concept. From its initial broad perspective and early validation emphasis, the concept work is focusing more specifically on internal investigations of opportunities for increased productivity, and on reducing the influence of geographic location in the process of delegateing responsibilities for controlling particular airspace.

Further demonstration and validation are required to show whether this concept can support the integration of the entire NAS infrastructure, with all airspace definitions, within the proposed En Route Automation Modernization methodology.

The validation process investigates all opportunities to exploit the potential productivity and flexibility benefits offered by changes in technology and communications. These opportunities include continued use of legacy requirements for local knowledge, changes in work methods to make high altitude airspace more "generic," and turning to performance based procedures for infrastructure and customer cost efficiencies.

Leveraging work being performed by: (1) EUROCONTROL on the European Air Traffic Management System Concept and the associated ATM 2000+ strategy, and (2) the FAA in support of the International Civil Aviation Organization Air Traffic Management Concept Panel.

KEY FY 2007 PRODUCTS AND MILESTONES:

Operational concept development

- Update the RTCA NAS Concept of Operations.
- Develop a concept of use for the virtual tower.
- Expand the business continuity planning concept on facilities risk, roles and procedures.

Concept validation

- Continue to populate the Validation Data Repository to capture all FAA activities and results associated with concept and concept-of-use validation. Establish metrics that would allow comparable results across program validation efforts in the U.S. and Europe.
- Incorporate and expand next-level metrics such as Required Navigation Performance, Required Surveillance Performance, and Required Communications Performance to expand the performance framework for Required ATM System Performance and Real-Time Streamlining Protocol (RTSP) – thus supporting the move from technology based procedures to a Performance based NAS.
- Conduct feasibility study on the virtual tower concept.
- Conduct human in the loop analysis of high/low airspace split on training requirements for sector controllers along with the information needs and systems requirements.

Concept system design

- Extend closed-loop system dynamic modeling of decisions and demand dynamics related to scheduling and management of aircraft with the Aircraft Operations Center (AOC) and service providers.
- 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.
- Apply the performance framework for concepts including Required ATM System Performance and RTSP.

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2005)	$18,868
FY 2006 Appropriated	2,970
FY 2007 Request	3,000
Out-Year Planning Levels (FY 2008-2011)	12,000
Total	$36,838

Budget Authority ($000)	**FY 2003 Enacted**	**FY 2004 Enacted**	**FY 2005 Enacted**	**FY 2006 Enacted**	**FY 2007 Request**
Contracts:					
Operations Concept Validation	1,250	2,700	2,000	2,970	3,000
Personnel Costs	0	0	0	0	0
Other In-house Costs	0	0	0	0	0
Total	**1,250**	**2,700**	**2,000**	**2,970**	**3,000**

OMB Circular A-11, Conduct of Research and Development ($000)	**FY 2003 Enacted**	**FY 2004 Enacted**	**FY 2005 Enacted**	**FY 2006 Enacted**	**FY 2007 Request**
Basic	0	0	0	0	0
Applied	0	0	0	0	0
Development (includes prototypes)	1,250	2,700	2,000	2,970	3,000
Total	**1,250**	**2,700**	**2,000**	**2,970**	**3,000**

Operations Concept Validation Product and Activities	FY 2007 Request ($000)	Program Schedule					
		FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011
Operations Concept Validation	**$3,000**						
Operational Concept Development							
Develop a concept of use for the virtual tower		◆	◇	◇	◇	◇	◇
Expand the business continuity planning concept on facilities risk, roles and procedures		◆	◇	◇	◇	◇	◇
Update The RTCA NAS Concept of Operations		◆	◇	◇			
Concept Validation							
Continue to 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		◆	◇	◇			
Expand the performance framework for Required ATM System Performance and RTSP by incorporating and expanding next level metrics, such as Required Navigation Performance, Required Surveillance Performance, and Required Communications performance to support the move from technology based procedures to a Performance based NAS		◆	◇	◇	◇	◇	
Conduct a feasibility study on the virtual tower concept		◆	◇	◇	◇	◇	◇
Conduct human-in-the-loop analyses of the high/ low airspace split on training requirements for sector controllers along with the information needs and systems requirements		◆	◇	◇	◇		
Concept System Design							
Extend closed-loop system dynamic modeling of decisions and demand dynamics related to scheduling and management of aircraft with AOC and service providers		◆	◇	◇	◇	◇	◇
Leverage human factors research work, and human factors and operational validations experimentation, to define requirements needed to support agreed-to operational improvements of the NAS Concept of Operations through 2010		◆	◇	◇	◇	◇	◇
Apply the Performance Framework for Concepts Including Required ATM System Performance and RTSP		◆	◇	◇	◇	◇	◇
RTCA							
Develop Aviation Community inputs to MASPS, MOPS and Integrated Plans to Support Future Concepts and Modernization		◆	◇	◇	◇	◇	◇
Total Budget Authority	**$3,000**	**$2,970**	**$3,000**	**$3,000**	**$3,000**	**$3,000**	**$3,000**

◆ - 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 5, NOT THE PROGRAM BUDGET LINE ITEM.

FAA Budget Appropriation	Budget Item	Program Title	Budget Request
R,E&D	A11.b.	Propulsion and Fuel Systems	$4,048,000

Supports FAA Strategic Goals: Increased Safety, Greater Capacity, and International Leadership.

Intended Outcomes: The Propulsion and Fuel Systems Program strives to enhance the airworthiness, reliability, and performance of civil turbine and piston engines, propellers, fuels, and fuel management systems. The program is also reducing the number of accidents associated with the failure of aircraft structures, components, and systems. In addition, the program is working with fuel, airframe, and engine manufacturers to test new unleaded fuels as they become available.

By FY 2008, the program will conduct the research needed to develop tools, guidelines, and data to support improvements in turbine engine certification requirements.

Agency Outputs: The FAA issues certification and advisory standards, and it endorses the specifications and practices recommended by recognized technical societies to maintain the airworthiness of aircraft engines, fuels, and airframe fuel management systems. The Agency also publishes information and sponsors technology workshops, demonstrations, and other means of training and technology transfer. The Propulsion and Fuel Systems Program provides the technical information, R&D resources, and technical oversight necessary for the Agency to deliver the propulsion, fuel, and fuel transfer system technologies.

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

- Subcommittee on Aircraft Safety of the FAA Research, Engineering and Development Advisory Committee – representatives from industry, academia, and other government agencies annually review the program's activities.
- Technical Community Representative Groups – FAA representatives apply formal guidelines to ensure that the program's research projects support new rule making and development of alternate means of compliance for with existing rules.
- The Coordinating Research Council (CRC) Unleaded Aviation Gasoline Development Group includes Texaco, Exxon Mobil, Phillips Petroleum, Chevron, British Petroleum, Cessna, Raytheon (Beech), Teledyne Continental, and Textron Lycoming – facilitates two-way transfer of technology between government and industry to benefit all participants.
- The CRC Molecular Marker Ad Hoc Committee includes turbine engine manufacturers, major oil companies and the FAA – provides the oversight to ensure the safe implementation of adding molecular markers to jet fuel.
- The Aerospace Industries Association (AIA) working subcommittees on rotor integrity and rotor manufacturing.
- The National Transportation Safety Board, particularly with regard to recommendations A-90-89, A-90-90, A-98-19, A-98-20, and A-98-28l.

Accomplishments:

- Demonstrated the probabilistic rotor design and life management code (Design Assessment for Reliability with Inspection - DARWIN™) for titanium alloys. The code provides commercial aircraft turbine engine manufacturers an acceptable means to comply with Advisory Circular 33.14-1, "Damage Tolerance for High Energy Turbine Engine Rotors."
- Conducted two DARWIN™ training workshops for the government and industry.
- Demonstrated the DEFORM™ defect deformation micro code for analysis of titanium alloy defects during the turbine rotor disk forging process.

- Demonstrated an enhanced version of the DARWIN™ code that addresses surface anomalies.
- Completed vacuum fatigue crack growth tests on nickel rotor disk super alloys.
- Demonstrated portable industrial process monitor for vacuum arc remelting.
- Demonstrated an advanced vacuum arc remelting controller for the production of premium quality aerospace alloys.
- Demonstrated an enhanced version of the DARWIN™ code that addresses multiple anomalies.
- Demonstrated the feasibility of safety net unleaded fuel.
- 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.
- Drafted a report documenting the impact of red dye contamination in Jet A fuel for continuous engine operation.
- Drafted a report documenting compression ignition (diesel) engines for general aviation use.
- Drafted a report documenting an investigation of turbine Jet A fuel operating at very low temperatures (near freeze point).

R&D Partnerships:

- Turbine Rotor Material Design Program - Southwest Research Institute (SwRI) has teamed with Pratt and Whitney, General Electric, Honeywell, and Rolls Royce to provide DARWIN™, a probabilistic-based rotor life and risk management certification tool.
- The AIA working subcommittees on rotor integrity and rotor manufacturing.
- Specialty Metals Processing Consortium – includes the Sandia National Laboratory, Special Metals, Carpenter Technology, Schultz Steel, Allvac, Precision Rolled Products, RMI Titanium Co., Timet Co., General Electric Aircraft Engines, Rolls-Royce, and Pratt and Whitney.
- 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 and Whitney, Rolls Royce, Honeywell and Boeing also contributed funding to this effort.
- CRC Unleaded Aviation Gasoline Development Group – includes Texaco, Exxon Mobil, 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 Airworthiness Assurance Center of Excellence – this Center leverages monetary and intellectual contributions of university researchers, including an academic partnership it has initiated with the University of Dayton Research Institute that has investigated the performance of Jet A fuel in very low temperature flight operations.

- The FAA General Aviation Center of Excellence 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" (i.e., aviation fuel).

MAJOR ACTIVITIES AND ANTICIPATED FY 2006 ACCOMPLISHMENTS:

- Complete a draft report on cold dwell fatigue in titanium alloys.
- Continue enhancement of the DARWIN™ probabilistic rotor design code.
- Continue fatigue tests of nickel rotor materials containing anomalies.
- Complete draft report on Phase II of the Turbine Rotor Material Design program.
- Continue laboratory characterization and engine ground testing of candidate unleaded fuels to replace 100 octane low-lead gasoline.
- Expand research on blended fuels containing ethanol for general aviation piston engines.
- Evaluate the effect of molecular marker in Jet A Fuel.

FY 2007 PROGRAM REQUEST:

Ongoing Activities

The program will continue to assess industry-provided lead free fuel formulation candidates, including petrochemical and ethanol based fuels to replace the low lead aviation gasoline currently in use. In addition, researchers will continue to investigate the effects of molecular markers in Jet A fuel as requested by Congress in FY 2004.

Researchers will continue to advance DARWIN™, a probabilistically based turbine engine rotor design and life risk assessment code. 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 also continue research into metallurgical factors that can shorten fatigue life of titanium rotor disk alloys.

New Initiatives

No new initiatives are planned in FY 2007.

KEY FY 2007 PRODUCTS AND MILESTONES:

- Continue enhancement of the DARWIN™probabilistic rotor design code.
- Continue developing an understanding of the relationship between cold dwell fatigue and the microstructure of titanium as well as the fatigue life debit.
- Continue developing a design methodology for use by industry to prevent cold dwell fatigue and assess the fleet risk.
- Continue fatigue testing of nickel rotor material samples containing naturally occurring defects.
- Continue laboratory characterization and engine ground testing of industry-supplied candidate unleaded fuels to replace 100 octane low lead avgas including ethanol and ethanol blends.
- Draft a report on the effects of molecular markers in Jet A fuel.
- Continue to expand research on blended fuels containing ethanol for piston engines.

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APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2005)	$84,041
FY 2006 Appropriated	5,741
FY 2007 Request	4,048
Out-Year Planning Levels (FY 2008-2011)	15,727
Total	$109,557

Budget Authority ($000)	**FY 2003 Enacted**	**FY 2004 Enacted**	**FY 2005 Enacted**	**FY 2006 Enacted**	**FY 2007 Request**
Contracts:					
Propulsion Systems Research	6,046	5,461	6,089	4,508	2,592
Personnel Costs	1,224	1,052	922	1,155	1,366
Other In-house Costs	87	94	104	78	90
Total	**7,357**	**6,607**	**7,115**	**5,741**	**4,048**

OMB Circular A-11, Conduct of Research and Development ($000)	**FY 2003 Enacted**	**FY 2004 Enacted**	**FY 2005 Enacted**	**FY 2006 Enacted**	**FY 2007 Request**
Basic	0	0	0	0	0
Applied	7,357	6,607	7,115	5,741	4,048
Development (includes prototypes)	0	0	0	0	0
Total	**7,357**	**6,607**	**7,115**	**5,741**	**4,048**

A11b - Propulsion and Fuel Systems Product and Activities	FY 2007 Request ($000)	Program Schedule					
		FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011
063-110 Propulsion and Fuel Systems Research							
Turbine Engine Research	**$1,842**						
Complete draft report on Phase II of the Turbine Rotor Material Design Program		♦					
Complete draft report on dwell time fatigue in titanium alloys		♦					
Continue enhancement of the Probabilistic Rotor Design and Life Management code (DARWIN™)		♦	◊	◊	◊	◊	
Continue to investigate advanced damage tolerance methods for turbine rotor disks		♦	◊	◊	◊	◊	◊
Continue developing a design methodology to assess fleet risk and prevent cold dwell fatigue		♦	◊	◊	◊		
Unleaded Fuels and Fuel System Safety Research	**$750**						
Continue lab characterization and engine ground testing of candidate unleaded fuels to replace 100 octane low-lead gasoline		♦	◊	◊	◊	◊	◊
Evaluate ethanol based piston fuel		♦	◊	◊			
Evaluate the effect of molecular markers in Jet A fuel		♦	◊	◊			
Personnel and Other In-House Costs	**$1,456**						
Total Budget Authority	**$4,048**	**$5,741**	**$4,048**	**$3,948**	**$3,932**	**$3,889**	**$3,958**

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FAA Budget Appropriation	Budget Item	Program Title	Budget Request
F&E	1A01B	Runway Incursion Reduction	$8,000,000

Supports FAA Strategic Goals: Increased Safety, and Greater Capacity

Program Goals and 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 has been developed to support Agency investment decisions. Current program initiatives are aimed at evaluating pilot situational awareness tools.

The Program directly contributes to achieving Objective 3, "reduce the risk of runway incursions," of the FAA's *Flight Plan 2006 –2010* strategic goal of *Increased Safety*.

Airports referred to in this program description include:

DFW Dallas/Ft. Worth International Airport

SAN San Diego International Airport

LGB Long Beach – Daugherty Field

GEG Great Circle Airport – Spokane, Washington

Agency Outputs:

- Operational concepts, system prototypes, field test data, technical specifications and life cycle cost estimates for selected technology solutions
- Non-technology solutions, such as improved airport markings/signage, education, training, and advisory circulars

Customer/Stakeholder Involvement: Operational concepts, technical specifications and system evaluations for runway incursion reduction initiatives are fully coordinated with stakeholders within the air traffic service provider, pilot and airport operator communities. Reducing runway incursion incidents remains a top FAA priority – as reflected in Safety Objective 3 of the current FAA *Flight Plan*.

Accomplishments:

- Evaluated operation of runway status lights (RWSL) at DFW.
- Developed (initial) RWSL, take-off hold lights (THL) enhancements.
- Installed the Low-Cost Surface Surveillance (LCSS), System 1 at GEG.
- Evaluated operation of LCSS at GEG.
- Prepared enhanced airport lighting evaluation report.

R&D Partnerships:

Partnerships for RIRP technology initiatives exist with several members of industry, with Federally Funded Research and Development Consortia (e.g. MIT Lincoln Laboratory, MITRE), with selected airport operators (e.g. DFW, SAN, LGB, GEG), and with other government agencies (e.g. the Volpe National Transportation Systems Center).

MAJOR ACTIVITIES AND ANTICIPATED FY 2006 ACCOMPLISHMENTS:

- Conduct RWSL shadow operations at SAN.
- Conduct the operational evaluation of RWSL THL at DFW (west side).
- Conduct RWSL shadow operations for DFW (east side).
- Develop a business case for RWSL.
- Complete the Phase II evaluation of the critical area management at GEG.
- Install the NOVA 9000 system at GEG.
- Complete the final approach runway occupancy signal (FAROS) shadow operations test.
- Initiate and conduct the FAROS field evaluation.

FY 2007 PROGRAM REQUEST:

The requested funding will allow the program to:

- Support implementation of RWSL at three additional airports.
- Conduct evaluation of the LCSS, System 2 at GEG.
- Complete the FAROS field evaluation.
- Conduct pilot awareness of FAROS operations.

KEY FY 2007 PRODUCTS AND MILESTONES

- Continue researching potential technology solutions for small-to-medium-sized airports.
- Continue developing performance standards and requirements for selected runway incursion reduction technologies.
- Complete the evaluation and business case development for RWSL.
- Develop evaluation reports, technical specifications, and life cycle cost estimates for selected products.
- Install RWSL airfield lighting equipment and conduct evaluation of RWSL for the east side of DFW Airport.
- Conduct the RWSL operational evaluation at SAN.

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2005)	$46,295
FY 2006 Appropriated	6,440
FY 2007 Request	8,000
Out-Year Planning Levels (FY 2008-2011)	15,000
Total	$75,735

Budget Authority ($000)	**FY 2003 Enacted**	**FY 2004 Enacted**	**FY 2005 Enacted**	**FY 2006 Enacted**	**FY 2007 Request**
Contracts:					
Runway Incursion Reduction	6,700	8,200	9,027	6,440	8,000
Personnel Costs	0	0	0	0	0
Other In-house Costs	0	0	0	0	0
Total	**6,700**	**8,200**	**9,027**	**6,440**	**8,000**

OMB Circular A-11, Conduct of Research and Development ($000)	**FY 2003 Enacted**	**FY 2004 Enacted**	**FY 2005 Enacted**	**FY 2006 Enacted**	**FY 2007 Request**
Basic	0	0	0	0	0
Applied	0	0	0	0	0
Development (includes prototypes)	6,700	8,200	9,027	6,440	8,000
Total	**6,700**	**8,200**	**9,027**	**6,440**	**8,000**

Runway Incursion Reduction Product and Activities	FY 2007 Request ($000)	Program Schedule					
		FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011
Runway Incursion Reduction	**$8,000**						
Runway Status lights (RWSL)							
Conduct operational evaluations		◆					
Resolve OPERATIONAL EVALUATION ISSUES			◇				
Prepare presentation to the Joint Resources Council		◆	◇				
Develop THL		◆	◇	◇			
Perform THL operational evaluation		◆	◇	◇	◇		
Develop system enhancements					◇	◇	◇
Low-Cost Surface Surveillance							
Install System 1		◆					
Evaluate System 1		◆					
Install and evaluate System 2			◇	◇	◇		
FAROS/Flashing Precision Path Indicator							
Conduct shadow operations		◆	◇				
Perform field evaluation			◇				
Total Budget Authority	**$8,000**	**$6,440**	**$8,000**	**$5,000**	**$5,000**	**$5,000**	**$0**

◆ - 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 5, NOT THE PROGRAM BUDGET LINE ITEM.

FAA Budget Appropriation	Budget Item	Program Title	Budget Request
F&E	1A02A	Safe Flight 21 – Alaska Capstone	$16,800,000

Supports FAA Strategic Goals: Increased Safety, Greater Capacity, International Leadership, and Organizational Excellence.

Program Goals and Intended Outcomes: Capstone is a technology-focused safety program in Alaska that seeks near term safety and efficiency gains in aviation by accelerating implementation and use of modern technology. It links multiple programs and initiatives under a common umbrella for planning, coordination, focus and direction. The Capstone program provides tangible benefits that include: weather, terrain, and traffic information; flight following and locating capabilities; global positioning system (GPS) en route instrument flight rules infrastructure and non-precision instrument approaches; and training for pilots flying aircraft with Automatic Dependent Surveillance-Broadcast (ADS-B) avionics. The program is building an infrastructure, consistent with NAS modernization plans, while it identifies the transition path for procedure development/technology implementation and provides near-term safety benefits.

The program's first priority is to improve aviation-system safety in Alaska through the introduction of new Communications, Navigation, and Surveillance (CNS) technologies. These enabling technologies include ADS-B, Flight Information Services-Broadcast (FIS-B), and Traffic Information Service-Broadcast (TIS-B).

Capstone directly contributes to the FAA's *Flight Plan 2006 –2010* strategic goal of *Increased Safety* under Objective 3, "reduce accidents in Alaska,." This program will expand through a three-phased approach from Bethel and Southeast Alaska throughout the entire state. The FAA strategy is to *expand* and *accelerate* the implementation of safety and air navigation improvement programs in Alaska. The Capstone Program Office recently finalized the Capstone Statewide Strategic Plan to provide for statewide implementation of ADS-B. "Bundled" capabilities/technologies such as ADS-B, FIS-B, Automated Weather Sensor Systems, and GPS/WAAS (Wide-Area Augmentation System) approaches have improved safety and access to remote locations in the Bethel/YK Delta and Southeast Alaska areas. 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 emerging technologies into the NAS. Its objectives will be achieved as follows:

- Make the Universal Access Transceiver data link and the GPS/WAAS navigation available to pilots statewide.
- Install a ground infrastructure that provides
  - 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;
  - TIS-B;
  - Operator flight monitoring; and
  - Removal of the legacy navigation infrastructure.

Developmental work will continue on the following:

- Multilateration for runway safety and terminal surveillance;
- 1090 MHz data link; and
- Satellite usage for relay of voice and ADS-B information.

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, Aircraft Owners and Pilots Association, Airline Pilots Association, Alaska Aviation Safety Foundation, Alaska Airmen's Association, Department of Defense, State of Alaska Department of Transportation and Public Facilities, Air Traffic Control Association, Cargo Airline Association, MITRE Corporation, and commercial airlines.

Accomplishments:

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

- Achieved a 40% reduction in accidents for Capstone-equipped aircraft in the Y-K delta Installed Ground Based Transceivers (GBT) in the Bethel area to provide critical information to controllers, dispatchers, and pilots;
- Installed certified ADS-B avionics in approximately 200 commercial aircraft operating in the Bethel area;
- Installed certified ADS-B avionics in approximately 70 commercial aircraft operating in the Southeast Alaska;
- Commissioned thirteen automated weather observation systems with weather cameras in the Bethel area and one in Southeast Alaska;
- Commissioned two communications sites;
- Published 19 first-time GPS approaches for ten airports;
- Trained 140 pilots and associated personnel on ADS-B avionics in collaboration with the University of Alaska;
- Initiated use of the first GPS/WAAS receiver as sole means for en route navigation in Alaska; and
- Completed a strategic plan for expanding Capstone statewide.

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

The FAA works closely with the aviation industry to support Safe Flight 21 – Alaska Capstone. This partnership allows industry to share in the funding of avionics and infrastructure and to build on ongoing industry initiatives. These initiatives include:

- Identifying/resolving ADS-B technology issues;
- Developing ADS-B operational concepts;
- Focusing data collection activities to answer operational and avionics certification issues;
- Addressing 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; and
- Ensuring that all stakeholders are included in Alaska Capstone planning and in the evaluation of operational enhancements/data link alternatives.

Major FY 2006 Anticipated Activities:

The FAA expects to complete the following activities in FY2006:

- Replace developmental GBTs in the Bethel area with production-level systems for Air Traffic surveillance;
- Upgrade avionics to meet recently approved industry standards;
- Continue to install primary flight displays, navigation displays and ADS-B avionics in up to 200 Southeast Alaska Capstone-participating aircraft;
- Expand use of arrival/departure procedures in Alaska;
- Install and commission GBTs in Southeast Alaska;
- Install and test ADS-B data displays in the Juneau control tower and flight service station;
- Test surveillance of mixed-equipage (transponder and ADS-B) via multilateration in the Juneau area; and
- Develop and demonstrate a prototype satellite communications system to complement the Capstone GBTs.

FY 2007 Program Request:

The requested funding will provide:

- Ongoing test and evaluation, procedure development, certification tasks, and simulation activities;
- Initial approach control service for aircraft in the Bethel area; and
- Beginning expansion of avionics and ground infrastructure statewide.

Key FY 2007 Products and Milestones:

FY 2007 products and milestones involve activities that will prove beneficial for achieving program success:

- Install avionics and GBTs in Southeast Alaska; and
- Provide approach control services for aircraft in the Bethel area.

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2005)	$118,568
FY 2006 Appropriated	14,360
FY 2007 Request	16,800
Out-Year Planning Levels (FY 2008-2011)	80,000
Total	$229,728

Budget Authority ($000)	**FY 2003 Enacted**	**FY 2004 Enacted**	**FY 2005 Enacted**	**FY 2006 Enacted**	**FY 2007 Request**
Contracts:					
Safe Flight 21-Alaska Capstone	19,600	21,000	28,768	14,360	16,800
Personnel Costs	0	0	0	0	0
Other In-house Costs	0	0	0	0	0
Total	**19,600**	**21,000**	**28,768**	**14,360**	**16,800**

OMB Circular A-11, Conduct of Research and Development ($000)	**FY 2003 Enacted**	**FY 2004 Enacted**	**FY 2005 Enacted**	**FY 2006 Enacted**	**FY 2007 Request**
Basic	0	0	0	0	0
Applied	0	0	0	0	0
Development (includes prototypes)	19,600	21,000	28,768	14,360	16,800
Total	**19,600**	**21,000**	**28,768**	**14,360**	**16,800**

Safe Flight 21 – Alaska Capstone Product and Activities	FY 2007 Request ($000)	Program Schedule					
		FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011
Safe Flight 21 – Alaska Capstone							
Optional Enhancements	**$16,800**						
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 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	**$16,800**	**$14,360**	**$16,800**	**$20,000**	**$20,000**	**$20,000**	**$20,000**

◆ - 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 5, NOT THE PROGRAM BUDGET LINE ITEM.

FAA Budget Appropriation	Budget Item	Program Title	Budget Request
F&E	1A01F	Safer Skies	$3,600,000

Supports FAA Strategic Goals: Increased Safety, Greater Capacity, and International Leadership.

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 (AC), 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 participants on the team continue to develop intervention strategies for runway incursions, loss of control, and weather. A collision avoidance evaluation has been initiated to determine if logic changes are required to reduce approach and landing related accidents.

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. Research on 30 mountain passes has been completed, providing guidance to pilots to assist their navigating and flying through specific mountain passes.

MAJOR ACTIVITIES AND ANTICIPATED FY 2006 ACCOMPLISHMENTS:

- Begin work to update the Traffic Alert and Collision Avoidance System (TCAS) and examine rule making changes to upgrade the collision avoidance system equipage on the U.S. air fleet.

These efforts are being undertaken to further reduce approach and landing related accidents in response to findings from a recently completed scheduled collision avoidance evaluation that has confirmed a safety vulnerability within TCAS.

- Continue to assess existing and emerging weather-related technologies that affect commercial and GA operations.
- Continue developing and implementing Safer Skies interventions for commercial and general aviation in areas of CFIT, runway incursion, approach and landing, loss of control, and weather focus areas.
- Develop mountain pass guidance to allow GA pilots to navigate and fly safely, both through and within specific mountain passes – twenty five additional mountain passes are scheduled for completion including a concentration in the Alaska region.
- Complete simulator evaluations for loss of control of helicopters during changing weather conditions.
- Support development of certification processes and standards for Unmanned Aerial Vehicle (UAV) operations within the NAS.

FY 2007 PROGRAM REQUEST:

FY 2007 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, CFIT, approach and landing, and Weather focus areas for commercial and general aviation. Key programs will develop guidance for general aviation pilots to use in flying mountain passes and will implement the logic recommendations derived from the collision avoidance evaluation.

KEY FY 2007 PRODUCTS AND MILESTONES:

During FY 2007 the program will:

- Continue to support the implementation of logic recommendations for collision avoidance systems.
- Continue to develop and implement Safer Skies interventions for commercial and general aviation in areas of CFIT, runway incursion, approach and landing, loss of control, and weather focus areas.
- Continue to develop policy, regulations and certification guidelines and standards for UAV operations within the NAS.
- Continue to develop mountain pass guidance to assist GA pilots in safety navigating and flying through and in specific mountain passes – an additional 25 mountain passes scheduled.
- Continue to assess existing and emerging weather-related technologies that affect commercial and GA operations.
- Begin to develop guidance, gained from simulator studies, to prevent loss of control of helicopters during changing weather conditions.

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2005)	$8,773
FY 2006 Appropriated	3,370
FY 2007 Request	3,600
Out-Year Planning Levels (FY 2008-2011)	12,000
Total	$27,743

Budget Authority ($000)	**FY 2003 Enacted**	**FY 2004 Enacted**	**FY 2005 Enacted**	**FY 2006 Enacted**	**FY 2007 Request**
Contracts:					
Safer Skies	2,000	3,400	3,373	3,370	3,600
Personnel Costs	0	0	0	0	0
Other In-house Costs	0	0	0	0	0
Total	**2,000**	**3,400**	**3,373**	**3,370**	**3,600**

OMB Circular A-11, Conduct of Research and Development ($000)	**FY 2003 Enacted**	**FY 2004 Enacted**	**FY 2005 Enacted**	**FY 2006 Enacted**	**FY 2007 Request**
Basic	0	0	0	0	0
Applied	0	0	0	0	0
Development (includes prototypes)	2,000	3,400	3,373	3,370	3,600
Total	**2,000**	**3,400**	**3,373**	**3,370**	**3,600**

Safer Skies Product and Activities	FY 2007 Request ($000)	Program Schedule					
		FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011
Safer Skies							
Safer Skies Implementation	**$3,600**						
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	**$3,600**	**$3,370**	**$3,600**	**$3,000**	**$3,000**	**$3,000**	**$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 5, NOT THE PROGRAM BUDGET LINE ITEM.

FAA Budget Appropriation	Budget Item	Program Title	Budget Request
F&E	1A01C	System Capacity, Planning and Improvement	$5,500,000

Supports FAA Strategic Goals: Increased Safety, Greater Capacity, and International Leadership.

Program Goals and Intended Outcomes: The System Capacity, Planning, and Improvement program provides measurement tools, procedural recommendations, capacity related technologies, and problem solving methodologies to measure and improve the National Airspace System (NAS) operational structure. This program encompasses a series of projects and activities that deliver capacity enhancements to alleviate incidents of traffic congestion, system delays, and operational inefficiencies within the aviation system. These initiatives seek to develop long-term responses to capacity demands that will promote system accessibility and flexibility resulting in improved on-time performance.

The ASCI program supports the Agency's efforts to adopt a performance-based organization by:

- Implementing a performance measurement tool that translates the organization's 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; and
- Providing timely and accurate performance metrics designed to measure current FAA goals and customer needs.

The Capacity Office complies with mandates levied by Congress through the Government Performance and Results Act (GPRA) of 1993 and by the White House through an executive order controlling infrastructure investment. These vehicles require the Agency to produce and report on airport improvement plans that advance the aviation industry's high-priority initiatives for increased capacity and implement the recommendations of the Presidential Commission on Improved Airline Competitiveness.

Agency Outputs: The ASCI program strives to deliver high-quality, cost-effective services to meet the needs of its customers, 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. Various Airport design studies will continue to provide problem identification and solution sets at specific targeted airports. Performance metrics required by the Air Traffic Organization (ATO), and captured through that organization's Strategic Management Process tool, will continue to provide a framework for assessing operational performance against Agency goals and targets. ASCI sponsors a wide range of tasks designed to measure, assess, and improve aviation capacity. The following programs are critical to the refinement of the aviation system:

Airport Capacity Enhancement Studies

Investigates capacity and delay issues at the major airports within the NAS. Together with airports and other aviation industry stakeholders, the Agency draws upon the capabilities of computer simulation modeling to conduct studies that recommend improvements for the operating efficiency of the infrastructure.

International Terminal Benchmarking

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.

ATO Strategic Management Process

Designs, develops, and implements a communications management tool within regional, en route, and terminal businesses to improve the efficiency and effectiveness of strategy implementation within the Air Traffic Services regional environment.

Aviation Capacity Enhancement Plan

Identifies new and ongoing agency initiatives to increase airport and airspace capacity. Additionally, compiles 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 that 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, and aircraft interval/acceptance rates.

Customer/Stakeholder Involvement: The success of the FAA is largely due to effective capacity programs led by all facets of the Agency, its customers, and its stakeholders alike. Field experts from the affected disciplines – 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:

- Completed the Final Draft of the Future Airport Capacity Task (FACT) II for AOA-1.
- Completed the JFK International Airport New Large Aircraft (NLA) Airway Facilities Tower Integration Laboratory (AFTIL) Controller/Pilot Orientation.
- Supported the FAA Facilitation Group for the NLA program.
- Completed the Indianapolis Design Team Study.
- Completed the San Francisco International Airport NLA Ground Movement Study.
- Provided statistical data to support the airfield delay simulation performance measurements.
- Develop web-based software application infrastructure to provide service units with centralized access to ATO and performance measures linked to the corporate strategy.
- Completed PDARS installation at ten Terminal Radar Approach Control (TRACON) facilities identified in the FAA *Operational Evolution Plan* (OEP).
- Completed the Portland International Airport Study and presented the recommendations for completion of improvements contained in the final report.
- Completed the final draft of the 2004 *Aviation Capacity Enhancement Plan*.
- Conducted the Domestic Reduced Vertical Separation Minima Benefit Analysis.
- Completed evaluation of the most efficient flow of deicing pads at Denver.
- Analyzed the effect of runway closures at Denver due to pending runway reconstruction.

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 also collaborates with major air carriers and the operators of 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 NASA officials need to respond to the

goals and objectives of their Aviation Safety Program and their Aviation System Monitoring and Modeling program. From an FAA perspective, the system contributes to the Agency's ability to meet the requirements of 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. Work undertaken by 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 2006 ACCOMPLISHMENTS:

- Complete the LAX International Airport NLA AFTIL Controller/Pilot Orientation.
- Complete two FACT Reports.
- Complete the Airfield Delay Simulation Performance Model Outputs.
- Draft the operational procedures for the A380.
- Expand PDARS installation at an additional ten TRACON centers specified in the FAA OEP.
- As part of the ATO Strategic Management Process:
  - Identify data sources, collect baseline data, conduct gap analysis and establish performance targets for all ATO Service/Business Units; and
  - Develop a web-based software application infrastructure to provide all ATO Service/ Business Units with centralized access to ATO and Service Unit cost and performance analysis, forecasting, reporting and initiative tracking capabilities.

KEY FY 2007 PRODUCTS AND MILESTONES:

- Update the Airport Capacity Benchmark Report.
- Draw upon Airport Capacity Benchmark data to generate performance metrics that can be used in forecasting and target setting models.
- Complete PDARS installation at the remaining OEP TRACON centers.
- Provide Airfield Delay Simulation National Goal Forecasting.
- As part of the ATO Strategic Management Process, develop:
  - System and process modifications based on the general needs of stakeholders, dissemination of Strategic Management Process software application to remaining Service Units, communication of strategy management best practices; and
  - New measures to monitor and assess strategic objectives, strengthen existing metrics, validate continuing relevance of metrics.

FY 2007 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 that can result in increased capacity and reduced delays. The Capacity Program will effectively design data systems to measure and analyze operational performance for the assessment of system improvements. The program will also produce capacity studies and analyses to improve operational activity at the nation's most congested airports.

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2005)	$29,223
FY 2006 Appropriated	6,435
FY 2007 Request	5,500
Out-Year Planning Levels (FY 2008-2011)	26,00
Total	$67,158

Budget Authority ($000)	**FY 2003 Enacted**	**FY 2004 Enacted**	**FY 2005 Enacted**	**FY 2006 Enacted**	**FY 2007 Request**
Contracts:					
Aviation System Capacity Improvement	5,100	6,500	3,968	6,435	5,500
Personnel Costs	0	0	0	0	0
Other In-house Costs	0	0	0	0	0
Total	**5,100**	**6,500**	**3,968**	**6,435**	**5,500**

OMB Circular A-11, Conduct of Research and Development ($000)	**FY 2003 Enacted**	**FY 2004 Enacted**	**FY 2005 Enacted**	**FY 2006 Enacted**	**FY 2007 Request**
Basic	0	0	0	0	0
Applied	0	0	0	0	0
Development (includes prototypes)	5,100	6,500	3,968	6,435	5,500
Total	**5,100**	**6,500**	**3,968**	**6,435**	**5,500**

System Capacity, Planning and Improvement Product and Activities	FY 2007 Request ($000)	Program Schedule					
		FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011
System Capacity, Planning and Improvement	**$5,500**						
NAS Performance Measurement							
Develop En Route & Oceanic Svc Unit SMP			◇	◇			
Develop Terminal Svc Unit SMP		◆	◇	◇			
Develop Flight Services Svc Unit SMP		◆	◇	◇			
Install PDARS at OEP airports		◆	◇	◇			
Airport Development							
Update capacity benchmarks study		◆	◇	◇	◇	◇	◇
Model and simulate NLA ground movements		◆	◇	◇	◇		
Develop metrics for 35 OEP airports		◆	◇	◇	◇	◇	◇
Complete 2005 ACE Plan		◆	◇				
Conduct (future) airport capacity task			◇	◇	◇	◇	◇
Conduct airfield delay simulation national goal forecasting			◇				
Develop airfield delay simulation performance model outputs		◆					
Capacity Improvement Initiatives							
Conduct LAX NLA AFTIL Controller/Pilot Orientation		◆	◇				
Obtain A380 design group and waivers			◇				
Develop performance measures model (RDSIM)			◇				
Total Budget Authority	**$5,500**	**$6, 435**	**$5,500**	**$6,500**	**$6,500**	**$6,500**	**$6,500**

◆ - 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 5, NOT THE PROGRAM BUDGET LINE ITEM.

FAA Budget Appropriation	Budget Item	Program Title	Budget Request
R,E&D	A14.a.	System Planning and Resource Management	$1,234,000

Supports FAA Strategic Goals: Increased Safety, Greater Capacity, International Leadership, and Organizational Excellence.

Intended Outcomes: Through this activity, which manages the FAA's R&D portfolio, the FAA is meeting the President's criteria for research and development, increasing program efficiency, and reducing management and operating costs. The FAA is also increasing customer and stakeholder involvement in its programs and fostering greater acceptance of U.S. standards and technology to meet global aviation needs. The FAA carefully manages these activities to ensure that costs are contained – this includes both in-house and contracted efforts. In addition, this program produces the annual National Aviation Research Plan, undertakes strategic planning for the Research, Engineering and Development (R,E&D) program, administers the congressionally mandated R,E&D Advisory Committee (REDAC), conducts external program coordination, fosters future research opportunities, and provides program advocacy and outreach.

In FY 2007 through FY 2010, the FAA will maintain an R&D management workforce comprising no more than 10% of our overall R&D workforce and will sustain the System Planning and Resource Management budget at 2% or less of the total R,E&D budget.

Agency Outputs: In FY 2007 the FAA will:

- Host two REDAC meetings and, at least twelve subcommittee meetings, including support of the new Joint Planning and Development Office (JPDO) Subcommittee, which advises the Administrator regarding the work of the JPDO and the national initiative to transform the U.S. air traffic control system for 2025. The Committee produces periodic and special reports providing advice and recommendations to the FAA on its R,E&D program;
- Prepare the annual R,E&D budget submission;
- Manage the R,E&D portfolio;
- Publish the annual National Aviation Research Plan (NARP);
- Continue to coordinate research activities with NASA through FAA's R&D Field Offices; and
- Support the Next Generation Air Transportation System initiative.

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: Program accomplishments include:

- Received an OMB Program Rating Assessment Tool score of 92.5;
- Published and submitted the annual National Aviation Research Plan to Congress;
- Managed two REDAC meetings and over twelve subcommittee meetings;
- Developed the annual R,E&D budget submission;
- Hosted the 6th USA-Europe Air Traffic Management Seminar, the only such symposium held specifically to discuss air traffic management research worldwide; and
- Supported the JPDO's Next Generation Air Transportation System activities.

R&D Partnerships: The FAA's R&D partnerships are described in each budget line item.

MAJOR ACTIVITIES AND ANTICIPATED FY 2006 ACCOMPLISHMENTS:

- Publish the National Aviation Research Plan (February 2006).
- Provide strategic direction for FAA R,E&D program.
- Administer REDAC activities.
- Obtain REDAC review of and recommendations for FY 2008 R,E&D Program.
- Obtain REDAC guidance for the FY 2008 R,E&D Program.
- Coordinate R&D activities with NASA and other partners.
- Support Next Generation Air Transportation System activities.

FY 2007 PROGRAM REQUEST:

To see that it continues to meet the President's R&D criteria, the Agency will re-evaluate its R&D strategies to ensure they remain viable and meet Agency needs; foster external review and customer input to R,E&D programs and activities; and publish program activities and accomplishments.

The Agency will continue to support the work of the REDAC in its task to advise the FAA Administrator on the R&D Program. In particular, it will seek the counsel and guidance of the committee for the FY 2009 program, review the proposed FY 2009 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 concurrent with the President's Budget Request.

The Agency will continue to maintain its field offices at the NASA Ames and Langley Research Centers as a vital part of efforts to coordinate and integrate the research and development programs of the two organizations.

Ongoing Activities

Ongoing activities include:

- Publish the National Aviation Research Plan; and
- Sustain R,E&D Advisory Committee Activities.

New Initiatives

No new initiatives are planned in FY 2007.

KEY FY 2007 PRODUCTS AND MILESTONES:

- Publish the National Aviation Research Plan.
- Prepare the annual R,E&D budget submission.
- Manage the FAA R&D portfolio.
- Conduct an R&D strategy assessment.
- Administer and facilitate REDAC activities by:
  - Obtaining REDAC recommendations on planned R,E&D investments for FY 2009; and
  - Aiding the REDAC in its preparation of other reports, as requested by the Administrator.
- Participate on NASA's Aero-Space Technology Advisory Committee.
- Continue participating in the JPDO Next Generation Air Transportation System activities.
- Support NASA research and development activities in support of national aviation goals.

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2005)	$36,742
FY 2006 Appropriated	1,189
FY 2007 Request	1,234
Out-Year Planning Levels (FY 2008-2011)	4,536
Total	$43,701

Budget Authority ($000)	**FY 2003 Enacted**	**FY 2004 Enacted**	**FY 2005 Enacted**	**FY 2006 Enacted**	**FY 2007 Request**
Contracts:					
R,E&D Plans and Programs	902	436	455	1,143	1,192
Personnel Costs	43	56	53	46	39
Other In-house Costs	2	5	8	0	3
Total	**947**	**497**	**516**	**1,189**	**1,234**

OMB Circular A-11, Conduct of Research and Development ($000)	**FY 2003 Enacted**	**FY 2004 Enacted**	**FY 2005 Enacted**	**FY 2006 Enacted**	**FY 2007 Request**
Basic	0	0	0	0	0
Applied	947	497	516	1,189	1,234
Development (includes prototypes)	0	0	0	0	0
Total	**947**	**497**	**516**	**1,189**	**1,234**

A14a – System Planning and Resource Product and Activities	FY 2007 Request ($000)	Program Schedule					
		FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011
011-130 R,E&D Plans and Programs							
R,E&D Plans and Programs	**$472**						
Publish annual plan for R&D		♦	◊	◊	◊	◊	◊
Conduct R,E&D financial management		♦	◊	◊	◊	◊	◊
Prepare annual budget submissions		♦	◊	◊	◊	◊	◊
R,E&D Advisory Committee	**$120**						
Recommend 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	**$42**						
Total Budget Authority	**$1,234**	**$1,189**	**$1,234**	**$1,172**	**$1,144**	**$1,104**	**$1,116**

FAA Budget Appropriation	Budget Item	Program Title	Budget Request
R,E&D	A11.l.	Unmanned Aircraft Systems Research	$1,200,000

Supports FAA Strategic Goals: Increased Safety, and Greater Capacity.

Intended Outcomes: The Unmanned Aircraft Systems (UAS) Research Program supports FAA regulatory actions and safety oversight needed to ensure the safety of civil unmanned aerial vehicles (UAV) operations in the National Airspace System. The program's worldwide research activities focus on technology surveys, methodology development, data collection and generation, laboratory and field validation, and technology transfer. These activities provide the basis for developing airworthiness standards, devising operational requirements, establishing maintenance procedures, and conducting safety oversight activities for UAS civil applications.

Agency Outputs:

Researchers are developing methodologies and tools to define UAS design and performance characteristics. They are generating data to support standardization of UAS civil operations and the new standards are being implemented to establish UAS certification procedures, airworthiness standards, and operation requirements. Policies and guidance materials are also being published to equip FAA certification engineers and safety inspectors with the knowledge and tools they need to ensure the safe integration of UAS into the NAS.

Customer/Stakeholder Involvement:

Full and safe integration of UAS into civil aviation requires the FAA to work closely with other government and private agencies that have a long history of developing and operating UAS – such as the following DoD, DHS, NASA, industrial organizations, and other Civil Aviation Authorities (CAA) worldwide:

- The Joint Planning and Development Office has identified UAS integration to NAS as one of the emerging challenges to the nation's air transportation system. One of the strategies in the FAA's current Flight Plan is to "Develop policies, procedures, and approval processes to enable operation of UAVs."
- The Subcommittee on Aircraft Safety of the FAA Research, Engineering and Development Advisory Committee has recommended that the FAA make UAS-related research one of its top priority areas supporting the Agency's regulatory activities.
- Technical Community Representative Groups – FAA representatives apply formal guidelines to ensure that the program's research projects support new rule making and development of alternate means to comply with existing rules.
- Since UAS civil operation is a new area, the FAA will work closely with its industry partners to gain knowledge and expertise.

Accomplishments:

This is a new program.

R&D Partnerships:

The program has entered into interagency agreements with other Government agencies (DoD, DHS, and NASA), a memorandum of cooperation with foreign CAAs, and other procurement vehicles (contracts, grants, cooperative agreements, etc.) with industrial and academic entities.

MAJOR ACTIVITIES AND ANTICIPATED FY 2006 ACCOMPLISHMENTS:

None – this is a new research program.

FY 2007 PROGRAM REQUEST:

Ongoing Activities

None.

New Initiatives

The following research will be initiated:

- Investigate current technological capabilities to sense potential traffic conflicts.
  The results of this research will determine detect, sense, and avoid (DSA) system characteristics and limitations to enable UAV see-and-avoid capabilities. Having this information in the cockpit, will allow the pilot to execute the avoid function manually or automatically. A set of parameters will be identified to quantify performance characteristics and limitations of each DSA system. These parameters will be used to compare the candidate DSA technologies. Additionally, these performance parameters will be used in follow on studies to pair candidate technologies with aircraft classifications and operational implementation to establish a means of compliance to 14 CFR Part 91.113.
- Review the safety implications of system performance impediments to command, control and communications (C3).
- Collect and review data concerning flight termination systems for UASs.
- Evaluate historical and current technology development.

KEY FY 2007 PRODUCTS AND MILESTONES:

Requirements of DSA Capabilities

- Identify DSA research requirements.
- Initiate the DSA research project.
- Develop the DSA project plan.

C3 Performance

- Identify C3 research requirements.
- Initiate the C3 research project.
- Develop the C3 project plan.

Flight Termination

- Identify flight termination research requirements.
- Initiate the flight termination research project.
- Develop the flight termination project plan.

Evaluation of Historical and Current Technology Development

- Initiate the technology survey.
- Develop the project plan.

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2005)	0
FY 2006 Appropriated	0
FY 2007 Request	1,200
Out-Year Planning Levels (FY 2008-2011)	4,374
Total	$5,574

Budget Authority ($000)	FY 2003 Enacted	FY 2004 Enacted	FY 2005 Enacted	FY 2006 Enacted	FY 2007 Request
Contracts:					
Unmanned Aircraft System	0	0	0	0	1,200
Personnel Costs	0	0	0	0	0
Other In-house Costs	0	0	0	0	0
Total	**0**	**0**	**0**	**0**	**1,200**

OMB Circular A-11, Conduct of Research and Development ($000)	FY 2003 Enacted	FY 2004 Enacted	FY 2005 Enacted	FY 2006 Enacted	FY 2007 Request
Basic	0	0	0	0	0
Applied	0	0	0	0	1,200
Development (includes prototypes)	0	0	0	0	0
Total	**0**	**0**	**0**	**0**	**1,200**

A11.l. – Unmanned Aircraft Systems Research Product and Activities	FY 2007 Request ($000)	Program Schedule					
		FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011
Unmanned Aircraft System Research							
Detect, Sense, and Avoid Research	**$400**						
Complete identification of DSA research requirements			◊				
Complete survey of existing DSA capabilities				◊			
Determine DSA characteristics and operational requirements				◊			
Develop UAS DSA performance requirements					◊		
Conduct DSA operational restriction study					◊		
Conduct technology field evaluation					◊	◊	◊
Command, Control, and Communications	**$450**						
Complete identification of C3 research requirements			◊				
Complete C3 technology survey				◊			
Determine C3 performance requirements					◊		
C3 Frequency spectrum, interference, and security investigations					◊		
Conduct field tests					◊		
Flight Termination	**$200**						
Complete identification of flight termination research requirements			◊				
Complete technology survey on flight termination				◊			
Determine flight termination requirements					◊		
Conduct field test and evaluation					◊		
Historical and Current Technology Survey	**$150**						
Conduct the technology survey			◊				
Complete technology survey and publish report				◊			
Risk Analysis and Management							
Perform risk assessments of UAS introduction to NAS				◊			
Develop risk management concepts, models, tools					◊		
Develop methodologies of safety management of operations					◊		
Conduct data analysis of safety management						◊	
Flight Test Research Program							
Establish flight test requirements				◊			
Install and test ground control equipment					◊		
Conduct in-flight tests of DSA, C3, and flight termination technologies for validation					◊		
Conduct flight tests of new technologies						◊	
Design and Performance Characteristics Study							
Determine airframe design requirements				◊			
Conduct light load characteristics study				◊			
Define airworthiness assurance requirements					◊		
Determine requirements/restrictions of operational environmental conditions					◊	◊	◊
Personnel and Other In-House Costs	**$0**						
Total Budget Authority	**$1,200**	**$0**	**$1,200**	**$1,133**	**$1,105**	**$1,063**	**$1,073**

FAA Budget Appropriation	Budget Item	Program Title	Budget Request
F&E	1A01K	Wake Turbulence	$1,000,000

Supports FAA Strategic Goals: Increased Safety, and Greater Capacity.

Intended Outcomes: The Air Traffic Control (ATC) wake turbulence hazard mitigation procedures currently regulating departing aircraft reduce an airport's overall operational capacity. Also affecting arrival rates, wake turbulence is a major indirect contributor to terminal delays, especially when bad weather conditions do not permit visual operations. The Wake Turbulence Program seeks to achieve a reduction of wait time between departures on closely spaced parallel runways (those that are adjacent to each other and separated by less than 2500 feet). The resulting increased numbers of departures per airport runway are expected to enhance overall ATC service capabilities considerably within the National Airspace System (NAS).

The Wake Turbulence Research Program is tied both to the FAA *Flight Plan 2006-2010* and the Operation Evolution Plan (OEP). Objective One for the Greater Capacity Goal of this year's Plan, "Increase Airport Capacity to Meet Projected Demand," includes an initiative to "Conduct research to improve safety and increase throughput using wake turbulence monitoring, operational procedures, and controller tools." A result of collaboration between the FAA and the aviation industry, the current OEP (version 7) further defines the program component for the *Flight Plan 2006 –2010* parallel runway initiative as: Safety, Policy, Procedures and Airspace, "Wake Turbulence Research and Development Effort to Enhance Departure and Arrival Operations for Closely Spaced Parallel Runways (CSPR)."

The desired outcome of the F&E component of the Wake Turbulence Program will be a ground-based capability to space aircraft airport departures with shorter times for wake turbulence mitigation than are allowable today. Beginning in FY 2006 and continuing into FY 2007, the FAA will evaluate the prototype ground-based departure spacing system developed by NASA and will initiate the systems engineering planning required to integrate the capabilities of this prototype into the NAS. Future funding (if the NASA prototype demonstrates a beneficial capability) will allow the NASA system to be added to existing terminal automation platforms and enable procurement of the specialized wind/wake sensors (if required).

Agency Outputs:

If NASA succeeds in creating a viable prototype that demonstrates significant benefit to airport departure operations, the FAA will develop, deploy and operate the following:

- Modified air traffic control wake mitigation procedures for aircraft departing on airport CSPRs, and
- Enhancements to FAA airport/TRACON automation systems and additional weather/wake sensors (if required) at affected airports.

Funding requested in FY 2007 allows for the continued evaluation of the NASA technology prototype in a particular airport environment, but does not yet support its integration into the NAS. Subsequent development and integration by the FAA is pending the results of the NASA prototype demonstration and the availability of FAA resources needed to introduce a new capability into the NAS.

Customer/Stakeholder Involvement:

Development of a ground-based departure spacing system is being jointly undertaken by the FAA and NASA as a component of an overall joint FAA/NASA Wake Turbulence Program. A key stratagem of the joint program is the requirement of periodic (semi-annual) program status meetings with key stakeholders. To involve an even broader audience to review the work being accomplished, the program leads hold forums (WakeNet USA) twice a year to make wake turbulence research results public. Program staff members also

coordinate their efforts with those of their European counterparts so that both may accelerate this important work.

Customers and stakeholders within the FAA who directly participate in or advise the joint Wake Turbulence Program are: the Air Traffic Organization - Terminal Services, the Air Traffic Organization – System Operations Services, the Air Traffic Organization – Safety, and the Flight Standards Service. Collaborators outside of the Agency include: the Boeing Company, the Lockheed Martin Corporation, United Parcel Service, United Airlines, the Raytheon Company, the Air Line Pilots Association, and the National Air Traffic Controllers Association.

Accomplishments: (includes FY 2004 F&E funded and FY 2005 R,E&D funded activities related to the development of a wake turbulence mitigation departure spacing tool – program was not F&E funded in FY 2005):

- Acquired prototype pulsed Light Detection and Ranging (LIDAR) sensors and increased their wake turbulence detection and tracking rate to 85 percent of wakes created by arriving aircraft.
- Developed crosswind prediction algorithms that will be key components of the NASA ground-based departure spacing system prototype.
- Initiated development of pulsed LIDAR scanning and processing techniques for detecting and tracking wake vortices of aircraft during takeoff and climb.

R&D Partnerships:

As described under Customer/Stakeholder Involvement, the FAA/NASA Wake Turbulence Program is constructed as a joint/collaborative program of researchers across the FAA, NASA, EUROCONTROL and supporting organizations. Entities participating in the program include:

- NASA, Efficient Aircraft Spacing Projects
- FAA, Air Traffic Organization – Planning
- DOT, Volpe National Transportation Systems Center
- MITRE/Center for Advanced Aviation Systems Development
- George Mason University
- Raytheon Company
- MIT Lincoln Laboratory
- Computer Sciences Corporation
- NorthWest Research Associates
- ASE Inc.
- Coherent Technologies Inc
- CSSI, Incorporated
- Air Traffic Simulation, Inc.
- ICF Consulting
- Logistics Management Institute

MAJOR ACTIVITIES AND ANTICIPATED FY 2006 ACCOMPLISHMENTS:

- Develop techniques for detecting and tracking the wakes of aircraft during takeoff and climb.
- Evaluate (prototype) alternative computer human interface for use in the ATC decision support tool for wake turbulence mitigation departure spacing.
- Modify the FAA wake turbulence encounter model for use in evaluating changes in aircraft departure procedures.

- Deploy new instrument suite in evaluating the NASA ground-based departure spacing system prototype.

FY 2007 PROGRAM REQUEST:

In FY 2007, the NASA departure spacing prototype demonstration will be nearing completion and funding will be needed to provide for an FAA evaluation of the feasibility of adapting the prototype, and its associated operational procedures, as an additional NAS service capability. The requested funding will also provide for the initial system engineering planning for integrating the NASA prototype capability into the FAA airport service infrastructure. Subsequent FAA investment decisions will determine the extent to which the capability will be implemented in the NAS and funding requirements for FY 2008 and beyond.

KEY FY 2007 PRODUCTS AND MILESTONES:

- Complete the evaluation of NASA's initial air traffic control decision support tool prototype system for separating aircraft from the wakes of departing aircraft.
- Support development of pulsed LIDAR to detect and track wake turbulence from departing aircraft.
- Evaluate the terminal area crosswind prediction algorithm.

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2005)	$4,000
FY 2006 Appropriated	3,960
FY 2007 Request	1,000
Out-Year Planning Levels (FY 2008-2011)	0
Total	$8,960

Budget Authority ($000)	FY 2003 Enacted	FY 2004 Enacted	FY 2005 Enacted	FY 2006 Enacted	FY 2007 Request
Contracts:					
Wake Turbulence	0	4,000	0	3,960	1,000
Personnel Costs	0	0	0	0	0
Other In-house Costs	0	0	0	0	0
Total	**0**	**4,000**	**0**	**3,960**	**1,000**

OMB Circular A-11, Conduct of Research and Development ($000)	FY 2003 Enacted	FY 2004 Enacted	FY 2005 Enacted	FY 2006 Enacted	FY 2007 Request
Basic	0	0	0	0	0
Applied	0	0	0	0	0
Development (includes prototypes)	0	4,000	0	3,960	1,000
Total	**0**	**4,000**	**0**	**3,960**	**1,000**

Wake Turbulence Product and Activities	FY 2007 Request ($000)	Program Schedule					
		FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011
Wake Turbulence	**1,000**						
Evaluate terminal winds algorithm		◆	◇				
Evaluate NASA Prototype		◆	◇				
Development of LIDAR processes for detecting and tracking wakes of departing aircraft		◆					
Development of Computer-Human Interface for Integrated Capability		◆					
Support of Wake Detecting LIDAR Systems		◆	◇				
Total Budget Authority	**$1,000**	**$3,960**	**$1,000**	**$0**	**$0**	**$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. IN THE FACILITIES AND EQUIPMENT APPROPRIATIONS, PERSONNEL AND OTHER COSTS ARE BUDGETED IN ACTIVITY 5, NOT THE PROGRAM BUDGET LINE ITEM.

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FAA Budget Appropriation	Budget Item	Program Title	Budget Request
R,E&D	A12.b.	Wake Turbulence	$3,066,000

Supports FAA Strategic Goals: Increased Safety, and Greater Capacity.

Intended Outcomes: The Wake Turbulence Program addresses the FAA goal for capacity and the DOT Mobility Strategic Objective to "Advance accessible, efficient, intermodal transportation for the movement of people and goods." The program is increasing the capacity of terminal airspace during inclement weather by developing modifications to air traffic control wake turbulence mitigation procedures used during these weather conditions. The program also is addressing wake turbulence impacts as air routes are redesigned and new types of aircraft are introduced into the National Airspace System. Program outcomes include:

- Reducing delays during less than visual flight rules conditions;
- Implementing new wake turbulence separation standards and procedures that will improve airport arrival and departure rates, and thus increase NAS productivity and capacity. (Research provides operational concept inputs to NASA's more general technology based development program.); and
- Determining wake turbulence separations required with the design of more efficient airspace routes and the introduction of new aircraft designs.

By FY 2009, the program will complete International Civil Aviation Organization-level wake vortex standards performance assessment.

Agency Outputs: The Wake Turbulence Program conducts applied research to develop improved air traffic control mitigation procedures that will help to solve operational problems involving arrivals at airports with closely spaced parallel runways. During periods of less than ideal weather and visibility conditions, implementation of these new wake turbulence mitigation procedures will allow air traffic control to operate these airports at arrival rates closer to their design capacity. Additionally, in partnership with NASA, the research program will define wake mitigation solutions that safely enable more departures from closely spaced parallel runways. New developments in the NASA wake vortex model will be incorporated into a set of modeling tools to assess required wake turbulence separations in the design of more efficient airspace routes and the introduction of new aircraft designs.

Customer/Stakeholder Involvement: The program addresses the needs of the FAA Air Traffic Organization and works together with the Flight Standards organization to ensure the new procedures and solutions are safe and that the airports targeted for their implementation are those with critical needs to reduce air traffic delays. The program works with controllers, airlines, and pilots to include user recommendations and ensure that training and implementation issues are addressed from the start. The program also works with NASA to support their mid-term and long-term technology application research activities in wake turbulence and to ensure that their solutions focus on remaining wake constraints and effectively integrate into the NAS.

Accomplishments: The following represent major accomplishments of the wake turbulence program:

- Collected and analyzed over one year's aircraft wake turbulence data and associated weather and air traffic operational data at Lambert – St. Louis International Airport;
- Submitted a waiver to Air Traffic Control Order 7110.65 as it affects closely spaced parallel runways (2500 foot rule) at Lambert – St. Louis International, the initially selected airport;
- Updated the wake turbulence safety assessment capability specifications used to simulate and test the vertical flight terminal instrumentation procedures endorsed by Flight Standards Services (this update was based on data collected at the Lambert – St. Louis International Airport);

- Continued cooperative data exchange with European wake turbulence data collection efforts;
- Enhanced the capabilities of a line detection and ranging-based wake tracking system; and
- Developed a plan for wake turbulence data collection and analyses required to apply the Lambert - St. Louis International Airport derived wake mitigation procedures to subsequent airports.

R&D Partnerships: In addition to maintaining its partnership with the FAA's Flight Standards organization, the airlines, and the controllers' and pilots' labor organizations, the program closely coordinates and leverages its wake turbulence research activities with industry, academia, and other government agencies. This coordination is accomplished 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 aviation research community to share results of the international wake research activities.

MAJOR ACTIVITIES AND ANTICIPATED FY 2006 ACCOMPLISHMENTS:

- Complete the sensor installation and initiate wake turbulence data collection effort at an additional airport that would benefit (as St. Louis has) from changes to its wake mitigation procedures for closely spaced parallel runway approaches;
- Complete a post implementation evaluation of the application of modified wake turbulence mitigation procedures at St. Louis Lambert Field;
- Develop a national change to Air Traffic Order 7110.65 as it applies to closely spaced parallel runways; and
- Complete a concept definition for wind-dependent wake turbulence mitigation procedures for aircraft departing on closely spaced parallel runways.

FY 2007 PROGRAM REQUEST:

Ongoing Activities

- Continue wake data collection and analyses at additional airports to support national and airport specific changes to 2,500-foot rule for airport closely spaced parallel runways.
- Complete the safety analysis associated with the requested national change to Air Traffic Order as it applies to closely spaced-parallel runways.
- Implement the national change.

New Initiatives

- Develop wake turbulence encounter analysis tools to accomplish analyses associated with design of airspace efficient routes, air traffic control procedure changes, and introduction of new aircraft designs.
- Apply these wake turbulence encounter analysis tools in the evaluation of air route changes, modifications to en route air traffic control aircraft separation procedures changes and introduction of new aircraft designs.

KEY FY 2007 PRODUCTS AND MILESTONES:

- Complete wake turbulence data collection and analysis at a second airport that could benefit from a modification of its wake mitigation procedures for closely spaced parallel runway approaches.
- Complete the post implementation evaluation of modified wake turbulence mitigation procedure application at an airport subsequent to St. Louis.

- Gain approval for a national change to Air Traffic Order 7110.65 as it applies to the use of closely spaced parallel runways for integrated landing system approach operations.
- Complete the FAA assessment of NASA's concept for wind dependent wake turbulence mitigation procedure for aircraft arriving on closely spaced parallel runways.
- Initiate development of a suite of analysis tools for evaluating the potential of wake turbulence encounters resulting from the design of airspace efficient routes, air traffic control procedure changes, and the introduction of new aircraft designs.

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2005)	$16,884
FY 2006 Appropriated	2,273
FY 2007 Request	3,066
Out-Year Planning Levels (FY 2008-2011)	11,329
Total	$33,552

Budget Authority ($000)	**FY 2003 Enacted**	**FY 2004 Enacted**	**FY 2005 Enacted**	**FY 2006 Enacted**	**FY 2007 Request**
Contracts:					
Wake Turbulence	7,580	0	3,966	2,036	2,833
Personnel Costs	315	259	163	225	222
Other In-house Costs	28	15	133	12	11
Total	**7,923**	**274**	**4,262**	**2,273**	**3,066**

OMB Circular A-11, Conduct of Research and Development ($000)	**FY 2003 Enacted**	**FY 2004 Enacted**	**FY 2005 Enacted**	**FY 2006 Enacted**	**FY 2007 Request**
Basic	0	0	0	0	0
Applied	7,923	274	4,262	2,273	3,066
Development (includes prototypes)	0	0	0	0	0
Total	**7,923**	**274**	**4,262**	**2,273**	**3,066**

A12.b.- Wake Turbulence Product and Activities	FY 2007 Request ($000)	Program Schedule					
		FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011
041-150 - Wake Turbulence							
Adapt and implement wake avoidance procedure modification for closely spaced parallel runways at an additional airport (subsequent to St. Louis)	**$800**	♦	◊				
Develop and validate weather dependent wake avoidance concepts for less than VFR conditions	**$200**	♦	◊				
Develop and obtain national modification to Air Traffic Control Order 7110.65 as it affects closely spaced parallel runway approaches	**$500**	♦	◊				
Implement wake avoidance procedure modifications at additional top 35 delayed airports (including safety assessments)	**$200**		◊	◊	◊	◊	◊
Adapt and implement wake avoidance procedure modification for closely spaced parallel runways at 2nd airport subsequent to St. Louis	**$300**	♦	◊	◊	◊		
Obtain waiver to allow use of CSPR at Lambert -St. Louis International Airport		♦					
Develop wake turbulence encounter assessment tools for analysis of potential air traffic routing and separation changes in the en route airspace	**$833**		◊	◊			
Accomplish wake turbulence assessments of potential air traffic routing and separation changes in the en route airspace				◊	◊	◊	◊
Personnel and Other In-House Costs	**$233**						
Total Budget Authority	**$3,066**	**$2,273**	**$3,066**	**$2,915**	**$2,855**	**$2,764**	**$2,795**

FAA Budget Appropriation	Budget Item	Program Title	Budget Request
R,E&D	A11.k.	Weather Program	$19,545,000

Supports FAA Strategic Goals: Increased Safety, Greater Capacity, and International Leadership.

Intended Outcomes: The Weather Program strives to reduce the number of accidents associated with weather and to minimize the impacts of adverse weather events on the operational capacity of our National Airspace System. Program personnel collaborate with the National Weather Service (NWS) and NASA to improve short-term and mid-term forecasts of naturally occurring atmospheric hazards, such as turbulence, severe convective activity, icing, and restricted visibility. Additional research is on-going to provide weather observations, warnings, and forecasts that are more accurate, accessible, and efficient, and to meet a range of current and planned regulatory requirements. Improved forecasts enhance flight safety, reduce air traffic controller and pilot workload, improve flight planning, increase productivity, and enhance common situational awareness.

By 2009, the weather program will develop a six- to twelve-hour freezing precipitation forecast capability.

By 2015, high-glance-value weather products – with longer forecast lead times and increased accuracy for turbulence, severe convective activity, icing, and restricted visibility – will be developed and available electronically to all aviation users.

Agency Outputs: The weather research program develops new and improved weather algorithms for NAS platforms such as the weather and radar processor, the integrated terminal weather system, the operational and supportability implementation system, and the enhanced traffic management system – as well for as National Weather Service platforms.

The program routinely transfers technology to help private weather service companies supporting the NAS to benefit as follows from the FAA's improved weather products:

- Depiction of current and forecasted in-flight icing areas – enhances safety and aircraft use;
- 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; and
- In-situ and remote detection and forecast of en route turbulence, including clear air turbulence – enhances en route safety.

Customer/Stakeholder Involvement: The program's weather research priorities and plans are consistent with user needs, and its researchers regularly work with the other FAA organizations, such as the NAS Weather Office.

Many of the programs research projects and priorities are drawn from the interagency National Aviation Weather Initiatives, which are strongly influenced by other NAS drivers, including "Safer Skies" and Flight Plan Safety Objectives. Also, the weather program continually seeks input from the aviation community in public forums such as the annual National Business Aircraft Association conference and the Friends/Partners in Aviation Weather Forum, as well as industry-produced documents and publications, to revalidate its priorities and plans.

Accomplishments: Major accomplishments include:

- Improved the accuracy and resolution of data on upper winds, temperature, and moisture through rapid-update-cycle analyses and forecasts.
- Forecast freezing precipitation aloft and supported rule making that prevents turboprops from flying into conditions conducive to in-flight icing.
- Upgraded Next-Generation Weather Radar (NEXRAD) algorithms, storm cell identification and tracking, hail detection, and mesocyclone and tornado detection (leveraged with NWS).
- Received the 1999 Government Technology Leadership Award for transferring Weather Support to Decision Making system technology to a commercial weather provider.
- Received the 2000 Government Technology Leadership Award for enhancing the Aviation Digital Data Service with the implementation of a flight path tool depicting vertical cross sections of weather along user-specified flight routes.
- Extended the availability of weather data and capabilities that are generated through four recently-implemented weather products:
  - Current and up to one hour forecast 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; and
  - Current and up to twelve hour forecasts of marine stratus burnoff at San Francisco International Airport.
- Completed convective storm growth and decay field tests in Dallas, Orlando, Memphis, and New York.

  This research is resulting in the accurate short-term prediction of the initiation, growth, and decay of storm cells, and is enhancing the strategic and tactical flow management planning that allows more effective routing of traffic to/from airports and runways.
- Achieved FAA's 2002 Excellence in Aviation Award.
- Achieved the National Weather Association's 2002 Aviation Meteorology Award.
- Achieved the Office of Research and Acquisitions 2003 Mission Excellence Award.
- Achieved the Department of Commerce 2003 Silver Medal.

R&D Partnerships: 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 Weather Program collaborates with the FAA's NAS Weather Office 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 (MOA). The program's partners include: the National Center for Atmospheric Research; National Oceanic and Atmospheric Administration laboratories; Massachusetts Institute of Technology's Lincoln Laboratory; NWS' 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 2006 ACCOMPLISHMENTS:

- Obtain FAA approval of the in-flight icing forecast severity product for experimental use.
- Obtain FAA approval of two-hour national convective weather probabilistic forecasts for operational use.
- Implement the anomalous propagation mitigation algorithm into NEXRAD operations.

- Develop the six-hour winter precipitation forecast.
- Implement the experimental volcanic ash coordination tool at the Montreal Volcanic Ash Advisory Center.
- Obtain FAA approval of the mid-level turbulence forecast product for operational use.
- Test the 12-hour terminal ceiling and visibility forecast product.
- Obtain FAA approval for the oceanic convective nowcast test product.
- Evaluate the continental U.S. (CONUS) ceiling, visibility, and flight category forecast test products.
- Make the weather research and forecast model, with rapid refresh, available for experimental use.
- Conduct quality assessment evaluations of in-flight icing, turbulence, convective weather, national ceiling and visibility, and oceanic convective diagnosis products to support the aviation weather technology transfer process.

FY 2007 PROGRAM REQUEST:

Ongoing Activities

- Develop algorithms for forecasts of freezing drizzle aloft, also:
  - Integrate terminal, regional, and national convective weather forecast capability; and
  - Develop oceanic hazard diagnostic and forecast products.
- Develop ceiling and visibility now-cast products as part of the northeast corridor efforts associated with the Terminal Ceiling and Visibility Program.
- Transition weather research products to operations in the NWS, the FAA, and industry automation and weather systems.
- Continue development of automated data analysis and assimilation techniques.

New Initiatives

No new initiatives are planned in FY 2007.

KEY FY 2007 PRODUCTS AND MILESTONES:

- Gain FAA approval for operational use of the in-flight icing forecast product for Alaska.
- Gain FAA approval by FAA for experimental use of the six-hour national convective weather probabilistic forecast product.
- Implement 3D mosaics for CONUS into NEXRAD operations.
- Evaluate the over-night frost prediction technique.
- Implement the Real-Time Verification System at the National Weather Service headquarters.
- Evaluate an experimental version of the weather research and forecast numerical model, with rapid refresh.
- Complete experimental use of the probabilistic turbulence forecast product.
- Gain FAA approval for operational use of en route CONUS ceiling, visibility and flight category analysis products.
- Gain FAA approval for operational use of oceanic cloud-top height product.
- Develop the terminal integrated ceiling and visibility experimental product.
- Develop verification techniques, and conduct quality assessment evaluations of, in-flight icing, turbulence, convective weather, national ceiling and visibility, and oceanic cloud-top height products to support the aviation weather technology transfer process.

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2005)	$314,804
FY 2006 Appropriated	20,376
FY 2007 Request	19,545
Out-Year Planning Levels (FY 2008-2011)	71,972
Total	$426,697

Budget Authority ($000)	**FY 2003 Enacted**	**FY 2004 Enacted**	**FY 2005 Enacted**	**FY 2006 Enacted**	**FY 2007 Request**
Contracts:					
Weather Program – Safety	19,249	19,073	19,248	19,212	18,432
Weather Program – Efficiency	4,176	2,981	0	0	
Personnel Costs	1,145	1,264	1,224	1,074	1,035
Other In-house Costs	113	117	199	90	78
Total	**24,683**	**23,435**	**20,671**	**20,376**	**19,545**

OMB Circular A-11, Conduct of Research and Development ($000)	**FY 2003 Enacted**	**FY 2004 Enacted**	**FY 2005 Enacted**	**FY 2006 Enacted**	**FY 2007 Request**
Basic	0	0	0	0	0
Applied	24,683	23,435	20,671	20,376	19,545
Development (includes prototypes)	0	0	0	0	0
Total	**24,683**	**23,435**	**20,671**	**20,376**	**19,545**

A11k - Weather Program – Safety Product and Activities	FY 2007 Request ($000)	Program Schedule					
		FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011
041-110 Aviation Weather Analysis and Forecasting							
In-flight Icing	**$1,568**						
Approve by FAA experimental forecast severity product		♦					
Approval by FAA of operational forecast severity product			◊				
Implement current icing product for AK operationally					◊		
Implement hi-res current icing product operationally						◊	
Advanced Weather Radar Techniques	**$1,695**						
Implement AP mitigation algor. into NEXRAD operations			◊				
Implement 3D Mosaics for CONUS into NEXRAD operations				◊			
Aviation Forecasts	**$2,445**						
Implement experimental VACT at the Montreal VAAC		♦					
Implement enhanced RTVS at NWS headquarters			◊				
Model Development and Enhancement	**$1,967**						
Availability of WRF with rapid refresh for research use		♦					
Evaluate experimental WRF with rapid refresh			◊				
Winter Weather Research	**$443**						
Develop 6-hour precipitation forecast		◊					
Evaluate over-night frost prediction technique			◊				
Turbulence	**$1,583**						
Approve by FAA mid-level turbulence forecasting product for operational use		♦					
Complete experimental probabilistic turbulence forecasting product			◊				
Implement low-level turbulence forecast product operationally							◊
National Ceiling & Visibility	**$841**						
Evaluate CONUS forecast test products		♦					
Approval by FAA of operational CONUS analysis product			◊				
Implement AK forecast product operationally							◊
Convective Weather	**$3,476**						
Approve by FAA oper 2-hour natl conv Wx prob. forecast		♦					
Approval of experimental 6-hr natl conv Wx probabilistic forecast			◊				
Implement 6-hour national convective probabilistic forecast operationally							◊
Terminal Ceiling and Visibility	**$1,225**						
Test 12-hour ceiling & visibility forecast product		♦					
Integrate ceiling & visibility experimental product			◊				
Test air traffic decision tool for NY airports						◊	
Oceanic Weather	**$602**						
Approve by FAA convective nowcast test product		♦					
Approval by FAA of operational cloud-top height product			◊				
Approval by FAA of operational in-flight icing forecast product							◊
Quality Assessment	**$2,587**						
Conduct evaluations to support AWTT process			◊				
Devel verif. Tech. & conduct evaluations for AWTT							◊
Personnel and Other In-House Costs	**$1,113**						
Total Budget Authority	**$19,545**	**$20,376**	**$19,545**	**$18,551**	**$18,150**	**$17,543**	**$17,728**

FAA Budget Appropriation	Budget Item	Program Title	Budget Request
R,E&D	A14.b	William J. Technical Center Laboratory Facility	$3,430,000

Supports FAA Strategic Goals: Increased Safety, Greater Capacity, International Leadership, and Organizational Excellence.

Intended Outcomes: The FAA sustains research facilities located at the William J. Hughes Technical Center (WJHTC) in support of its R&D program goals. These facilities consist of NAS systems, aircraft, simulation facilities, communication systems laboratory, and a Human Factors laboratory.

Agency Outputs: R&D programs require specialized facilities to emulate and evaluate field conditions. For example, human factors projects require ground-based laboratories to perform human-in-the-loop simulations, measure human performance, and evaluate human factors issues. These laboratories are comprised of integrated cockpit and air traffic control workstation simulators, and the performance issues they delve into reflect the perspectives of the pilot and flight crew. Airborne and navigation projects require additional "flying laboratories" that are specially instrumented and reconfigurable to support a variety of projects.

Customer/Stakeholder Involvement: The WJHTC facilities directly support Agency projects and integrated product teams in the following areas:

- Capacity and air traffic management technology
- Communications, Navigation, And Surveillance
- Operational Evolution Plan (OEP) concept validation
- Next Generation Air Transportation System
- Weather
- Airport technology
- Aircraft safety technology
- Human Factors
- Information Security
- Environment and Energy
- Automated Dependent Surveillance-Broadcast
- Terminal Instrumentation Procedures (TERPS)
- Wide/Local Area Augmentation System (WAAS/LAAS)
- Safe Flight 21.

Accomplishments: The technical laboratory facilities provide the reliable test bed infrastructure to support R&D program goals and outputs.

R&D Partnerships: In addition to the FAA's research programs, WJHTC laboratories cooperate with the Canadian Ministry of Transport, NASA, U.S. Air Force, EUROCONTROL, RTCA, Aircraft Owners and Pilots Association, International Civil Aviation Association, academia, and industry.

MAJOR ACTIVITIES AND ANTICIPATED FY 2006 ACCOMPLISHMENTS:

The following programs are supported by the laboratories:

- Runway Incursion
- Information Security
- Separation Standards
- Global Positioning System (GPS)/WAAS/LAAS

- TERPS
- Satellite Communication
- Data Link
- Acquisition Human Factors
- Delay Reduction
- Safe Flight 21
- STARS Operational Testing
- Dynamic Vertical Reduced Separation Minima (DRVSM)
- The OEP
- Airspace Resectorization Studies.

FY 2007 PROGRAM REQUEST:

The WJHTC will sustain technical laboratories/facilities that support R&D programs.

Ongoing Activities

- Next Generation Air Transportation System
- Capacity Initiatives (Airspace, Procedures)
- Information Security
- Satellite Communication and Navigation Programs
- Separation Standards
- GPS/WAAS/LAAS
- TERPS
- Runway Incursion
- Aircraft Safety
- Air Traffic Control/Airway Facilities Human Factors
- OEP Concept Validation
- DRVSM.

New Initiatives

No new initiatives are planned in FY 2007.

KEY FY 2007 PRODUCTS AND MILESTONES:

The test beds at the WJHTC provide the necessary infrastructure for R&D programs to achieve Agency goals. Specific milestones and products are contained within individual programs.

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2005)	$96.686
FY 2006 Appropriated	3,359
FY 2007 Request	3,430
Out-Year Planning Levels (FY 2008-2011)	14,275
Total	$117,750

Budget Authority ($000)	**FY 2003 Enacted**	**FY 2004 Enacted**	**FY 2005 Enacted**	**FY 2006 Enacted**	**FY 2007 Request**
Contracts:					
WJHTC Laboratory Facility	3,683	979	983	572	779
Personnel Costs	2,281	2,401	2,293	2,712	2,584
Other In-house Costs	33	25	86	75	67
Total	**5,997**	**3,405**	**3,362**	**3,359**	**3,430**

OMB Circular A-11, Conduct of Research and Development ($000)	**FY 2003 Enacted**	**FY 2004 Enacted**	**FY 2005 Enacted**	**FY 2006 Enacted**	**FY 2007 Request**
Basic	0	0	0	0	0
Applied	5,997	3,405	3,362	3,359	3,430
Development (includes prototypes)	0	0	0	0	0
Total	**5,997**	**3,405**	**3,362**	**3,359**	**3,430**

A14b – WJHTC Laboratory Facility Product and Activities	FY 2007 Request ($000)	Program Schedule					
		FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011
011-140 WJHTC Laboratory Facility							
Systems Support Laboratory (En Route, Terminal, Automated Flight Station, Communications, and Scan Radars)	**$195**						
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)	**$195**						
Approach Procedures		♦	◊	◊	◊		
Free Flight Phase 2		♦	◊	◊	◊	◊	◊
Airspace Design		♦	◊	◊	◊	◊	◊
Operational Evolution Plan Concept Validation		♦	◊	◊	◊	◊	◊
Dynamic Vertical Reduced Separation Minima (DRVSM)		♦	◊	◊	◊	◊	◊
STARS Operational Testing		♦	◊	◊	◊		
Aviation Support Laboratory (Aircraft)	**$195**						
Satellite Communications and Navigation Programs		♦	◊	◊	◊	◊	◊
Separation Standards		♦	◊	◊	◊		
GPS WAAS/LAAS		♦	◊	◊	◊	◊	◊
TERPS		♦	◊	◊	◊	◊	◊
Aircraft Safety		♦	◊	◊	◊	◊	◊
Runway Incursion		♦	◊	◊	◊	◊	◊
Human Factors Laboratory	**$194**						
Air Traffic Control Human Factors		♦	◊	◊	◊	◊	◊
Airway Facilities Human Factors		♦	◊	◊	◊	◊	◊
Operational Evolution Plan Concept Validation		♦	◊	◊	◊		
Personnel and Other In-House Costs	**$2,651**						
Total Budget Authority	**$3,430**	**$3,359**	**$3,430**	**$3,467**	**$3,532**	**$3,591**	**$3,685**

FAA Budget Appropriation	Budget Item	Program Title	Budget Request
F&E	1A01I	Wind Profiling and Weather Research, Juneau	$1,100,000

Supports FAA Strategic Goals: Increased Safety, and Greater Capacity.

Program Goals and Intended Outcomes: The Juneau Airport Wind System (JAWS) Program directly supports goals delineated in the FAA's *Flight Plan 2006-2010*. The program emphasizes direct needs of commercial and general aviation airplanes and helicopters in the Juneau, Alaska area, where the only modes of transportation in and out of the state capital are by air or sea.

The program contributes to achieving two strategic goals and objectives of *Flight Plan 2006-2010*. It supports the strategic goal of *Increased Safety* by providing critical wind information to enable commercial and general aviation RNP operations in Juneau, and it disseminates timely turbulence information to pilots to reduce cabin injuries caused by turbulence. JAWS also supports the strategic goal of *Greater Capacity* by improving landing and departure capabilities for aircraft during hazardous wind conditions.

Agency Outputs:

The JAWS program generates turbulence advisories and wind information that are used by commercial and general aviation pilots in the Juneau area. Commercial (in particular, Alaska Airlines) and general aviation pilots rely on the wind information generated by JAWS to allow Required Navigation Precision (RNP) procedures to be utilized.

Customer/Stakeholder Involvement:

Customers include the National Weather Service (NWS) and General Aviation pilots. Alaska Airlines is the principal stakeholder.

Accomplishments:

- Investigated the feasibility of developing a turbulence warning system in Juneau as a result of aircraft incidents in Juneau.
- Installed anemometers and wind profilers in the Juneau area.
- Developed correlations between hazards encountered by aircraft and measurements from JAWS sensors.
- Installed early prototype to provide FAA and Alaska Airlines with wind information from JAWS sensors.
- Refined correlations by undergoing additional field programs using Doppler radar, large (737) and small aircraft.
- Developed and installed an operational prototype to provide JAWS advisories to the FAA.

R&D Partnerships:

The JAWS program was initiated as a research effort and later matured into an F&E program. The principal developer, NCAR, is primarily an aviation weather R&D organization.

MAJOR ACTIVITIES AND ANTICIPATED FY 2006 ACCOMPLISHMENTS:

- Implement the JAWS operational prototype in Juneau.
- Complete an Operational Evaluation of the prototype system.
- Obtain human factors and user feedback on the prototype system.
- Develop the end-state JAWS on a COTS hardware platform.

- Complete safety mitigation efforts at the JAWS mountaintop anemometer sites.
- Install the end-state JAWS system to allow for operational testing.

FY 2007 PROGRAM REQUEST:

The requested funding will allow the program to maintain and operate the current system.

KEY FY 2007 PRODUCTS AND MILESTONES:

The currently identified $1.1M will allow only for the operations and maintenance of the current prototype system.

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2005)	$22,990
FY 2006 Appropriated	$3,130
FY 2007 Request	$1,100
Out-Year Planning Levels (FY 2008-2011)	$0
Total	$27,200

Budget Authority ($000)	FY 2003 Enacted	FY 2004 Enacted	FY 2005 Enacted	FY 2006 Enacted	FY 2007 Request
Contracts:					
Wind Profiling and Weather Research Juneau	5,464	5,965	4,861	3,130	1,100
Personnel Costs					
Other In-house Costs					
Total	**5,464**	**5,965**	**4,861**	**3,130**	**1,100**

OMB Circular A-11, Conduct of Research and Development ($000)	FY 2003 Enacted	FY 2004 Enacted	FY 2005 Enacted	FY 2006 Enacted	FY 2007 Request
Basic					
Applied					
Development (includes prototypes)	5,464	5,965	4,861	3,130	1,100
Total	**5,464**	**5,965**	**4,861**	**3,130**	**1,100**

Wind Profiling and Weather Research, Juneau Product and Activities	FY 2007 Request ($000)	Program Schedule					
		FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011
Juneau Airport Wind System							
Safety Mitigation							
Develop Anemometer Site Design Drawings		◆					
Upgrade Anemometer Sites		◆					
Operations and Maintenance (O&M)	**$1,100**						
JAWS O&M		◆	◇				
Total Budget Authority	**$1,100**	**$3,130**	**$1,100**	**$0**	**$0**	**$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. IN THE FACILITIES AND EQUIPMENT APPROPRIATIONS, PERSONNEL AND OTHER COSTS ARE BUDGETED IN ACTIVITY 5, NOT THE PROGRAM BUDGET LINE ITEM.

APPENDIX B

Partnership Activities

The Federal Aviation Administration (FAA) enhances and expands its research and development (R&D) capabilities by partnering with other government, industry and academic organizations. Such partnerships help the FAA leverage critical resources and capabilities to ensure that the agency can achieve its goals and objectives. By reaching out to other government agencies, industry and the academic community, the FAA gains access to both internal and external innovators, promoting the transfer of technology, personnel, information, intellectual property, facilities, methods, and expertise. These partnerships also foster the transfer of the FAA technologies to the private sector for other civil and commercial applications. The Agency uses a variety of partnership mechanisms to achieve its goals. These include:

- Working with Government
  - Memoranda of Understanding/Agreement
  - Inter/Intra Agency Agreements

- Working with Government, Industry and Academia
  - Cooperative Research and Development Agreements

- Working with Industry
  - Small Business Innovation Research
  - Patents

- Working with Academia
  - Joint University Program
  - Aviation Grants
  - Centers of Excellence

Working with Government

The FAA researchers collaborate with their colleagues in government, industry, and academia through memoranda of understanding/agreement (MOU/MOA) and other mechanisms. The National Aeronautics and Space Administration (NASA) is the FAA's closest R&D partner in the federal government. The two agencies cooperate on research through a series of memoranda of understanding (http://faa-www.larc.nasa.gov/). The FAA also works closely with the Department of Defense (DOD), especially in the environmental area. Table B.1 provides details of the agreements currently in place with NASA and DOD.

Table B.1. Current FAA/NASA Memoranda of Understanding

Tracking Number	Subject	Objective
FNA 01	Cockpit/Air Traffic Control (ATC) Integration Research	Pursue, through either cooperative or joint efforts, ATC-related technologies and techniques that will increase NAS capacity and improve the safety and efficiency of flight operations.
FNA 02	Human Factors Research	Perform human factors research to improve the efficiency of air- and ground-based flight operations and enhance safety by reducing the consequences of human error.
FNA 05	Program Support	Strengthen the working relationship between the FAA and NASA by locating FAA engineering field offices at NASA centers to conduct research and communication/ coordination, and by providing a mechanism for support of unique programs such as the Aviation Safety Reporting System.
FNA 07	Airspace System User Operational Flexibility and Productivity	Achieve, through integrated R&D activities, an air transportation system that better facilitates user operational flexibility and productivity throughout the airspace. In particular, it is envisioned that closely coupling the FAA's expertise in air traffic management and NASA's expertise in aeronautics will result in an integrated air-ground system that more fully meets the needs of airspace users for safe, efficient, and cost-effective flight operations.
FNA 08	Aviation Safety Research	Achieve, through joint, cooperative R&D, a significant reduction in the fatal accident rate for all categories of aircraft over the next 25 years. This initiative will address both near-term and long-term requirements. The results of this initiative, when implemented, are anticipated to lead to an 80-percent reduction in the fatal accident rate by year 2007, as compared to the 1994 to 1996 baseline.
FNA 09	Aviation Environmental Compatibility	Establish the roles for the FAA and NASA in achieving broad national goals for environmental compatibility of aviation and provide a framework for the FAA and NASA collaboration.
FNA 10	Future Space Transportation Systems	Promote collaborative use by the FAA and NASA of technical information, research results, and potentially funded activities, which will assist each agency in fulfilling its respective roles and responsibilities for research and development of future space transportation systems.
FAA/DOD MOA	Collaboration on Research and Development to Measure and Mitigate the Environmental Impacts of Aircraft Noise and Aviation Air Emissions	Cooperate in conducting and coordinating research and development projects and exchanging research and development data, analyses and related information and material concerning the environmental impacts of aircraft noise and aviation emissions.

In addition to MOUs, the FAA partners with other agencies through a variety of inter-agency committees and group. For example, the FAA and other interested federal agencies established the Federal Interagency Committee on Aviation Noise to encourage debate and agreement over needs for future aviation noise abatement and new research efforts. The committee conducts annual public forums in different geographic regions with the intent to align noise abatement research with local public concerns.

Working with Government, Industry and Academia

The FAA complies with all applicable federal guidelines and legislation concerning the transfer of technology. The FAA's goal is to transfer knowledge, facilities, equipment, or capabilities developed by its laboratories and R&D programs to the private sector. This helps expand the United States technology base and maximize the return on federal R&D investments. Technology transfer mechanisms include:

Cooperative Research and Development Agreements (CRDAs). These agreements allow the FAA and its partner(s) to share facilities, equipment, services, intellectual property, and personnel resources with industry, academia, and state/local governments in collaborative R&D activities. CRDAs are a highly effective way to meet congressionally mandated technology transfer requirements. In FY 2005, the FAA established 4 new CRDAs, bringing the present total of active agreements to 25. Details of the new CRDAs are shown in Table B.2.

Table B.2. FAA Cooperative R&D Agreements, FY 2005

CRDA Number	FAA Program	Subject	Recipient Organization	Award Date	Comple-tion Date
1993-A-0040	Weather	Development of advanced weather information systems with graphical display products	Harris Corporation Melbourne, FL	02/24/93	02/24/06
1993-A-0043	Weather	Development of advanced weather information systems with graphical display products	WSI Corporation Billerica, MA	09/13/93	09/13/06
1994-A-0065	Airport Technology	Testing of a soft ground arresting system developed to safely stop aircraft that overrun the available length of runway	DATRON Engineered Systems Divi-sion, Aston, PA	09/07/94	09/07/06
1996-A-0097	Airport Technology	Development of the National Airport Pavement Test Machine	The Boeing Company Seattle, WA	07/29/96	07/29/11
1998-A-0116	Communicat ions, Navi-gation, and Surveillance	The evaluation of Automatic Dependent Surveillance – Broadcast (ADS-B) technolo-gies in support of the Safe Flight 21 Program	Cargo Airline Association Washington, DC	03/19/99	03/19/05

CRDA Number	FAA Program	Subject	Recipient Organization	Award Date	Completion Date
1998-A-0121	Weather	Utilize state-of-the-art meteorological measurement, sensing, and display equipment to disseminate real-time weather warnings and forecasts to aviation users	Jeppesen Sanderson, Inc. Englewood, CO	04/15/99	04/15/05
1998-A-0122	Aging Aircraft	Cooperative research in aircraft structural integrity, including the use of the Full-Scale Aircraft Structural Test and Evaluation Research facility	McDonnell Douglas Long Beach, CA	10/15/98	12/15/04
1999-A-0124	Weather	Utilize state-of-the-art meteorological measurement, sensing, and display equipment to disseminate real-time weather warnings and forecasts to aviation users	Sonalysts, Inc. Waterford, CT	04/09/99	04/09/05
1999-A-0138	Aircraft Safety Technology	Evaluation of high octane unleaded aviation gasoline for general aviation piston engines	Exxon Mobile Research and Engineering Company Florham Park, NJ	10/19/99	10/19/05
1999-A-0139	Aircraft Safety Technology	Evaluate the use of acoustic emission technology for the inspection of spherical Halon fire bottles and its performance in an industrial environment to identify problems related to its use	Walter Kidde Aerospace Wilson, NC	11/30/99	11/30/04
2001-A-0158	Controller Pilot Data Link Communications	Controller Pilot Data Link Communication Build 1A	ARINC Annapolis, MD	08/24/01	08/24/06
2001-A-0160	Aircraft Safety Technology	Type 1 deicing/anti-icing fluid holdover time	American Eagle Airlines, Inc. Dallas, TX	12/21/01	12/21/04
2001-A-0163	Communications, Navigation, and Surveillance	Utilize state-of-the-art meteorological, measurement, sensing, and display equipment to disseminate real-time weather warnings and forecasts to aviation users	Freese-Notis Weather, Inc. Des Moines, IA	03/22/02	03/22/06
2001-A-0164	Airport Technology	Utilize statistical analysis for determining airplane contact risks of varying span airplanes on taxiways of varying separation	The Boeing Company Seattle, WA	04/05/02	04/05/05

CRDA Number	FAA Program	Subject	Recipient Organization	Award Date	Completion Date
2002-A-0171	Capacity and Air Traffic Management Technology	Develop modeling and simulation tools to assist in tech implementation of capacity enhancing capabilities for the National Airspace System	The Boeing Company McLean, VA	07/17/02	07/17/07
2003-A-0179	Communications, Navigation, and Surveillance	Develop a software tool to convert unpublished instrument procedures	Universal Avionics Systems Corp. Tucson, AZ	03/31/03	03/31/05
2003-A-0181	Communications, Navigation, and Surveillance	Controller Pilot Data Link Communication Builds 1 and 1A	SITA Information Networking Computing, B.V. Vienna, VA	09/25/03	09/25/08
2003-A-0187	Aeromedical Research	Aircraft decontamination after noxious perturbation of the cabin interior	Strategic Technology Enterprises, Inc. Mentor, OH	10/22/03	10/22/04
2004-A-0189	Office of Innovations and Solution	Video security system to enhance aviation security	Presearch Incorporated Fairfax, VA	01/27/04	01/27/05
2004-A-0193	Environment and Energy	Gasper Air Flow Characterization	B/E Aerospace Holbrook, NY	02/18/04	02/18/05
2004-A-0199	Air Traffic Organization	Research on the Success of the Radical Organizational Change at the Federal Aviation Administration's Air Traffic Organization	University of Maryland at College Park College Park, MD	05/13/04	05/13/05
2005-A-0203	Air Traffic Management	Efficiency of the Air Traffic Controller Operator Working Position	Frequentis, USA Rockville, MD	04/14/05	04/14/07
2005-A-0206	Advanced Traffic Management Systems	Evaluation of the Surface Management System Capabilities and Improvements	FedEx Express Memphis, TN	05/24/05	05/24/08
2005-A-0208	Air Traffic Models & Evaluation	Utilize state-of-the-art technologies and the initial development of the Aviation Integrated Reasoning Modeling Matrix to develop a system that will support the current and future needs of the FAA	Optimal Systems, Monroeville, NJ	06/08/05	06/06/08
2005-A-0209	Information Resource Management	Electronic Submission of Confidential Financial Disclosure Forms	HRWorx, LLC Herndon, VA	08/25/05	08/25/07

Working with Industry

Small Business Innovation Research (SBIR). These contracts encourage the private sector to invest in long-term research that helps the federal government meet its R&D objectives. Eligible small business contractors compete for Phase I contracts to conduct feasibility-related experimental or theoretical research. A Phase II contract is awarded based on the results of Phase I, which is the actual research phase. Contractors are encouraged to pursue other than funding sources for Phase III and to attract venture capitalists to commercialize the innovation.

In FY 2005, the FAA submitted one Phase I SBIR contract entitled "Development of a low cost, voice activated cockpit for General Aviation aircraft and helicopters for use in Precision Visual Flight Rules operations." One Phase I contract was terminated during this time. One Phase I contract entitled, "Airborne Internet Web Services Technologies" was administered. Three Phase II contracts are being administered:

- Development of Fiber Optic Approach Lighting Systems
- Evaluation of Composite Joints in General Aviation Structure
- Aircraft Wiring Integrity Verification Using Psuedo-Random Binary Sequence

Patents issued through the U.S. Patent and Trademark Office. Inventors are encouraged to patent new technologies through the U. S. Patent and Trademark Office. A patent is a grant of a property right and gives the owner the right to exclude anyone else from making, using, or selling the invention. Inventions patented by the FAA inventors are available for commercial licensing with royalty payments being shared with the inventor and the agency. The agency's Technology Transfer Program Office promotes the agency's patents for commercialization. Table B.3. provides a list of the current U.S. patents issued to the U.S. Department of Transportation/FAA.

Table B.3. Patents Issued for DOT/FAA

Patent No.	Title/ Description	Date of Patent
6,812,834	Reference sample for generating smoky atmosphere A reference sample for testing fire detectors and a method for testing using the reference samples.	11/02/04
6,470,730	Dry transfer method for the preparation of explosives test samples A method of preparing samples for testing explosives and drug detectors of the type that search for particles in air.	10/29/02
6,467,950	Device and Method to Measure Mass Loss Rate of an Electrically Heated Sample A device and a method for measuring the mass loss rate of a sample of combustible material placed on a mass-sensitive platform.	10/22/02
6,464,391	Heat Release Rate Calorimeter for Milligram Samples A calorimeter that measures heat release rates of very small samples (on the order of 1 to 10 milligrams) without the need to separately and simultaneously measure the mass loss rate of the sample and the heat of combustion of the fuel gases produced during the fuel generation process.	10/15/02

Patent No.	Title/ Description	Date of Patent
6,116,049	Adiabatic Expansion Nozzle A nozzle for producing a continuous gas/solid or gas/aerosol stream from a liquid having a high room temperature vapor pressure.	09/12/00
5,981,290	Micro-scale Combustion Calorimeter A calorimeter for measuring flammability parameters of materials using only milligram sample quantities.	11/09/99

During FY 2005, the FAA successfully negotiated and entered into three licensing agreements for Patent No. 5,981,290 "Micro-scale Combustion Calorimeter" and Patent No. 6,464,391 "Heat Release Rate Calorimeter for Milligram Samples." It also entered into an exclusive license for a patent pending on the "Electronic Submission of Confidential Financial Disclosure Forms."

Working with Academia

FAA/NASA Joint University Program for Air Transportation Research. This cooperative research partnership among three universities (Ohio University, the Massachusetts Institute of Technology, and Princeton) conducts scientific and engineering research on technical disciplines that contribute to civil aviation, including air traffic control theory, human factors, satellite navigation and communications, aircraft flight dynamics, avionics and meteorological hazards. The FAA and NASA benefit directly from the results of the research, and, less formally, from valuable feedback from university researchers regarding the goals and effectiveness of government programs. An additional benefit is the creation of a talented cadre of engineers and scientists who will form a core of advanced aeronautical expertise in industry, academia, and government. http://www.princeton.edu/~stengel/JUPnew.html

Aviation Grants. The FAA awards research grants to qualifying colleges, universities, and legally incorporated nonprofit research institutions. Funded research grants may use any scientific methodology deemed appropriate by the grantee and do not need to be linked to the immediate needs of the FAA R&D projects. The evaluation criteria for grant proposals include the potential application of research results to the FAA's long-term goals for civil aviation technology. Table B.4 is a list of the FAA research grants initiated in FY 2005. In FY 2005, the FAA awarded $4.16 million in new grants. It also awarded an additional $13.5 million in grants that originated in prior fiscal years for a total of $17.66 million in grant awards.

Table B.4. FAA Research Grants Originating in FY 2005

FAA Program	Grant Number and Objective	Recipient Institution	Award and Completion Dates	Award Amount
Flightdeck/Maintenance/ System Integration Human Factors	2005-G-001. Modify the current certification processes to ensure that avionic displays meet certification minima conducive to safe and efficient flight.	Kansas State University	02/24/05 05/23/06	$100,000

FAA Program	Grant Number and Objective	Recipient Institution	Award and Completion Dates	Award Amount
Air Traffic Control/ Airway Facilities Human Factors	2005-G-002. Apply structural equation modeling to the 1999 Shiftwork Survey of air traffic controllers to model relevant predictors and outcomes in the data	Texas Tech University	02/24/05 02/23/06	$27,940
Flightdeck/Maintenance/ System Integration Human Factors	2005-G-003. Develop the Normal Operations Safety Survey for air traffic management	University of Texas at Austin	04/27/05 04/26/06	$145,845
Aviation Safety Risk Analysis	2005-G-004. Introduce the use of physiological measurement as an objective assessment tool for flight task difficulty among qualified pilots.	Robert Wood Johnson Medical School, New Jersey	04/18/05 10/17/06	$407,548
Propulsion Systems Research	2005-G-005. Provide guidance to the Rotor Integrity Subcommittee on their development of the enhanced life management process for high-energy rotors.	Southwest Research Institute	04/12/05 04/11/06	$468,995
Aging Aircraft	2005-G-006. Review research on corrosion and fatigue damage accumulation in propeller materials and rotor aircraft. Review and analyze failure mechanisms, environmental and operational dependencies, corrosion prevention strategies, inspection strategies and repair methods.	Ohio State University	05/17/05 05/16/06	$52,135
Aviation Safety Risk Analysis	2005-G-007. Design suites of computational tools that identify aircraft touchdown points in commercial and simulated operations. Assess the uncertainty associated with the location of touchdown points.	Robert Wood Johnson School of Medicine, New Jersey	05/13/05 05/12/06	$177,999
Air Traffic Control/ Airway Facilities Human Factors	2005-G-009. Develop interventions to improve safety culture attributes and enable transfer of best practices from pilots to others	Saint Louis University	05/18/05 05/17/06	$150,000
Aging Aircraft	2005-G-010. Develop new and improved methods and criteria to process and present operational usage data on large commercial transport and commuter aircraft flight and ground loads	University of Dayton Research Institute	05/26/05 05/25/06	$500,000

FAA Program	Grant Number and Objective	Recipient Institution	Award and Completion Dates	Award Amount
Aeromedical Research	2005-G-014. Establish health surveillance in relationship to bleed air events and analyze filter samples of air quality to identify contaminants to which passengers and crews are exposed.	University of Oregon Labor and Education Research Center	05/28/05 04/26/07	$1,289,269
Flightdeck/Maintenance/ System Integration Human Factors	2005-G-015. Investigate how flight data is used in current air traffic control tower cabins in order to produce a requirement document for flight data in air traffic control towers.	Texas Tech University	07/15/05 07/14/06	$274,682
Airports Technology Research	2005-G-016. Develop a three-dimensional, finite-element model of subgrade and flexible pavements that considers different wheel configurations to understand the stresses and strains resulting from bigger and heavier aircraft.	Rowan University	08/11/05 02/09/07	$57,609
Aeromedical Research	2005-G-017. Develop a prototype of an integrated air monitoring package to monitor both ambient levels of cabin air chemicals and warn of intentional releases.	Smiths Detection, Inc.	08/18/05 11/01/07	$1,217,349
Flightdeck/Maintenance/ System Integration Human Factors	2005-G-018. Explore the performance limits for helicopter pilots who inadvertently fly into instrument meteorological conditions.	University of Nevada, Reno	08/26/05 08/25/06	$180,345
Aeromedical Research	2005-G-019. Define a method to reduce loss of control in flight through use of off-the-shelf flight simulator visual simulation software and high quality academic components.	Embry-Riddle Aeronautical University	08/29/05 - 11/28/06	$199,999
Propulsion Systems Research	2005-G-020. Determine the flight performance of aviation grade ethanol for detonation resistance and fuel efficiency.	South Dakota State University	08/31/05 08/30/08	$999,885

Air Transportation Centers of Excellence. The FAA sponsors seven centers that are established through cooperative agreements with academic institutions to assist in mission-critical research and technology. Through these long-term collaborative, cost-sharing efforts, the government and university/industry teams leverage their resources to advance aviation technology.

Airliner Cabin Environment – Established in 2004, the Center of Excellence for Airliner Cabin Environment Research is led by Auburn University. Conducts R&D on cabin air quality and on chemical and biological threats. Other member universities include: Purdue University, Harvard University, Boise State University, Kansas State University, the University of California at Berkeley, and the University of Medicine and Dentistry of New Jersey. http://www.acer-coe.faa.gov

Advanced Materials – Established in 2003, the Center of Excellence for Advanced Materials is lead by the University of Washington and Wichita State University. Conducts R&D on: material standardization and shared databases; bonded joints; structural substantiation; damage tolerance and durability; maintenance practices; advanced material forms and processes; cabin safety; life management of materials; and nanotechnology for composite structures. Other member universities include: Edmonds Community College, Northwestern University, Oregon State University, Purdue University, the University of California at Los Angeles, the University of Delaware, Tuskegee University, and Washington State University. http://www.coe.faa.gov

Aircraft Noise and Aviation Emissions Mitigation – Established in 2003 with NASA and Transport Canada as co-sponsors, the Partnership for Air Transportation Noise and Emissions Reduction Center of Excellence is led by the Massachusetts Institute of Technology. Conducts R&D to identify, understand, and measure the impacts of aircraft noise and aviation emissions and, as appropriate, to mitigate these problems. Seeks to reduce uncertainty in issues dealing with climate impact and the health and welfare effects of emissions to a level that enables actions to be undertaken to address their effects. Other member universities include: Boise State University, Florida International University, the Pennsylvania State University, Purdue University, Stanford University, the University of Central Florida, and the University of Missouri-Rolla. http://web.mit.edu/aeroastro/www/partner or www.partner.org

General Aviation Research (CGAR) – Established in 2001, the Center of Excellence for General Aviation Research is lead by Embry-Riddle Aeronautical University. Conducts safety-related R&D with application to non-commercial aviation. Core member universities include: Wichita State University, the University of North Dakota, Florida A&M, and the University of Alaska. http://www.cgar.faa.gov

Airworthiness Assurance – Established in 1997, the Airworthiness Assurance Center of Excellence is a multi-institutional, multi-disciplinary team that includes 31 academic members. Conducts safety-related R&D in aircraft maintenance, inspection and repair, crashworthiness, propulsion and fuel systems safety, and advanced materials. http://www.coe.faa.gov/aace

Operations Research – Established in 1996, the National Center of Excellence for Aviation Operations Research is lead by five universities: the University of California at Berkeley, Massachusetts Institute of Technology, Virginia Polytechnic Institute, the University of Maryland, and George Mason University. Performs R&D in the areas of: traffic management and control, human factors, performance metrics and measurements, safety data analysis, scheduling, workload management and distribution, navigation, communications, data collection and distribution, and aviation economics. http://www.nextor.org

Airport Technology – Established in 1995, the Center of Excellence for Airport Technology is lead by the University of Illinois at Urbana-Champaign. Conducts research in airport pavement technology and wildlife hazard mitigation. Other member universities include: Northwestern University, Embry-Riddle Aeronautical University, and North Carolina A&T University. http://cee.uiuc.edu/research/coeairporttech/

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APPENDIX C

Research, Engineering and Development Advisory Committee (REDAC)

The Federal Aviation Administration (FAA) values the ongoing involvement of the Research, Engineering and Development Advisory Committee in reviewing its current and planned research, engineering and development (R,E&D) programs.[1] FAA has established a formal process for the agency to reply to Committee recommendations. This document summarizes recent Committee recommendations and FAA responses. In fiscal year 2005, the Committee submitted the following reports to the FAA and received detailed responses:

- *Guidance for FAA Fiscal Year 2007 R&D*, November 15, 2004
- *Transitioning Air Traffic Management Research into Operational Capabilities*, March 31, 2005 (Preliminary findings)
- *Review of FAA Fiscal Year 2007 R&D Program Plans*, May 2, 2005

In fiscal year 2005, the FAA expects to receive the Committee's recommendations on FAA's planned research and development investments for fiscal year 2008, including detailed recommendations from the standing subcommittees.

1. *Guidance for FAA R&D Program in Fiscal Year 2007*, November 15, 2004

a. Subcommittee on Environment and Energy

Recommendation: Administrator should estimate resources (particularly staffing) required from AEE to fully participate in future JPDO efforts and make the appropriate allocations so that resources are not shifted away from other critical efforts.

Response: The FAA is in the process of determining the resources, including staffing, required for the JPDO environment Integrated Product Team (IPT). We are working jointly with other relevant agencies to prepare these estimates and expect to have a draft by January 2005. We will brief the estimates to the subcommittee at the next meeting, scheduled for February 22-23, 2005.

Recommendation: Determine appropriate mechanisms for REDAC Environment and Energy subcommittee to coordinate with the appropriate DOT, DOE, and EPA environmental research advisory committees. Set-up the appropriate internal structures (within the agencies) to coordinate environmental research and policy.

[1] http://research.faa.gov/redac.asp

Response: The FAA plans to present information on DOT, DOE, and EPA research advisory committees to the REDAC Environment and Energy Subcommittee at the next meeting, February 22-23, 2005. We believe we should jointly determine how the REDAC Environment and Energy Subcommittee should coordinate with the advisory committees of these agencies. The JPDO environment IPT will coordinate environmental research and policy across agencies.

Recommendations: Refine local and global cost components of the Environmental Design Space (EDS) within AEDT. Carefully assess the level of validation and verification needed for cost components.

Response: The FAA is refining the cost components of AEDT, including requirements for validation and verification. We will present these estimates to the Transportation Research Board AET Committee January 31 to February 2, 2005, and subsequently to the REDAC Environment and Energy Subcommittee at the next meeting, 22-23 February 2005.

Recommendations: Increase resources for APMT (either through direct appropriation or through increased MITRE involvement) to ensure that the U.S. meets requirements for CAEP. Provide appropriate resources to expand particulate matter (PM) and hazardous air pollutant (HAP) measurement activities.

Response: The FAA will take these recommendations into account as we build our Fiscal Year 2007 research budget, and as we work with MITRE to identify Fiscal Year 2006 research projects. We will also explore these recommendations across agencies within the JPDO IPT.

b. Subcommittee on Airports

Recommendation: The committee was pleased to note that FAA has quickly initiated research projects that were requested at the last committee meeting in April. These included projects to evaluate the durability of polyurea paint, evaluate use of ICAO spacing standards on taxiway centerline lights as a means of reducing costs, and to investigate reports of severe intensity variations when different style lighting fixtures are used on the same taxiway lighting circuit. The committee supports a new FAA initiative to evaluate taxiway deviations of Design Group III aircraft at SFO in order to compare taxiway centerline tracking as a function of aircraft size.

Response: Preparations are underway to evaluate taxiway deviations of Design Group III aircraft at SFO.

Recommendation: The committee discussed need for FAA to accelerate the dissemination of preliminary research results in view of the lengthy publication cycle for formal reports.

Response: We have accelerated the dissemination of preliminary research results in view of the lengthy publication cycle for formal reports by sending draft reports to Committee members when the Technical Center provides the draft report to AAS at FAA Headquarters. These are preliminary reports for Committee information only.

Recommendation: The committee agreed with FAA that research on techniques for strengthening airport bridges to accommodate the A380 aircraft is not needed because of the routine nature of the engineering effort involved.

Response: We have stopped research on techniques for strengthening airport bridges for the A380 aircraft because of the routine nature of the engineering effort involved.

Recommendation: The committee urged FAA to coordinate ongoing research of FOD-detecting radar with similar efforts underway in Vancouver.

Response: The Technical Center is coordinating its research effort of FOD-detecting radar with similar efforts underway in Vancouver, Canada.

Recommendation: The committee urged FAA to review maintenance issues regarding the Engineered Materials Arresting Systems (EMAS) product developed under an earlier Cooperative Research and Development Agreement at the Technical Center.

Response: The FAA continues to review maintenance and durability issues on the Engineered Materials Arresting Systems (EMAS) product.

c. Subcommittee on Human Factors

Recommendation: Implement a strategy to ensure that Human Factors is incorporated and sustained in research and acquisition programs in the new environment of ATO.

Response: In the new organizational environment with the human factors research program management function located within the ATO, it is important to maintain the capability to support both ATO and AVR research needs. The integration of the agency's human factors research and engineering in system acquisitions and applications would benefit from re-enforcing human factors across ATO lines of business in two key dimensions: system engineering and analysis, and safety management. The Human Factors Research and Engineering Division will present information to ATO executives on the status of human factors, proposing a broad spectrum of initiatives with potential to achieve the desired results including possibilities in the following areas:

- **Staffing:** Development of a revised Human Capital Management Plan for Human Factors to support needs for availability and organizational coordination of human factors resources to satisfy the requirement for critical skills.

- **Policy:** Revision of human factors policy to clarify roles and responsibilities and effect improved integration.

- **Measures and Metrics:** Use of human-system performance measures, and quantification of human factors and human-system reliability in service area analyses, program requirements, acquisition baselines, system testing, and post-deployment assessments.

- **Source Selection Criteria:** Use of human-system integration criteria in Section M of source selection (proposed contract) evaluations.

- **Safety Management System:** Establishment of human factors guidance for support of the ATO Safety Management System.

Recommendation: Implement a strategy to fully integrate human factors considerations and human performance measures into the technical performance, management, and oversight of the Safety Management System.

Response: With new emphasis being placed on safety management, and the system to achieve a more rigorous safety culture, there is an opportunity for improved integration of human factors in this process. The Human Factors Research and Engineering Division will coordinate with the ATO Safety Office to:

- Incorporate human factors into the SMS process and the SMS Manual.
- Establish means to identify and include quantified human-system risks.
- Standardize tools by which to measure human-system performance and reliability.

Recommendation: Ensure that human performance data is collected and applied to provide data-driven decision capabilities to support such activities as standard definitions of human-system performance for TRLs, human intellectual capital management and development, system requirements development, criteria for source selection evaluations, and human-system performance measures in tests and evaluations.

Response: The agency strongly supports data-driven decisions. The Human Factors Research and Engineering Division will coordinate with and present information to ATO executives on:

- Applying more effort on areas where there is a lack of human performance data upon which to base program requirements and design decisions.

- Identifying and conducting human-system performance studies where needed and collecting information beyond user opinions and preferences.

- Systematically collecting human-system performance data readily available to support service area analyses and design and development decisions.

- Support agency practices related to human performance data requirements, collection, availability, and use to:

  – Enable the appropriate research, studies, and analyses
  – Standardize definitions of human-system performance for TRLs
  – Establish human factors targets for human intellectual capital management and development

- Incorporate human-system performance requirements and measures in development processes and in systems tests and evaluations
- Establish guidelines for human factors criteria for source selection evaluations

d. Subcommittee on Air Traffic Services

Recommendation: ATC Automation. It is now time to undertake serious analysis and development of a system for automatically performing routine aircraft separation, traffic flow management, clearance generation delivery, and acknowledgement functions. This effort should establish optimum roles for pilots and controllers working with highly automated systems, as well as optimum methods for safety assurance and system reliability/availability.

Response: We agree that these are items which should be considered for the future of the NAS. We note that these are topics that are part of the current work program and deliberations of the JPDO Agile Air Traffic System IPT. More detailed research requirements and strategies for addressing these issues will be part of the JPDO's Next-Generation Air Transportation guidance to the FAA and NASA for research and development.

Recommendation: A Seamless, Highly Fault-Tolerant System. Closely associated with the automation developments, but with a scope including the entire NAS ATM system, is the need for research and development to devise an integrated ATM system with less artificial separation between terminal, enroute, oceanic, and airport surface environments. An integral part of this work must be the development and implementation of a highly reliable, robust, and fault-tolerant ATM system. The resulting system may be distributed, centralized, or have some functions distributed and others centralized.

Response: There are a series of analyses being initiated in ATO to consider opportunities and requirements which are cross-domain. Examples include investigation into the efficacy and the requirements for extending terminal separations and work methods to larger portions of airspace; for example, proposals to combine enroute, terminal and oceanic operations in New York. Other opportunities being examined include cross domain requirements for communications, surveillance and displays. Additional longer term opportunities are expected to be identified by JPDO's Agile Air Traffic System IPT as more advance research by the FAA and NASA.

Recommendation: Weather Impacts to Aviation. The reduction, approaching elimination, of the effects of weather on flight safety and system and airport capacity is needed. An integrated FAA, NASA, NWS, DHS, and DoD weather research program modeled on the FAA Aviation Weather Research Program (AWRP), to effectively leverage the research work of all of the agencies is needed to develop this capability.

Response: Concur. The Department of Transportation's sponsored Joint Planning and Development Office (JDPO) has established a Weather Integrated Product Team (IPT), consisting of FAA, NASA, DHS, DoD, and NOAA personnel. This IPT has the charge to "Develop a system-wide capability to reduce weather impacts" and plans to achieve increased safety and efficiency in the national aviation system by deploying and integrating scientific and operational advances in weather technology to enable aviation system users to mitigate the negative impact of adverse weather. After developing a comprehensive aviation weather

requirements document, the IPT will create a multi-agency research and development roadmap, incorporating the current activities of FAA's Aviation Weather Research Program with those from other participating agencies.

Recommendation: Wake Turbulence Separation Reduction Operational Enhancement. Techniques to minimize the additional wake turbulence separation, beyond radar or visual separation at congested airports, are critically needed. A Wake Vortex Avoidance System (WakeVAS) is needed, that predicts when weather conditions will produce "wake independent conditions" on arrival and departure paths. The current NASA – FAA initiative, which is consistent with recent MITRE-Lincoln Laboratory recommendations, should be better supported by the FAA.

Response: The FAA appreciates the Subcommittee's recommendation. The work by NASA looks promising in terms of potential capacity enhancing benefits for our nation's airports. We have taken the initial step in terms of identifying a time frame when the NASA developed technology would integrate into the National Airspace System (NAS) Architecture. We have also included funding for engineering development of the NASA prototype into our Facilities and Engineering budgetary planning process. However, we are uncertain that we will have sufficient funding in the FY 2006 timeframe to initiate the engineering development of the NASA WakeVAS prototype and also accomplish other critically needed NAS enhancements. Your recommendation will be seriously considered as we determine our future funding priorities.

Recommendation: Development of Rational Separation Standards. A serious research and development effort is needed to assess and rejustify current separation standards and develop methods to safely accommodate blunders. The study should consider the use of time-based separation as a possible alternative to distance based separation.

Response: We agree that when the spacing requirements in clearances is related to flow, time rather than distance spacing lead to operations that are more efficient. This is already being accomplished with the introduction of Traffic Management Advisor in the enroute. Extending the concept to other parts of the airspace has been part of the operational concept for NAS but requires additional research into display characteristics and monitoring support before it can be implemented.

The general separation standards and related minima, e.g., the 5-mile en route separation, are based on surveillance and display accuracy, and are specified as minima to ensure that targets as displayed are actually separated. These minima are not based on general flow characteristics. The FAA is currently conducting analyses to relate these procedures to the quality of the displayed information versus the current technology based criteria – "40 miles from a radar." Moving to performance based separation procedures should provide operational efficiencies as well as opportunities to reduce infrastructure costs.

e. Subcommittee on Aircraft Safety

Recommendation: Some key programs, each consisting of several projects, have unstable – and sometimes inadequate – funding. To guard against loss of critical research capability program funding needs to be strengthened and made more consistent.

Response: The FAA is equally concerned. The current situation originated with a 30 percent reduction in the Presidential request for the FY 2004 FAA R&D budget. Reduced R&D funding will be continued for the foreseeable future. The FAA will assess the situation for FY 2007 when it may become necessary to terminate activities that have had unstable and/or inadequate funding.

Recommendation: Based on the SASO presentation at its most recent meeting, the subcommittee was concerned about the direction the project was taking. Subsequent to the meeting, some members dialogued with the FAA researchers and AFS. One member visited with the key academic researcher contributing to SASO to discuss his work. The subcommittee concludes that the academic research is being conducted by distinguished experts in the field who, however, need industry and FAA input and guidance to ensure that the research is properly taking into account industry and regulatory conditions and requirements. The selection of Part 137 as an early test of SASO methodology is a reasonable choice as long as Part 137 test results are not extrapolated to more complex Parts without considering differences between them.

Response: The FAA will continue to brief the members of the subcommittee on SASO activities and actively seeks their comments and recommendations.

Recommendation: An NPRM is in preparation for fire protection requirements on extended range cargo operations for up to six and one half hours. Research is required to identify means of compliance that would not impose an undue burden in terms of weight or range.

Response: The FAA has issued an NPRM proposing regulatory requirements for extended operations for all air carrier airplanes. A concern is the increased weight and cost associated with additional fire protection on longer flights. The FAA has conducted tests and studies on the use of nitrogen from a fuel tank inerting system to suppress cargo fires, and is preparing tests on this approach for hidden fire protection. This work could be extended to determine the relationship between the weight of an on board inert gas generating system (OBIGGS) and a stored halon gas system versus range of protection.

Recommendation: The time is approaching when the FAA must consider the certification implications of supersonic business jets and define the research necessary to support timely certification. Some potential technical issues are:

- Landings based solely on synthetic vision.
- Tandem or side facing pilot seats.
- Certification issues related to high-altitude emissions and supersonic flight over land

Response: The issue is not so much about research as it is about the means of compliance practices, standards and regulations (many of which are unknown at this time) that might impede certification efforts. The FAA would be open to the idea for working with an industry representative group to discuss these issues and formulate a research plan that would provide the necessary knowledge to promote timely certification.

The FAA has been working closely with NASA researchers for several years in the area of synthetic vision and has in place a Memorandum of Agreement (MOA) in "Enhanced Situational Awareness" which addresses many new proposed flight deck technologies that may be included on future aircraft designs.

Recommendation: The SAS reviewed the proposal for a new national aircraft crash test facility. It advocates that the requirement be clearly defined in conjunction with the civil and military aviation communities to assure there is sufficient justification to replicate existing European capabilities in the United States.

Response: The FAA concurs with this recommendation. To determine if there is sufficient need for such a facility in the United States, the FAA plans to conduct a cost benefit analysis that would include a thorough assessment of the requirements of the FAA and other potential Government and industry users. This analysis will be completed before proceeding with any proposals for a new national aircraft crash test facility.

Recommendation: There are growing indications of a coming pilot shortage for carrier and business aircraft operations. By about 2007 this will be clearly manifest. Training and qualification of entering pilots and maintenance of their proficiency is a safety issue of great importance. Commercial pilot training and qualification standards need to be improved as necessary.

Response: The problem may be more of a shortage of commercial pilots with significant flight experience than a shortage of commercial pilots. Commercial pilots today train under one of two training programs: Traditional (mandatory) or Advanced Qualification Program (AQP) (voluntary). While Traditional training was once the dominant force in pilot training, AQP carriers now represent 85 percent of air passenger miles flown by U.S. carriers. In the case of the Traditional programs, the FAA is now completing the first total overhaul of pilot training regulations (outside of AQP) in 30 years. A government-industry Aviation Rulemaking Committee (ARC) is currently completing its work in that area. Standards for pilot training and checking have been significantly upgraded, sufficient to deal with low-hour pilots.

This leaves the case of the AQP. While this program is considered to be the world's leading pilot training program, it has very little participation from the regional airline community. While eight of the top ten carriers train under AQP guidelines, only three regional carriers currently participate. The FAA will study the factors inhibiting the regional air carriers from participating in the program and modify guidance as required.

Recommendation: As the number of aircraft being operated increases, especially with the introduction of new aircraft, so does the complexity and diversity of the technology deployed. This underscores the necessity to establish and maintain a sufficiency of well-trained, appropriately qualified AMTs in the U.S.

Response: The FAA has addressed the issue of requiring A&P mechanics to have a higher degree of proficiency, level of education, and knowledge by sponsoring significant R&D in the past. Subsequently, the GAO conducted an investigation of AMT qualifications. The FAA responded to the GAO report by initiating a change to Advisory Circular (AC) 147-3, and in particular the appendix to that AC. The AC is currently in the legal review process.

Recommendation: The subcommittee, in general, is concerned about the steady decline in airline participation in safety-related research programs and projects.

Response: The current situation appears to stem from the financial distress that is being experienced by many of the airlines. The FAA agrees with this concern and will work closely with the subcommittee to ensure that airlines become more actively involved in safety-related research and development activities.

Recommendation: Regarding PMA certification, the FAA should investigate the safety implications of the recently introduced principle of "functional equivalency".

Response: The FAA assumes that "functional equivalency" in PMA as referenced by the subcommittee is where an applicant demonstrates by comparative analysis that the candidate part is equal to or better in functional design than the Type Certificated (TC) part. The applicant under test and computation thoroughly analyzes the certificated part, compares it to the candidate part, reports all differences, and provides sound technical justification for these differences. If a proposed part is equal to or better than an approved TC part that meets required airworthiness standards, then the proposed part also meets those standards.

The current PMA Order 8110.42 has had this comparative principle since its inception in 1995 without any evidence of significant incidences. The FAA believes that the implementation, demonstration, and review of functional equivalence are adequate to address airworthiness issues and associated safety implications. The FAA would be interested in any specific instance(s) that the subcommittee might share with the FAA.

2. *Transitioning Air Traffic Management Research into Operational Capabilities*, March 31, 2005 (Preliminary findings)

a. Executive Oversight of Transitions

Recommendations: The FAA Executives (Administrator, ATO COO, Associate Administrators, and Vice Presidents) should be more engaged with ATM-related concepts as they transition from research, to ensure that the FAA commitment to implementation is clear and that the agency is positioned for success.

The FAA should form an internal, executive-level Transition Oversight Committee to periodically review all major transitions. The committee should be chaired by a senior FAA executive (e.g., Deputy Administrator) and should have representatives from all of the major FAA organizations (e.g., Associate Administrators and Vice Presidents) and report to the Administrator.

Each major project in transition to operational implementation should have an Executive-level sponsor who would have oversight responsibility during the transition process.

FAA Response: The FAA has at least six separately planned research portfolios. Only three of which are incorporated in an integrated planning and budgeting process. This has made it challenging to integrate and coordinate agency-wide research. To remedy this, the FAA plans to establish the FAA/NASA Executive Research Steering Committee to include senior executives (AVS-1, ATO-P VP [representing the ATO and JPDO], AEP-1, AST-1, NASA, ATO-PRD [representing the research performing organizations]) who will set Agency-wide R&D policy and identify mission needs that support both the near- and long-term needs of the FAA and JPDO. This new committee will have responsibility for R&D from initiation to the JRC implementation decision.

On May 12, 2005, a FAA/NASA research planning team met to discuss the organization of the FAA/NASA Executive Research Steering Committee. The initial meeting of this committee will be hosted by Charlie Keegan in Washington, D.C. on July 8, 2005.

b. Transition Management

Recommendation: The FAA should use program management processes based on best practices from industry to manage the transition of research from the laboratory to operational use. These processes should include the following elements:

- The establishment of a clear link between the research product and an aviation community need that has been subjected to a business case analysis
- The identification of any major technical or other uncertainties and a strategy for their mitigation
- The definition of decision points throughout the development process that provide opportunity to adjust forward plans in the context of changing needs (i.e., terminating projects whose business case does not justify their continuation)
- The definition of standard deliverables throughout the transition process facilitating the transfer of technology from laboratory to industry to operations
- Projects involving research organizations outside the FAA (e.g., NASA, Federally Funded Research and Development Centers, academia, etc.), require a joint transition process. This should include a formal transition plan, funding and personnel commitments, and the designation of senior managers responsible for oversight.

FAA Response: The recent FAA reorganization effort is clearly responsive to the REDAC's comments related to transition management. The ATO-Operations Planning Service Unit serves as the central point for transition management. Further the program management personnel are

being trained to employ standard program management principles and by providing Program Management Institute (PMI) training and certification for FAA program managers, the ATO is standardizing and improving the transition management processes.

c. Industry Involvement

Recommendation: The FAA should examine recent programs to identify best practices for the engagement of industry into the transition process. These practices should be part of program management doctrine and training.

FAA Response: The FAA is reviewing its current programs as a method of identifying best practices that can be applied to introduce new technologies and procedures. The model used to transition the User Request Evaluation Tool (URET) is an example of a successful transition of new technology into the operational environment. We plan to finish our review in August and apply those best practices in addressing the transition from development to operations.

d. Consensus

Recommendation: Where possible, the FAA should strive to create benefit-driven incentives and community consensus. However, when this is not possible, the needs of the nation's air transportation system must supercede parochial interests; this situation may result in mandated equipment and procedures.

FAA Response: We Concur. The Next Generation Air Transportation System presents a unique opportunity to rationalize the air transportation system in a way that optimizes the use of scarce resources and creates incentives to increase efficiency and reduce overall costs.

To ensure public benefits are realized from the investment of appropriated funds, the government has several tools to obtain compliance and equipage to support transition into the next generation air transportation system. In addition, the government may have to change current practices for funding system improvements and system operations.

As currently envisioned, the Next Generation system will differ dramatically from the current system in ways that should facilitate equipage. For example, the Next Generation System may call for the end of standard, “one-size-fits-all” operations. It will be able to accommodate aircraft with less sophisticated equipage, and it will also take full advantage of enhanced aircraft performance capabilities. With improved services linked to aircraft capability and the promise of a positive return on investment, operators should be eager to invest in complementary technologies. Where uniform equipage is necessary, the FAA will explore all appropriate strategies to achieve the required capabilities.

The FAA currently has broad authority for these types of actions, and they can be exercised after careful consideration of the effect on stakeholders (including the government, industry, and the traveling public) and the impact in key areas such as safety, security, environment, economic, legal/regulatory precedents, and international agreements.

e. Certification

Recommendations: The CPI program should continue to reduce the uncertainty, time, and costs associated with certifications.

Methods should be developed for the certification of new concepts and technologies involving integrated air-ground systems. It is also recommended that there be one office responsible for the certification of integrated air and ground systems.

FAA Response: The FAA concurs with this recommendation. We will continue to implement initiatives to improve the coordination and communication of certification requirements required to introduce more efficient integrated air-ground capabilities into the NAS. The Certification Process Improvement document has proven to be extremely beneficial to both the Aircraft Certification Service and its applicants since its introduction a number of years ago. The FAA will strive to develop an Air Traffic Organization-Aviation Safety partnership using a similar framework to clearly define the roles, responsibilities, tasks, and timeline for a coordinated operational acceptance of integrated air-ground capabilities.

f. Aircraft Equipage

Recommendation: The FAA should expand its efforts to provide early operational advantages to encourage expedited aircraft equipage whenever possible. Performance-Based NAS concepts can be used as incentives if more capable aircraft get better access. The implementation of Domestic Reduced Vertical Separation Minimums is a good example of a Performance-Based NAS improvement that provided an incentive for aircraft equipage.

FAA Response: The FAA concurs with this recommendation and will work closely with the community to evolve into a Performance-based NAS that will allow operators to leverage existing aircraft equipage capabilities while obtaining increased performance value as aircraft equipage capabilities are increased. AVS promotes the notion of using existing regulations and considering additional regulations and standards only as necessary. Thus, AVS is committed to the research, development, and implementation of technically feasible means of compliance practices that are economically viable as well.

g. Separation Standards

Recommendation: An initiative is needed to review and, where needed, establish new risk assessment methods to be used to establish aircraft separation standards. This would involve the international community and may best be done by an industry-government forum, supported by a technical team.

FAA Response: The agency is currently working to establish, where possible, technology neutral performance-based criteria for the current separation procedures. This is a necessary step to using other sources of surveillance and expanding the use of current procedures. As we move beyond that to the consideration of changes in separation standards, your concerns are noted. I have asked the ATO Operations Planning Office to contact you to review the detailed aspects of

the concerns. Together you can work out the next steps to make sure these concerns are fully understood and that the actions you suggested are considered during the review of separation standards.

3. *Review of FAA R&D Program Plans for Fiscal Year 2007,* May 2, 2005

a. Subcommittee on Air Traffic Services

Recommendation: ATC Automation: There is increasing evidence that air traffic controllers are reaching the limit of what they can achieve in providing separation services to ever increasing volumes of traffic. Since we do not want to limit the growth of aviation artificially, we must dramatically increase research efforts to understand the architectures and functional definitions of more highly automated systems to support air traffic services. Research and development to address these issues has been initiated within NASA, but it is the considered position of this committee that this research must be dramatically increased, with complementary efforts at the FAA, if the country is to be able to respond to the projected growth in air travel.

FAA Response: The FAA agrees that this is a key component of the FAA's to-be-built architecture and an integral part of the Next Generation Air Transportation System (NGATS). To address these issues, the Air Traffic Organization (ATO) has initiated a series of studies that look at the role of the sector team versus the strategic flow functions and opportunities to redefine the manner in which airspace is managed and staffed. These studies include investigations into multi-sector planning, high and low en route specializations, and moving from the traditional terminal airspace to arrival and departure services, which cover the full transition from cruise to runway. It is as important to understand the best methods for managing the traffic, as it is to optimize any one operational paradigm. The ATO is providing these concepts and the related activities to NASA and others to support consistent and complementary near-term activities as well as establish a common basis for their investigation in the farther term aspects of Air Traffic Management (ATM) found in the NGATS transformation including the future ATC "evaluator".

Recommendation: A Seamless, Highly Fault-Tolerant System: Closely associated with the automation developments, but with a scope including the entire NAS CNS/ATM system, is the need for research and development to devise an integrated ATM system with less artificial separation between terminal, en route, oceanic, and airport surface environments. Such a system might also include shared air/ground responsibility for separation, and must be viable in all weather and wake vortex situations as outlined in our recommendations below. An integral part of this work must be the development and implementation of a highly reliable, robust, and fault-tolerant ATM system. The resulting system may be distributed, centralized, or have some functions distributed and others centralized.

FAA Response: The FAA agrees. The FAA is currently looking at opportunities to accelerate the implementation of Automatic Dependent Surveillance - Broadcast (ADS-B) activities as a step towards that purpose. The first step in creating more flexible air transportation, as envisioned in the Joint Planning and Development Office's (JPDO) NGATS Plan, is to create a seamless surveillance picture for both ground and air. To meet both its current and future needs,

the NAS needs to provide surveillance information to the service provider and to the flight deck from first movement on the surface into the airborne portion of the flight and back to final shutdown. Today the increased coverage for the surface and new localities requires new secondary radars and an extensive system of ground-based interrogators to meet these coverage needs using the current transponder aircraft base. At this time, the FAA is also facing a decision on how to best address the need to replace its aging radar infrastructure. An integrated approach using the position broadcast by the flight deck as the basis for the service provider surveillance, as well as the flight deck situation picture, provides substantial cost savings for the FAA for its basic surveillance function. This approach also promotes the expanded use of the broadcast and related displays on the flight deck to increase safety, providing low visibility efficiencies and capacity gains as well as flight efficiencies for the aircraft and productivity gains for the FAA.

Recommendation: Weather Impacts to Aviation: The Subcommittee is keenly aware of a broad array of advanced aviation weather products that have been continuingly emerging from the weather research community under the auspices of the FAA weather research activity. To maximize the impact of these products, particularly in safety and capacity area associated with forecasts of thunderstorms, it is critical that these products are integrated with much greater emphasis to increase the effectiveness of the rapidly-developing air traffic system being developed and closely related to the Air Traffic Organization Research and Development (ATO-P) and JPDO activities.

FAA Response: The FAA concurs with the Subcommittee's recommendation and has recently established a Technical Community Representative Group (TCRG) that has representation from both aircraft safety (AVS) and air traffic systems (ATO) personnel to ensure the coordination the subcommittee has recommended. The Aviation Weather Research Program (AWRP) continues to integrate its efforts with all of the ATO organizations, including those planning the future NAS, such as ATO-P and the JPDO. AWRP personnel are active members of the JPDO Weather IPT and the AWRP resides within the ATO-P directorate for research and development.

Recommendation: Wake Turbulence Separation Reduction Operational Enhancement: Techniques to minimize the additional wake turbulence separation, beyond radar or visual separation at congested airports, are critically needed. A Wake Vortex avoidance system is needed, that predicts when weather conditions will produce "wake independent conditions" on arrival and departure paths.

FAA Response: The FAA appreciates the Subcommittee's recommendation. NASA has determined a development path for a Wake Vortex Avoidance System (WakeVAS) based on inputs from the FAA and other aviation community stakeholders. During the next year NASA will be developing a prototype system. The FAA has taken the initial step in terms of identifying a timeframe when the NASA prototype (if successful) would integrate into the National Airspace System (NAS) Architecture. We have also included funding for engineering development of the NASA prototype into our Facilities and Engineering (F&E) budgetary planning process. The President's FY 2006 F&E budget submission contains a $1million request for transitioning the functionality of the NASA WakeVAS prototype into a FAA engineering development program. FAA F&E budget planning for FY 2007 continues this system requirements development work

in preparation for an investment decision by the FAA to build and field a system based on the NASA development.

Recommendation: Development of Rational Separation Standards: A serious research and development effort is needed to assess current separation standards and develop methods to safely accommodate blunders. The study should consider the use of time-based separation as a possible alternative to distance based separation.

FAA Response: The FAA agrees that the current separation standards need to be modernized, including a move to performance-based descriptions of capability. The FAA has initiated efforts in this area starting with the current three mile separation minima procedures in the terminal environment establishing performance descriptions for those procedures. Current air traffic control procedures are related directly to the availability of equipment and indirectly to the information that this equipment provides. By translating these equipment requirements to the related information performance that they provide, the FAA can look at other methods for providing that information with clear performance objectives in mind. Representing the performance processes associated with procedures will provide a clear basis for setting criteria for the development of new separation procedures including consideration of blunders. The FAA also agrees that time-based separation is a viable alternative to distance based separation. It is the method used in our procedural airspace and is the method applied in our oceanic system ATOP. As the investigation of management by trajectory matures the concept, we expect that time-based separation will be a key component if that concept is parallel to the related time-based metering.

The FAA will continue to pursue the near-term movement to performance-based standard as the logical first step towards this goal and supports complementary research into new procedures and control paradigms.

Recommendation: Support for Research and Development: The successful development of these core technologies is clearly dependent on the availability of funding and commitment from the FAA, NASA, and CAASD. In light of the recent reductions in the NASA Aeronautics Program that have been reported in the press, the continued downward trend of research dollars within the FAA, and the reductions in budget for CAASD in the out years, the subcommittee is concerned that the research and development to support these critical core technologies will not be available in a timely manner. Therefore, it is recommended that the FAA executive leadership work with the JPDO in developing a compelling case to assure that the resources are made available to support the research to meet the need for increased capacity and productivity in the future.

FAA Response: The JPDO is in the process of refining the NGATS concepts and capabilities and identifying the time-phased research and development programs needed to achieve NGATS goals. We believe that the clear definition of the next generation system, a feasible implementation plan, and a robust benefits analysis will form a compelling rationale for needed investments in research and technology. FAA, NASA, and CAASD are currently directly involved in the research to support the need for NGATS and to define and secure the long-term research support to fully realize its benefits.

At the same time, the JPDO is modeling the projected shortfall of the current baseline (i.e., not pursuing NGATS) and the impacts of a phased implementation of NGATS capabilities. We are very early in the NGATS definition process, and these concepts must be validated and refined by significant research. Nevertheless, preliminary analysis indicates that the NGATS concept – as currently understood – will meet NGATS goals to meet 3 times current demand and reduce costs by 25 percent.

As you are aware, six entities (the Departments of Commerce, Defense, and Homeland Security, Office of Science and Technology Policy, NASA, and the FAA) are designing the next generation air transportation system. Thus, NGATS success rests not upon one particular program but the successful coordination of programs and funding across agency lines in ways that have not been done in the past.

This coordination process begins with the FY 2007 budget submission. The JPDO, through the coordinated agency-level efforts of the Integrated Product Teams, has identified near-term research requirements (five years) and is assessing the current research programs within the partner agencies. Gaps will be identified and ways to fill those gaps explored. The resulting multi-agency portfolio of research and technology programs – along with the benefits analysis – will be reflected in the JPDO's annual progress report to Congress and the partner agencies' budgets.

As you have noted, NASA is a critical partner in the continued improvement of the air transportation system, and its Aeronautics Directorate programs in air traffic management, security, and safety directly support stated targets and goals of NGATS. CAASD also provides unparalleled research, analytical, and system engineering support. The coordination of FAA, NASA, and Center for Advanced Aviation System Development (CAASD) research objectives around the common goals of the NGATS will create the necessary climate for increased aviation research investment.

b. Subcommittee on Airports

Recommendation: The development of the Engineered Materials Arresting System (EMAS) by the airport research program has contributed positively to the reduction of risk and aircraft damage in several overrun accidents to date. However, this successful system is currently available only through sole source procurement from a single vendor. The subcommittee urges the program to commit seed money to encourage other technologies or suppliers to participate in the further development and refinement of this highly valuable tool.

FAA Response: We understand the airports concerns with a sole source EMAS provider. However, the market for EMAS is limited and may not be capable of supporting more than one supplier. We do not believe we should expend R&D funds as seed money to encourage other suppliers to enter the EMAS market.

Recommendation: The recently completed assessment of the suitability of taxiway centerline lighting fixtures installed at 12.5 foot spacing on curved sections, as is currently required by

FAA standards; instead of the 25 foot spacing allowed by ICAO standards indicated that the FAA-approved lighting fixture installed at the ICAO 25 foot spacing do not provide adequate guidance under low visibility conditions. However, the assessment did not address the underlying question of whether the use of an ICAO-specified fixture at the ICAO-specified spacing satisfies the visibility requirements. The subcommittee urges the program to continue this research to determine whether the ICAO standards and fixtures provide adequate guidance, while allowing a reduction in the spacing, with an accompanying reduction in installation costs for these very expensive lighting systems.

FAA Response: We agree and will investigate if the use of ICAO-specified fixtures can produce cost savings and still meet visibility requirements.

Recommendation: The subcommittee supports the development of an in-house pavement testing laboratory at the National Pavement Test Facility to reduce turn-around time for pavement quality control tests and improve reliability of quality control of pavements constructed for destructive testing at the facility.

FAA Response: The FAA concurs with this recommendation. The FY 2006 budget request includes funds for the in-house pavement-testing laboratory.

Recommendation: The subcommittee also supports a modest increase in the level of program staffing in order to adequately manage research contractors used in the program. However, it is our feeling that staff increases need to be related to actual increases in the level of funding in the program.

FAA Response: The FAA concurs with this recommendation.

Recommendation: In the event that the requested higher funding levels are not achieved in the FY 06 budget, the subcommittee recommends that proposed modifications to the pavement test machine to evaluate 10-wheel landing gear and the development of lighting standards for vertical IFR landings be eliminated. Investigation of 10-wheel gear, while intellectually interesting, are required only for speculative aircraft designs, such as blended-body/wing concepts and for the AN-224 and certain military airplanes, that see only very limited service at US commercial airports. Development of vertical flight lighting standards for IFR operations will, at present, have application at only one heliport and could be deferred in the event of funding shortfalls.

FAA Response: The FAA concurs with this recommendation.

Recommendation: The current joint program with DoD to develop a high resolution, low cost radar for the detection of birds in the vicinity of airports offers significant safety potential. However, the subcommittee is concerned that the focus of this research project seems to be more on the enhancement of existing bird hazard data bases than on the development of an operational tool to provide real-time warnings to air crews. The subcommittee urges FAA to address the human factors issues that will need to be resolved to put such real-time radar into the pilot/controller interaction at busy airports.

FAA Response: The FAA concurs and will include the human factors issues in the development of the bird radar testing and evaluation.

Recommendation: The subcommittee is concerned that substantial research effort is being proposed by the Technical Center to investigate issues relating to the introduction of A380 airplanes into service in areas that either do not lie within the airports line of business, or for which research has not been requested by the AAS sponsor. Issues such as the certification of the airplane to operate on 150-foot wide runways, cockpit forward visibility, the adequacy of upper deck evacuation systems and the need to provide second-level access for fire fighting will be resolved by the FAA Regulation and Certification line of business as part of the JAA/FAA aircraft certification process, now underway, and do not require research by the airports research program. Proposed research into the adequacy of the Modifications of Standards submitted by individual airports to accommodate A380 operations appeared to surprise the AAS sponsor, and seems not to be needed. The subcommittee urges that AAS and XXX develop formal statements of research needs in this area to eliminate any confusion over exactly what research is being requested by the sponsor.

FAA Response: We concur. We will formally request the sponsors to provide written guidance clarifying the research needed to prepare for the introduction of A-380 and new large aircraft.

c. Subcommittee on Human Factors

Human Factors in Maintenance and Inspection

Recommendation: The Human Factors Subcommittee endorses the appointment of the Chief Scientific and Technical Advisor in this area. He should work closely with the TCRG to ensure a well-developed implementation path from requirements generation, through research to implementation, as well as a balance between short-term and long-term research requirements.

FAA Response: The Chief Scientific and Technical Advisor for Aviation Maintenance Human Factors is actively working with the Technical Community Representative Groups (TCRG) and industry. He has already developed and submitted new research requirements to the TCRG. The Human Factors Research and Engineering Division research program manager will work with him on the execution of those requirements that receive funding, and facilitate the appropriate use of research outputs. They will work collaboratively to balance short-term and long-term research requirements.

Selection, Training and Staffing of Air Traffic Control

Recommendation: The Human Factors Subcommittee recognizes the urgency of the controller replacement problem, but also sees this as an opportunity for human factors research addressing controller job performance so as to better understand the effectiveness of introducing new technology and training methods. The Subcommittee recognizes the complexity of the problem with multiple layers of agreements/constraints, historical labor/management issues and facility-specific training needs.

Recommendation: The Human Factors Subcommittee appreciates the improvements in Air Traffic Selection and Training (AT/SAT) selection procedures and training programs. The Human Factors Research and Engineering Division should work closely with other offices such as systems engineering, workforce planning, and air traffic training to model the impact of future concepts of operation, technology, and procedures on controller staffing, selection and training requirements. The development of methods, tools, and processes for modeling the controller job is needed as part of that collaboration.

Recommendation: The predicted time sequence of retirements and replacements may lead to a system-wide saturation with trainees (developmentals) within the next five years. With a ceiling of 35 percent develomentals at each facility (with which we agree) specific facilities will exceed this level. A dynamic staffing model needs to be facility specific so that such situations do not occur.

Recommendation: The FAA should continue, and even improve, the culture of collaboration with the Air Traffic Collegiate Training Initiative Schools. This is one area of opportunity in the training process, as the controller workforce increasingly comes through these programs. This means propagating new technology and future requirements to these schools so that they can better prepare future controllers. The CTI training should be a preferred entry route into the controller training process.

Recommendation: The job of controller is socially embedded, uses new technologies and will continue to be critical to safety of the air traffic system. Successful improvements in productivity are more likely to come from collaborative socio-technical systems approaches than from confrontation over relatively minor personnel issues.

FAA Response for Selection, Training and Staffing of ATC recommendations above: The Human Factors Subcommittee generated a set of recommendations regarding controller selection and training. The subcommittee's recommendations were presented to the Administrator by Dr. John Hansman and several activities have resulted. The Assistant Administrator for Regions and Center Operations convened a meeting of the principle parties in the FAA associated with this important area during the week of October 3, 2005. The Human Factors Research and Engineering Division has pledged to provide support to the Assistant Administrator's directives in several areas including the introduction of new simulator technology to the training process. In addition, to facilitate the introduction of new technology and training, a series of comprehensive task analyses will be generated as part of the human factors research program to address controller job performance for both the en route and terminal functions. The analyses will use a common methodology and will provide guidance to the selection, training and system development communities. The Human Factors Air Traffic Research program will also sponsor efforts to expand the use of selection tests into other areas such as selecting controllers on the basis of aptitude for a domain (i.e., terminal versus en route). The Human Factors Research and Engineering Division continues to work with members of the Personnel Selection research requirements group to define research requirements regarding the Collegiate Training Initiative program and a facility-specific dynamic staffing model.

d. Subcommittee on Aircraft Safety

Recommendation: Last year, SAS recommended that aircraft safety research be moved from ATO's Operations Planning into, preferably, AVS or into an independent R&D organization. SAS was – and remains - concerned that the needs and priorities of aircraft safety research do not naturally align with ATO's primary mission of meeting demand for increased airspace capacity under the OEP and might consequently be accorded a lower management and funding priority than required to properly support the FAA's safety mission.

This mismatch between primary institutional priorities may have become even greater (between JPDO and safety research) with the recent assignment of one and the same individual to the dual positions of Director of JPDO and ATO Vice President of Operations Planning. While SAS fully realizes that it is the FAA's goal to achieve the necessary capacity increase while improving safety, it fears that the institutional goals and resulting management priorities of JPDO, independently of the director, may not always be fully compatible with those necessary for oversight of safety research. Whereas JPDO's extremely important brief is to define and implement the NGATS for 2025, it is the role of safety research to support the FAA's safety mission today and over the next few years, as well as long-term. However, the near to mid-term safety research needs are not inherently of primary concern to JPDO. Thus, SAS repeats its recommendation from last year that safety research oversight be placed within AVS.

FAA Response: The FAA agrees that there needs to be close coordination with AVS in the definition and execution of aircraft safety research and that AVS have oversight of the safety research. We feel that within the current R,E&D process used by AVS and the ATO for aircraft safety, AVS does have oversight of the research. AVS personnel define the research requirements and, while ATO-P personnel are responsible for conducting the research, AVS personnel have significant oversight of the resulting projects. Both the ATO and the JPDO are fully supportive of the FAA's safety mission and will continue to support it over the long term in close cooperation with AVS.

Recommendation: The newly-established Center of Excellence for Airliner Cabin Environment Research (ACER) has assembled a strong academic research team and an impressive group of cost-sharing and actively engaged industrial partners. This is a clear indication of the recognition of the importance of its work. Its mission will take years to complete. While it is funded for at the next two years, it is an "above-target" program for '07. The research is sufficiently important, not least because of its potential public health benefits and its contribution to strengthening U.S. competitiveness in response to an ambitious European research program in the same area, that it needs to be continued in '07 and beyond. Continuation may require that the program be included in the base budget, and that the money would have to be taken from other base programs if earmarked funds were to become unavailable.

FAA Response: The FAA agrees with the subcommittee on the importance of the research in the area of cabin air quality. The FAA will continue to work within the budget to define research requirements in our highest priority areas, which will include cabin air quality.

Recommendation: SAS continues to support Unmanned Aircraft Systems (UAS) as an above-target program. The Subcommittee still thinks that the private sector perceives a significant emerging market opportunity and thus has a strong incentive to contribute to its success. Other government agencies, such as DHS and DoD, also have a major stake in a successful UAS and should contribute resources to its implementation.

FAA Response: The FAA is proceeding with an above target initiative to begin a research program in Unmanned Aircraft Systems in FY 2007.

Recommendation: The prospect of shrinking budgets for safety research at both NASA and FAA makes more urgent the need for effective collaboration between the agencies, including the establishment of an efficient technology alignment and transfer process. Also, the FAA needs to define a balanced process with a set of criteria for a periodic assessment of each project as to whether it should be continued or brought to conclusion.

FAA Response: The FAA strongly supports close cooperation with NASA. The FAA has been working closely with NASA researchers for several years in the Aviation Safety Program and plan to continue that close working relationship in the follow-on NASA Aviation Safety and Security Program. The FAA also agrees with the Subcommittee recommendation on the need to periodically assess our research to determine whether it should be continued or concluded. The current AVS R,E&D process will be modified to include criteria to conduct such an assessment to be implemented in the FY 2008 budget formulation process.

Recommendation: SAS received its first weather research briefing since weather was added to its portfolio. SAS recommends that industry be engaged and that the researchers have an understanding of the process by which technology is transferred into the cockpit, not least in order to make industry engagement effective. The research should also be coordinated with that into the effects of weather on aircraft and the air traffic system.

FAA Response: The FAA concurs with the Subcommittee's recommendation and has actively involved the industry in its AWRP. Before research is initiated, the program meets with the potential users. Also during the program planning phase, the researchers work with industry to develop the intended product. The FAA has recently established a TCRG that has representation from both AVS and ATO personnel to ensure the coordination the subcommittee has recommended.

Recommendation: The aircraft industry is introducing new materials, mainly composites, and new joining processes at the fastest pace in decades. SAS recommends that their long-term failure behavior needs to be understood through appropriate research before catastrophic failures occur. The need for such research appears to be underscored by the recent and as yet unexplained break-up of the composite rudder of an A310 under perfectly normal flying conditions.

FAA Response: The FAA agrees with the Subcommittee. Research that refines our understanding of the long-term failure behavior of structures made of advanced materials is important. The current research portfolio is focused on increasing our understanding of

advanced materials before we have failures, thus preventing accidents. Within the defined budget levels, we feel that the current level of funding for this area is appropriate.

Recommendation: There is no funding in '07 for support of the Mil-Handbook-5 project. This document is of fundamental importance for a large segment of the aviation community. It is an essential tool for maintaining the safety of the fleet. This project needs continued funding.

FAA Response: The FAA agrees with the Subcommittee that the continuation of support for the Mil-Handbook-5 project (now called the MMPDS) is important. A process has been put in place to allow commercialization of the MMPDS document. Therefore, the FAA will continue to fund this project, but at a reduced amount as the activity becomes self-sustaining.

Recommendation: The SASO (System Approach for Safety Oversight) requirements briefing at the recent SAS meeting helped members to better understand this complex program. It is understood that reaching the objectives of the program is of fundamental importance to the FAA's safety goal. While the general research approach appears to be sound, SAS recommends that more industry input is needed to assure relevancy of the research output.

FAA Response: The FAA agrees with the Subcommittee's recommendation and will seek to increase industry input.

e. Subcommittee on Environment and Energy

Recommendation: The Subcommittee requests that the FAA administrator determine the impact that the reduction in the NASA budget will have on the ability of the FAA to meet the environmental challenges facing or are likely to face the aviation systems and develop strategies within the agency and the JPDO to mitigate these effects, especially as they relate to the Next Generation Air Transportation System (NGATS).

FAA Response: I agree with you that achieving the NGATS environmental goals without NASA investment to develop and mature technologies will be extremely challenging. I have engaged in robust discussions with NASA's leaders about aeronautics funding priorities and relationships to NGATS. Also, the Senior Policy Council will address the Federal role in aeronautics research and development, funding levels, and alternatives. In response to your recommendation, I have also asked the Environmental Integrated Product Team to carefully examine environmental goals and address both sources and levels of funding necessary to achieve these goals.

Recommendation: The Subcommittee requests that the FAA administrator do all that is possible to ensure that APMT is adequately funded and that the Office of Environment and Energy be instructed to define portfolio management within the context in which APMT will be used.

FAA Response: Within budget constraints, we are doing everything possible to adequately fund the aviation portfolio management tool (APMT) effort. The Office of Environment and Energy is reevaluating priorities to ensure that sufficient funding is applied to APMT to support the

Committee on Aviation Environmental Protection (CAEP) work program. Also, our budget request to the Department includes additional funds to expand the capabilities of APMT to address NGATS scenarios. However, this request will have to compete for funds with other Department and Administration priorities. Regarding the second point, the Office of Environment and Energy recently initiated an APMT requirements and architecture study through the Partnership for Air Transportation Noise and Emissions Reduction (PARTNER) Center of Excellence. One of the goals of the study is defining portfolio management within the context in which
APMT will be used. I have asked my staff to keep the subcommittee informed of the progress.

Recommendation: The Subcommittee requests that the FAA administrator do all that is possible to ensure that PM and HAPs research is adequately funded and that the Office of Environment and Energy be instructed to provide a timeline for when the contribution of aircraft will be determined.

FAA Response: We are doing everything possible to fund Particulate Emissions (PM) and Hazardous Air Pollutants (HAPs) research. In FY 2005 we tripled investment in this area. This investment is already paying off. We recently applied results of the research to address a PM issue for a capacity expansion project. Also, per the Committee's recommendation, our budget request to the Department includes additional funds to expand the PM and HAPs research. However, this request will have to compete for funds with other Department and Administration priorities. Lastly, the Office of Environment and Energy together with other Federal agencies, in collaboration with industry, and in consultation with other stakeholders has developed a unified roadmap for understanding and quantifying aircraft PM in relation to other sources. The roadmap includes a timeline. Efforts to address the impacts of HAPs are less mature, but we have initiated several efforts aimed at reducing uncertainties and expect that we can develop a timeline for HAPs research in FY 2006.

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APPENDIX D

Acronyms and Abbreviations

A	
AAAE	American Association of Airport Executives
AACE	Airworthiness Assurance Center of Excellence
AAS	[FAA – ARP] Office of Airport Safety and Standards
AC	Advisory Circular
ACER	Center of Excellence for Airline Cabin Environment Research
ACI	Airports Council International
ACRP	Airport Cooperative Research Program
ADS-B	Automatic Dependent Surveillance – Broadcast
AEDT	Aviation Environmental Design Tool
AEP	[FAA – Staff Office] Aviation Policy, Planning and Environment
AET	Association for European Transport
AFCB	Arc-Fault Circuit Breaker
AFIB	Atrial fibrillation
AFS	[FAA – AVS] Flight Standards Service
AFTIL	Airway Facilities Tower Integration Laboratory
AIA	Aerospace Industries Association
AIP	Airport Improvement Program
ALPA	Airline Pilots Association
AMT	Aviation Maintenance Technician
AOC	Aircraft Operations Center
AOPA	Aircraft Owners and Pilots Association
A&P	Airframe and Powerplant
APA	Allied Pilots Association
APMT	Aviation Portfolio Management Tool
AQP	Advanced Qualification Program
ARAC	[FAA] Aviation Rulemaking Advisory Committee
ARC	[FAA] Aviation Rulemaking Committee
ARP	[FAA – Line of Business] Airports
ARTCC	Air Route Traffic Control Center
ASAP	Aviation Safety Action Program
ASEB	National Academy Aeronautics and Space Engineering Board
ASR	Alkali Silica Reactivity
AST	[FAA – Line of Business] Commercial Space Transportation
ASTM	American Society for Testing and Materials
ASU	Arizona State University
ATA	Air Transportation Association

ATC	Air Traffic Control
ATD&P	Advanced Technology Development and Prototyping
ATM	Air Traffic Management
ATO	[FAA – Line of Business] Air Traffic Organization
ATO-P	[FAA – ATO] Office of Operations Planning
ATOP	Advanced Technology for Oceanic Procedures
ATO-PRD	[FAA – ATO] Office of Operations Planning Research and Development
ATS	Air Traffic Services
AT/SAT	Air Traffic Selection and Training
AVR	[FAA – changed to AVS]
AVS	[FAA – Line of Business] Aviation Safety
AWRP	Aviation Weather Research Program
AWTT	Aviation Weather Technology Transfer
C	
C3	Command, Control and Communications
CAA	[British] Civil Aviation Administration
CAASD	[MITRE] Center for Advanced Aviation System Development
CAEP	[ICAO] Committee on Aviation Environmental Protection
CAMI	Civil Aerospace Medical Institute
CAST	Commercial Aviation Safety Team
CDA	Continuous-descent Approach
CDTI	Cockpit Display of Traffic Information
CERF	CDTI Enhanced Flight Rules
CFIT	Controlled Flight into Terrain
CGAR	Center of Excellence for General Aviation Research
CNS	Communications, Navigation, and Surveillance
COE	Center of Excellence
COMSTAC	[FAA] Commercial Space Transportation Advisory Committee
CONUS	Continental United States
COO	Chief Operating Officer
COTS	Commercial Off-the-shelf Software
CPI	Certification Process Improvement
CRC	Coordinating Research Council
CRDA	Cooperative Research and Development Agreement
CRM	Crew Resource Management
CSPR	Closely Spaced Parallel Runways
CTI	Collegiate Training Initiative
D	
DARWIN™	Design Assessment for Reliability with Inspection
DC	Decision Coverage
DEFORM™	A patented system used to analyze titanium alloy defects in turbine rotor disks

DHS	Department of Homeland Security
DOC	Department of Commerce
DOD	Department of Defense
DOE	Department of Energy
DOT	Department of Transportation
DRVSM	Dynamic Vertical Reduced Separation Minima
DSA	Detect, Sense, and Avoid
E	
EA	Enterprise Architecture
EDMS	Emissions Dispersion Modeling System
EDS	Environmental Design Space
ELV	Expendable Launch Vehicles
EMAS	Engineered Materials Arresting System
EPA	Environmental Protection Agency
ERDC	Engineer Research and Development Center
EUROCONTROL	European Organization for the Safety of Air Navigation
F	
FAA	Federal Aviation Administration
FAARFIELD	An airport pavement thickness design package developed for the FAA
FACT	Future Airport Capacity Task
FAROS	Final approach runway occupancy signal
F&E	Facilities and Equipment
FEDFAA	A pavement design computer program developed for the FAA
FG&C	Flight Guidance and Control
FICAN	Federal Interagency Committee on Aviation Noise
FIS	Flight Information Service
FIS-B	Flight Information Service-Broadcast
FNA	FAA-NASA Agreement
FOD	Foreign Object Debris
FOQA	Flight Operations Quality Assurance
FY	Fiscal Year
G	
GA	General Aviation
GAMA	General Aviation Manufacturing Association
GA&VF	General Aviation and Vertical Flight Technology
GAO	General Accounting Office
GBA	Ground-Based Transceiver
GEOSS	Global Earth Observation System of Systems
GPS	Global Positioning System
GWU	George Washington University

H	
HAP	Hazardous Air Pollutant
HIRF	High Intensity Radiated Field
HUMS	Health and Usage Monitoring System
HVAC	Heating, Ventilation, and Air Conditioning
I	
IATA	International Air Transport Association
ICAO	International Civil Aviation Organization
iCMM®	Integrated Capability Maturity Model
IEC	International Electrotechnical Commission
IFR	Instrument Flight Rules
ILS	Instrument Landing System
INM	Integrated Noise Model
IPRF	Innovative Pavement Research Foundation
IPT	Integrated Product Team
ISO	International Standards Organization
J	
JAA	Joint Aviation Authorities
JANUS	An operational error and analysis tool (not an acronym)
JPDO	Joint Planning and Development Office
JRC	[FAA] Joint Resources Council
JSAT	Joint Safety Analysis Team
JSIT	Joint Safety Implementation Team
L	
LAAS	Local-Area Augmentation System
LAHSO	Land and Hold Short Operations
LAN	Local Area Network
LCSS	Low-Cost Surface Surveillance
LEDFAA	Layered Elastic Design – Federal Aviation Administration
LIDAR	Light Detection and Ranging
LOSA	Line Operations Safety Audit
LSDYNA	A proprietary finite element code
M	
MAGENTA	Modeling System for Assessing Global Noise Exposure
MC	Modified Condition
MMPDS	Metallic Materials Properties Development Standards
MOA	Memorandum of Agreement
MoC	Memorandum of Cooperation
MOU	Memorandum of Understanding
MSD	Multiple-Site Damage

N	
NAPTF	National Airport Pavement Test Facility
NARP	National Aviation Research Plan
NAS	National Airspace System
NASA	National Aeronautics and Space Administration
NAWC	Naval Air Warfare Center
NBAA	National Business Aircraft Association
NEA	Nitrogen-Enriched Air
NEXRAD	Next-Generation Weather Radar
NGATS	Next Generation Air Transportation System
NOAA	[DOC] National Oceanic and Atmospheric Administration
NOTAM	Notice to Airmen
NOx	Oxides of nitrogen
NPRM	Notice for Proposed Rule Making
NTSB	National Transportation Safety Board
NWS	[DOC] National Weather Service
NYMA	New York Metropolitan Area
O	
OBIGGS	On board inert gas generating system
OEP	Operational Evolution Plan
Ops	[FAA Budget Appropriation] Operations
OSTP	[Executive Office of the President] Office of Science and Technology Policy
P	
PARTNER	Partnership for AiR Transportation Noise and Emissions Reduction
PINS	Points-in-Space
PM	Particulate Matter
PMA	Parts Manufacturer Approval
PMI	Program Management Institute
PVFR	Precision Vertical Flight Rule
R	
RAA	Regional Airport Authorities
R&D	Research and Development
REB	[FAA] Research and Development Executive Board
R,E&D	[FAA Budget Appropriation] Research, Engineering and Development
REDAC	[FAA] Research, Engineering and Development Advisory Committee
RIRP	Runway Incursion Reduction Program
RLV	Reusable Launch Vehicle
RLVWG	Reusable Launch Vehicle Working Group
RMI	Company name (no longer an acronym)
RNAV	Random Navigation/Area Navigation
RNP	Required Navigation Performance

RTCA	Company name (no longer an acronym)
RTSP	Real-Time Streamlining Protocol
RWSL	Runway Status Light
S	
SAE	Society of Automotive Engineers
SAGE	System for Assessing Aviation Global Emissions
SAMA	Small Aircraft Manufacturers' Association
SAS	[REDAC] Subcommittee on Aviation Safety
SASO	System Approach for Safety Oversight
SATS	Small Aircraft Transportation System
SBIR	Small Business Innovation Research
SDAT	Sector Design and Analysis Tool
SF	Safe Flight
SFO	San Francisco International Airport
SLD	Supercooled Large Droplet
SMS	Surface Management System
SNI	Simultaneous Non-Interfering
STERIS	Company name (not an acronym)
SUA	Special Use Airspace
SwRI	Southwest Research Institute
T	
TC	Type Certification
TCAS	Traffic Alert and Collision Avoidance System
TCRG	[FAA] Technical Community Representative Group
TERPS	Terminal Instrumentation Procedures
TFR	Temporary Flight Restrictions
THL	Take-Off Hold Lights
TIS	Traffic Information Service
TIS-B	Traffic Information Service-Broadcast
TO	Technical Operations
TRACON	Terminal Radar Approach Control
TRB	Transportation Research Board
TRL	Technology Readiness Level
U	
UAS	Unmanned Aircraft Systems
UAV	Unmanned Aerial Vehicle
UAV	Uninhabited Aerial Vehicle
UCB	University California Berkeley
UEDDAM	Uncontained Engine Debris Damage Assessment Model
URET	User Request Evaluation Tool
UTW	Ultra-thin white

V	
VAAC	Volcanic Ash Advisory Center
VACT	Volcanic Ash Coordination Tool
VF	Vertical Flight
VFR	Visual Flight Rules
VLTA	Very Large Transport Aircraft
W	
WAAS	Wide-Area Augmentation System
WakeVAS	Wake Vortex Avoidance System
WJHTC	William J. Hughes Technical Center
WRF	Weather Research and Forecast