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1.0 FAA R&D Program Overview

1.1 National Aviation Research Plan (NARP)

Delivery of the 2003 *NARP* fulfills the annual reporting requirement placed upon the Federal Aviation Administration by Section 44501(c) of the United States Code, to: "*…prepare and publish annually a national aviation research plan and submit the plan to the Committee on Commerce, Science, and Transportation of the Senate and the Committee on Science of the House of Representatives.*"

This Overview provides insight into FAA research activities and their relationship to the agency's mission and goals. It does not summarize the contents of this volume. Program descriptions and schedules are grouped in the 2003 *NARP* according to FAA goals structure and R&D mission support needs. Each grouping is preceded by a program area description that summarizes aspects of the program area's collective mission.

The five year planning cycle described in the 2003 *NARP* spans Fiscal Years 2004 through 2008. Current projections of costs and associated research activities for these years are provided in the program schedules that follow individual project descriptions.

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

1.2 Aviation R&D and the FAA Mission

The mission of the FAA is to provide: "*…a safe, secure, and efficient global aerospace system that contributes to national security and the promotion of U.S. aerospace safety."* Meeting all elements of this mission poses an increasing challenge.

Aviation is a key component of our nation's economy and way of life. Early in this decade, terrorist events demonstrated how vital the National Airspace System (NAS) is to the strength of our economy and conduct of our daily lives.

The 2003 *NARP* describes research efforts being undertaken by the FAA, often in partnership with other government agencies and private resources, to help ensure the NAS continues to have the tools and systems needed to transport our citizens and visitors safely, securely, efficiently, and in a manner that respects and preserves our natural environment.

In 2002, the FAA *Research and Development Highlights* was published to bring public attention to recent and cumulative accomplishments of the agency's R&D programs. This publication will appear annually under the new name of the FAA *R&D Annual Report*.

1.3 Aviation R&D and Aerospace Activity Forecasts

U.S. aerospace industries contribute heavily to our domestic economy and fuel its largest export sector. Despite the current international economic slowdown and concerns for aviation security, the 2002 *FAA R&D Strategy* foresees no decline in the significance of aviation to the nation:

> During the next 10-15 years … the aviation system will continue to be essential to the U.S. national security, economy, and quality of life for U.S. citizens, and is expected to continue its current pattern of growth. As early as 2013, U.S. enplanements are projected to reach nearly 1.1 billion passengers a year – 50 percent more than they carried in 2001. The projected increase in passengers and aviation activity will further strain a system that, prior to September 11, 2001, was already perceived as near full capacity. Over the next decade it will be critical to increase both capacity and efficiency in the NAS. In the period 2003-2013, demand for aerospace transportation services is projected to increase at average annual rates of 3.8 percent for domestic enplanements and 5.5 percent for cargo services.

No one solution or simple combination of solutions will allow our aviation industry to continue to expand services safely in the face of current challenges. Strong aviation research and development, both for the short term and the long term, remain central to our national interest.

1.4 R,E&D Advisory Committee

Established by Congress in 1989, the FAA's R,E&D Advisory Committee (REDAC) reports to the FAA Administrator on research and development issues and pro-

vides a liaison between the agency's R&D program and similar efforts within industry, academia, and other government agencies. The REDAC considers aviation research requirements in air traffic services, airport technology, aircraft safety, aviation information security, human factors, commercial space, and the environment.

A total of thirty members serve on the REDAC for alternating two-year terms. They represent corporations, universities, associations, consumers, and other government agencies. The FAA's Director of Aviation Research serves as the executive director of the committee. The full committee meets twice during the year, typically in April and in September.

NASA's Aero-Space Technology Advisory Committee and the REDAC conduct joint meetings to provide better support to inter-agency R&D modernization goals in the areas of safety, efficiency, and environment and energy.

Recent REDAC recommendations appear in Appendix A of this plan.

1.5 FAA/NASA Executive Committee

Since 1980, the FAA and NASA have provided members to a common R&D coordinating committee. In 1998, that committee was restructured into the "FAA/NASA Executive Committee" and was charged with the coordination of all joint R&D efforts.

According to the agreement that created the new committee, the role of NASA in national aviation R&D is to perform research, development, verification, and transfer activities on technologies with potential for long and short-term NAS improvement. The FAA's complementary R&D role is to select and prepare identified technologies for introduction into the NAS. FAA research provides the technology base and analyses, as well as the regulations and procedures, required for the evolving NAS; FAA also conducts limited research to refine relatively mature systems for specific uses. The results of FAA R&D have provided operational benefits in direct support of the agency's key goals.

1.6 FAA Strategic Goals and R&D

The prime elements of the FAA mission are embodied in the following research-dependent strategic goals, as stated in the agency's current *FAA Strategic Plan*:

Safety: "*By 2007, reduce U.S. aviation fatal accident rates by 80% from 1996 levels.*"

System Efficiency: "*Provide an aerospace transportation system that meets the needs of users and is efficient in the application of FAA and aerospace resources.*"

In legislation signed on November 19, 2001, the President created a new Transportation Security Administration (TSA) within the Department of Transportation. In 2003, TSA will become part of the Homeland Security Department. While the FAA's longstanding responsibilities for aviation security were transferred elsewhere, the FAA and its research facilities remain highly sensitive to security implications associated with evolving aviation technology and operational concepts and will cooperate closely with TSA. Responsibility for FAA Information Security remains with the FAA in the Office of the Chief Information Officer (AIO).

The FAA has identified additional goals that enable the agency to accomplish its mission. One such "enabling goal" carries with it requirements and implications for research and development:

Environmental Compatibility: "*Prevent, minimize and mitigate environmental impacts, which may represent the single greatest challenge to the continued growth and prosperity of civil aerospace.*"

Current and future R&D issues, challenges, and opportunities are identified in the 2002 *FAA R&D Strategy* in connection with the above goals. These are:

Ongoing R&D Issues Related to the FAA Safety Goal:

- The potential for terminal area and airport surface collisions.
- The introduction and certification of new technologies, with special emphasis on software reliability and failure modes in critical highly automated applications.
- New concerns associated with aging aircraft, e.g., mechanical and electrical systems, and "aging software," particularly in embedded systems.
- Human factors issues regarding the integration of increased flight deck and ground automation.
- New human-centered designs in cockpit/flight deck and air traffic control and management systems.

- The roles and responsibilities of flight crews and controllers in high-technology automation-rich environments.
- The need to collect and analyze safety-relevant operational data.
- The introduction of new technologies with possible new failure modes.
- The unintended adverse safety consequences associated with security countermeasures.
- An increase in the numbers of commercial space launches and landings, and associated sites, and increased complexity of space launch vehicles.
- The need to protect, detect, respond and recover from malicious cyber attacks. (Note: There is an integral relationship between the FAA's safety and security goals and the R&D required to achieve them.)
- The need to minimize accidents associated with icing, convestion, ceiling, and visibility."

Ongoing R&D Issues Related to the FAA System Efficiency Goal:

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

Ongoing R&D Issues Related to the FAA Environmental Capability Enabling Goal:

- Create an environmentally friendly global aerospace transportation system.
- Harmonize U.S. and international standards.
- Conduct comprehensive environmental assessments, including both airside and landside through models and data.
- Analyze and simulate alternative mitigation strategies, including economic factors and stakeholder impacts.

Figure 1-1 shows the relative percentages of requested FY 04 R&D funding directed toward meeting the three

Applicable Goal or Activity	FY 04 Level	Appropriation(s)
Safety	$132.1 M	R,E&D, F&E, AIP
Efficiency	$ 94.3 M	R,E&D, F&E, AIP
Environmental	$ 8 M	R,E&D,
Mission Support	$ 4.7 M	R,E&D

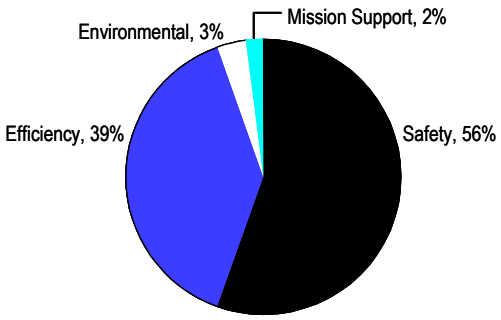

Figure 1-1: FY 04 R&D Funding Percentages by FAA Goals

FAA mission goals just described plus a Headquarters-based R&D Mission Support activity, which is described later in this Overview.

1.7 The FAA R&D Strategy

Through the REDAC, the Office of Aviation Research (AAR) works closely with NAS users to achieve R&D outcomes acceptable to the full aviation community. In September of 2002, AAR published the first biennial issue of the *FAA R&D Strategy* to guide research activities five years into the future. The planning framework presented in this document was developed as part of the *FAA R&D Strategy* to ensure alignment of the agency's R&D program with FAA mission and enabling goals.

Planning Framework

Because effective planning of research and development activities in fact requires a longer time perspective than the five years specifically addressed in the *FAA R&D Strategy*, the document introduces terms and concepts to accommodate the extended timing and diversity of R&D needs.

The R&D strategic planning framework is depicted in Figure 1-2. R&D sub-goals are "derived" from the agency's mission goals in order to clarify linkages between goal levels and the research essential to their achievement. Each derived R&D goal is expanded into one or more potentially measurable "performance objectives," addresses a specific aspect of the overall goal, and ultimately is dependent on research products for its accomplishment.

The full R&D portfolio works, as shown in the figure, toward the achievement of the overall program and agency goals. Each performance objective is inherently tied to a "challenge" faced by the FAA R&D community. R&D strategies are developed to meet each R&D challenge and related performance objective through the research products of a particular project or set of projects. A matrix tracing the products of all R&D projects upwards to the ultimate goals is being developed for presentation in the 2004 *FAA R&D Strategy*. Examples from this work in progress are provided within the program area descriptions of this *NARP*.

Metrics are being developed to measure the accomplishment of performance objectives and their relative contribution to meeting associated derived goals. Attainment of each objective depends largely on the new knowledge, tools, or systems provided by associated R&D projects.

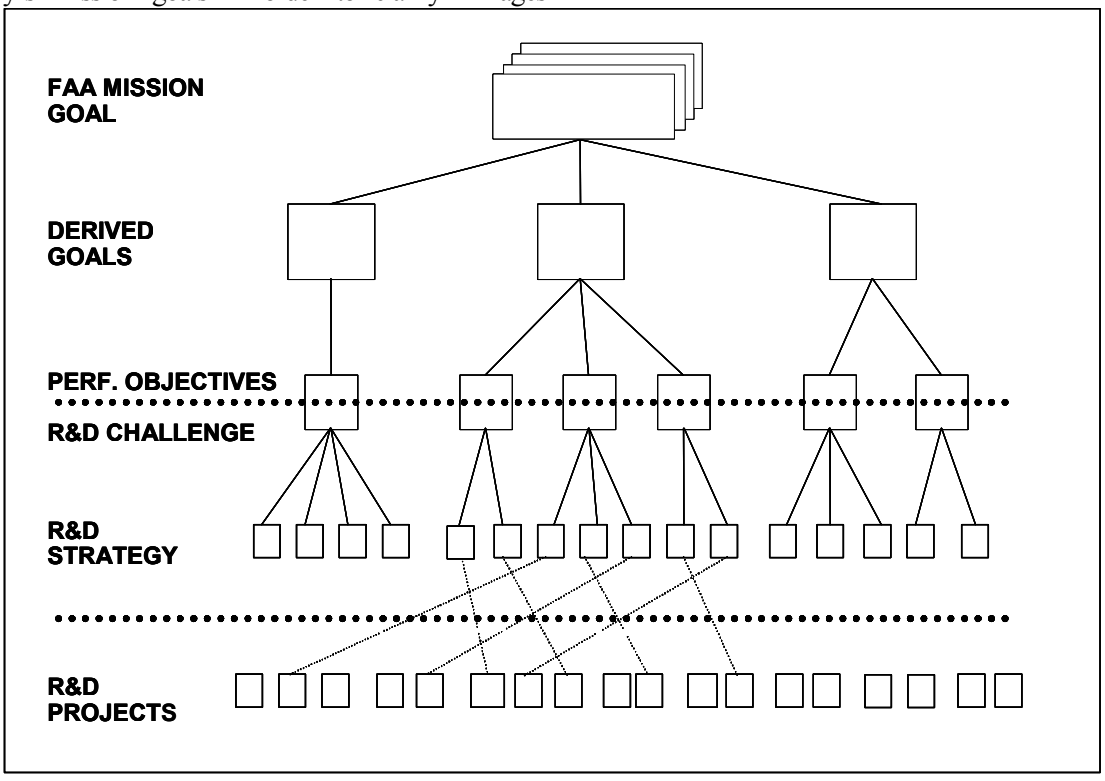

Figure 1-2: Goal-Performance Objective-Strategy Hierarchy, Showing Links to R&D Projects

The R&D goals framework facilitates communication across all levels of the FAA and serves as the basis for defining and measuring new performance metrics in support of DOT goals and in compliance with the Government Performance and Results Act of 1993. The *FAA R&D Strategy* will be updated biennially. Each new release of the plan will inform the full aviation community of the emphasis and direction of the FAA R&D program and encourage their comment, feedback, partnership, and collaboration.

Attainment of some FAA Performance Objectives may depend heavily on successful R&D, while in other cases, R&D may be an important, but less critical, element in achieving the objective.

1.8 FAA R&D Program Structure

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

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

- *Air Traffic Services*—R&D focuses on increasing system safety and capacity and enhancing the flexibility and efficiency of air traffic management operations. Improved decision support tools are key to enabling FAA air traffic specialists to collaborate with the user community in managing traffic flows as efficiently as possible. The R&D program also works to reduce occurrences of runway incursions, mid-air collisions, and aircraft encounters related to the effects of wake vortices and hazardous weather. Research is helping to develop new technologies that will improve navigational accuracy and landing guidance. Communication research develops technologies that improve the reliability of pilot-controller communications and permit the exchange of large data files, such as weather data, to pilots.
- *Airport Technology*—R&D develops and evaluates technologies and materials designed to help ensure safe and efficient airport operations. Research focuses on the development and evaluation of advanced, innovative technologies involving pavement design, construction, and maintenance; airport lighting and marking; rescue and firefighting equipment and procedures; runway friction; and wildlife control techniques. Research results are used to update FAA standards for the design, construction, and operation of airports and airport equipment. They also are incorporated into guidance material used by airport operators, consultants, and equipment manufacturers.
- *Aircraft Safety*—R&D focuses on ensuring the safe design, manufacture, and maintenance of aircraft. It addresses the hazards to all aircraft in service, as well as the special hazards endemic to select portions of the civil aircraft fleet. Older aircraft are more susceptible to structural and nonstructural problems associated with degradation, damage, fatigue, and corrosion. New aircraft with digital flight control and avionics systems and associated embedded software are more susceptible to disruption from external electromagnetic interference. Research focuses on developing technologies and standards for maintenance and modification of in-service aircraft to help ensure ongoing airworthiness. This work includes studies in the continued airworthiness of airframes, engines, and nonstructural systems; maintenance and repair of composites; atmospheric hazards; crashworthiness; fire safety; and the development of fire resistant materials.
- *Information Security and Technology*—R&D in this area continues to transition legacy and emerging FAA information systems to the high levels of security required to protect the flying public and critical national infrastructure, and to help ensure uninterrupted aviation operations.
- *Human Factors and Aeromedical Research*—Research focuses on enhancing performance and mitigating errors by the human component in aviation systems operations and maintenance. It addresses human capabilities and limitations in areas of information management and display, human-centered automation, selection and training, and human performance assessment across commercial and general aviation, and air traffic services. Additionally, research in the bioaeronautics area addresses issues related to performance,

safety and survivability in the cockpit and cabin environments.

- *Environmental*—R&D develops technical information, standards, and procedures to mitigate the environmental impact of aircraft operations, particularly upon noise and air pollution emissions. The program seeks to identify and balance technology, operations, and land-use measures with special emphasis on developing assessment methodologies that give insight into the system-wide consequences of alternative courses of action.
- *Commercial Space Transportation*—The overall mission of the Office of the Associate Administrator for Commercial Space Transportation (AST) is to protect public health and safety, protect the safety of property, and protect U.S. foreign policy and national security interests; to encourage, facilitate, and promote U.S. commercial space launches; to enhance the international competitiveness of the U.S. commercial space transportation industry; to further compliance with international obligations of the U.S.; and to facilitate new or improved U.S. space transportation infrastructure.
- *Aviation Research Mission Support*—includes the management, planning, control, and support activities associated with formulating the FAA R&D program. These efforts help to ensure that the program is a cohesive and integrated effort, consistent with FAA strategic goals and objectives, and fully coordinated with stakeholders and customers.

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

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

1.9 FAA R&D Performance Structure

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

1.9.1 William J. Hughes Technical Center

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

1.9.1.1 Ongoing WJHTC Research Involvement

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

- *Navigation and Surveillance*—FAA scientists conduct flight tests with actual Global Positioning System (GPS) signals and prototype ground stations to maximize GPS accuracy in connection with existing and projected communications capabilities. They also perform tests and evaluations of Automatic Dependent Surveillance—Broadcast capabilities to provide reliable aircraft position data to airborne and ground-based users and conduct static tests to determine data accuracy and integrity.
- *Terminal Areas*—Improving capacity at our airports is a difficult problem facing NAS modernization. Center staff work with simulation tools and test environments to refine proposed changes in takeoff and landing patterns, improvements in lighting and visual aids, and new procedures.
- *Security*—Now under the direction of the Transportation Security Administration, the Aviation Security Laboratory conducts extensive simulated and live testing in the areas of explosives and weapons detection, aircraft hardening, human factors, and security technology integration to provide the civil aviation system with maximum security while minimizing the adverse impacts on airline and airport operations. esponsibility for FAA Information Security remains with the FAA in the Office of the Chief Information Officer (AIO).
- *Safety*—The Airport and Aircraft Safety R&D Division conducts research in continued airworthiness using some unique, world-class facilities. Fire and accident testing on aircraft, components, and engines requires very specialized facilities and experienced people. The center's facilities in these and areas such as pavement and full-scale curved panel testing are the finest in the world.
- *Airport Technology*—Work is ongoing to improve airport safety and efficiency through research in pavement technology, airport lighting and marking, airport fire and rescue, and mitigation of wildlife hazards at airports.

1.9.1.2 R&D Partnerships

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

1.9.1.2.1 Industry

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

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

Projects overseen by the Technology Transfer Program Office include:

- Effective use of meteorological measurement and sensing equipment at airports with terrain-induced turbulence and in regions prone to in-flight icing.
- Development of a generic model for predicting the transport and validating the dispersal of glycols.
- Industrial validation of an acoustic emissions technology system prototype for use with on-board hazardous materials containers.
- Development and evaluation of internationally applicable alternative user interface display options and requirements for a next generation voice communication system.
- Test and evaluation of an unleaded high octane fuel formulation for general aviation piston engines.
- Measurement of the interaction/interference between a selected set of personal medical electronic devices and the magnetic fields emitted by walk-through metal detectors.

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

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

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

1.9.1.2.2 Government

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

1.9.1.2.3 Academia

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

1.9.2 Civil Aerospace Medical Institute

The FAA Civil Aerospace Medical Institute (CAMI) is a unique, internationally recognized aeromedical facility located at the Mike Monroney Aeronautical Center in Oklahoma City, Oklahoma. The institute maintains a cadre of in-house scientific specialists whose safety research thrusts are all distinctively human-centered and include:

- *Advanced ATC Systems Human Factors Research*—Using rapid prototyping techniques with advanced real-time ATC simulation capabilities, scientists analyze advanced ATC system designs and their effects on workload and performance, develop metrics of performance and workload, assess the applications of innovative control and design concepts, and identify and evaluate the applications of intelligent systems to enhance aviation safety.
- *Behavioral Stressors Research*—Human factors researchers investigate variables that could compromise safety by impairing both air traffic controller and pilot job performance levels (e.g., shift management, age, fatigue, color perception and a range of impairments induced by drugs or alcohol) and assess the effectiveness of policies, procedures, individual coping strategies, and countermeasures to reduce performance decrements and enhance individual performance.
- *Organizational Effectiveness Research*—Through field research, analytic information is developed to measure progress toward achieving agency change goals and for agency guidance on the relative merits of various innovations intended to enhance safety, efficiency, effectiveness, workforce health and satisfaction, and system performance. Relationships between psychological characteristics (e.g., work attitudes, organizational perceptions) and the work environment (e.g., business practices, organizational climate) are explored.
- *Flight Crew Performance Assessment*—General aviation human factors research emphasizes design of flight deck controls and displays related to emerging technology, development and validation of performance-based criteria for use in certification and regulation, and the successful integration of training devices into existing instructional systems to enhance flight crew performance and reduce accidents and incidents.
- *Selection, Validation, Research, and Team Performance*—Human factors researchers use laboratory and field studies to develop scientific evidence of the job validity of criteria within aviation selection and training systems. Cognitive strategies and processes underlying aviation skill acquisition through training are identified and assessment measures of individual and team performance developed to determine effects of advancing technologies on individual and work-team safety, efficiency, and effectiveness.

- *Aircraft Accident Research*—CAMI scientists maintain comprehensive bioinformatics databases and conduct extensive analyses involving the human factors, medical, physiological, and pathological aspects of aviation mishaps. Preventive measures and proactive interventions that will enhance aviation safety in the next millennium are rigorously investigated.
- *Forensic Toxicology Research*—Impeccable procedural integrity and robust toxicological and biochemical analyses of human samples from fatal aircraft accidents are required by the National Transportation Safety Board to help ensure continuous safety of the NAS. Scientists evaluate the underlying human basis for mishaps to prevent future tragedies in our transportation systems. State-of-the-art analytical and molecular biological techniques, including DNA analyses and gene expression, are developed to assist in identifying human causes or influences associated with aviation fatalities.
- *Biodynamics Research*—When failures do arise in aviation, occupant survival may depend directly upon the design of the seating and restraint systems in the aircraft. Evaluating the design and modeling of these systems, and ensuring their protective characteristics, requires both scientific and engineering talents.
- *Cabin Safety Research*—The ability to survive aircraft-related emergencies depends upon the systems, structures, and procedures that are developed and investigated in CAMI's aircraft evacuation facility where researchers conduct occupant evacuations from current aircraft configurations and develop evacuation research for larger, more complex aerospace vehicles of the future.
- *Aerospace Environment Safety Research*—Breathing and oxygen delivery systems for all aircraft occupants in normal and emergency situations are investigated. Threats to visual integrity and pilot performance from intense light emitters and ground-based lasers are defined. Improved measures of galactic cosmic radiation levels at various altitudes are developed by CAMI scientists to help ensure that those who work and travel in the aerospace system are not at a disproportionate risk for health problems from radiation exposures. Cabin air quality research is aimed at ensuring the health and safety of all aircraft occupants.

1.9.3 Centers of Excellence

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

1.9.3.1 General Aviation Center of Excellence

The Center of Excellence for General Aviation (GA) was established in April 2001 with Embry-Riddle Aeronautical University as the lead of a team, with other members Wichita State University, the University of North Dakota, Florida A&M, and the University of Alaska. The universities are teaming with industry and other government agencies to conduct GA safety-related research and development programs.

1.9.3.2 Center of Excellence in Airworthiness Assurance

The Center of Excellence for Airworthiness Assurance was established in 1997. In FY 2001, the center entered its second three-year phase with 28 academic members. Teaming with industry and other government partners, the center conducts research in the areas of:

- Maintenance, inspection, and repair,
- Crashworthiness,
- Propulsion and fuel systems performance safety, and
- Advanced materials.

Funded through contracts and grant awards, this center has a $100M contract cap over the next ten years and is making a $500K per year minimum commitment to fund basic and advanced research through cooperative agreements.

1.9.3.3 Center of Excellence in Operations Research

The FAA-selected team of the University of California (Berkeley), Massachusetts Institute of Technology, Virginia Polytechnical Institute, and the University of Maryland (College Park) lead the Center of Excellence in Op-

erations Research. This team includes ten university affiliates and twenty industrial partners. Funded through grant and contract awards, this center's areas of research involvement include traffic management and control, human factors, system performance and assessment measures, safety data analysis, scheduling, workload management and distribution, navigation, communications, data collection and distribution, and aviation economics.

1.9.3.4 Center of Excellence for Airport Pavement Research

The Center of Excellence for Airport Pavement Research was established with the University of Illinois (Urbana-Champaign) in April 1995 and is supported by Northwestern University. Pavement research focuses on new technologies to handle the estimated stress loads foreseen in the next generation of high-volume, commercial aircraft. The COE also supports the test design and analysis work at the FAA's Pavement Test Facility at the William J. Hughes Technical Center.

1.9.4 International Activity

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

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

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

The FAA is also working with the Joint Aviation Authorities and Transport Canada Civil Aviation to encourage international cooperation in identifying and developing technologies needed to support safety regulatory activity. The pilot program, begun in FY2000, is designed to encourage technical cooperation in limited areas through exchange of information. Continued airworthiness and regulatory concerns, exchange of information among the research communities on safety-related research, and identifying areas for collaborative research will focus initially on cabin safety, flight deck human factors, and aircraft icing issues. The agency also shares software, as controlled by FAA Order 1370.85, Software Release.

1.10 Long-Term Research

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

Of the $124M requested for R,E&D efforts in FY 2003, 27% of these funds are earmarked for long-term research, with the remainder devoted to developmental/near-term efforts. The $100M FY 2004 congressional budget submission for R,E&D designates 29% of the total request for long-term research. These percentages satisfy the agency's congressional mandate for conducting long-term research.

The "long range view" section concluding each program area description in the 2003 NARP provides insight into technologies that have been selected to be supported through long-term research.

2.1 Aviation Safety Research and Development Program Area Description

Mission

The unifying mission of the FAA Aviation Safety R&D Program Area is to support the agency's Safety Goal: "*By 2007, reduce U.S. aviation fatal accident rates by 80% from 1996 levels.*"

Figure 2.1-1 indicates the percentage of the total requested FY 2004 R&D funding that will be devoted to the support of Aviation Safety research.

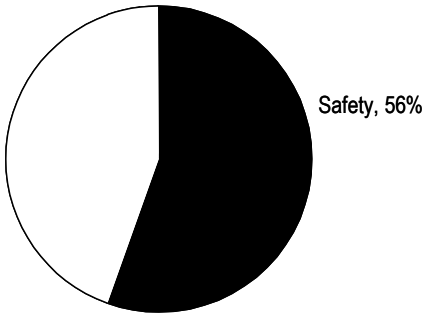

Figure 2.1-1: Percentage of Total FY 04 R&D Funding Supporting FAA Aviation Safety Goal

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

Program Area Structure

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

- Aviation Weather Safety Research *
  - Model Development and Enhancement
  - Next-Generation Weather Radar
  - Turbulence
  - Icing
  - National Ceiling and Visibility (C&V)
  - Winter Weather
- Advanced Technology Development and Prototyping **
  - Runway Incursion Reduction
  - General Aviation and Vertical Flight Technology (GA&VF)
  - NAS Safety Assessments
- Safe Flight 21**
  - Alaska Capstone
- Safer Skies **
- Aircraft Safety *
  - Fire Research and Safety
  - Propulsion and Fuel Systems
  - Advanced Materials/Structural Safety
  - Flight Safety/Atmospheric Hazards Research
  - Aging Aircraft
  - Aircraft Catastrophic Failure Prevention Research
  - Aviation Safety Risk Analysis
- Airports Technology ***
  - Post-Crash Rescue and Firefighting
  - Visual Guidance Systems
  - Surface Traction
  - Runway Incursions
  - Wildlife Control and Hazard Mitigation
- Commercial Space Transportation Safety ****
  - Space Transportation Vehicle Safety
  - Space Transportation Infrastructure
  - Space and Air Traffic Management Systems
  - Human Spaceflight Safety
- Human Factors and Aerospace Medicine *
  - Flight Deck/Maintenance/System Integration Human Factors
  - Air Traffic Control/Airway Facilities Human Factors
  - Aeromedical Research

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

Program Challenges and Strategies

The 2002 *FAA R&D Strategy* provides a conceptual framework that ties the work of the agency's R&D projects to the accomplishment of FAA strategic goals. Section 1.0 of this Plan, "FAA R&D Program Overview," provides a brief discussion of the relationship of high-level program goals (derived from the agency's strategic goals), through-specific challenges and strategies, down to the level of related project results. Table 2.1-1, adapted from the 2002 *FAA R&D Strategy*, outlines the current long-term planning structure for the Aviation Safety program area.

R&D Challenges	R&D Strategies
Derived Goal: Reduce the occurrence of aviation system accidents due to new or previously unrecognized causal factors.	
Safety Information Sharing and Analysis *– Develop and apply data and analytical tools for use by FAA and industry in identifying potential accident causes and developing effective safety programs and countermeasures.*	(1) Develop and apply data systems and risk management and decision support tools and methodologies to monitor and analyze aviation system operations and safety risks. (2) Develop broadened understanding of biomedical, toxicological, and human performance factors that can contribute to accidents.
System Safety and Risk Management *– Develop and apply knowledge and analytical tools to assess the safety implications of innovative technologies and operational procedures planned or proposed for implementation in the airspace system.*	(1) Develop tools to support the creation and introduction of high confidence software and systems in safety-critical NAS functions and aircraft avionics. (2) Assess and address the safety implications of new composites, alloys and other materials, and associated structures and fabrication techniques. (3) Assess and develop responses to the safety implications of evolving operational procedures and practices, including measures to enhance aviation security.
Derived Goal: Reduce the recurrence of aviation accidents due to known risk or causal factors.	
Hazards of the Flight Environment *– Characterize potential hazards of the flight environment and develop the knowledge base and technologies needed to eliminate or reduce those hazards.*	(1) Improve understanding, predictability and ability to deal with adverse weather, icing conditions, and other atmospheric hazards, and improve the delivery of weather products to pilots and aircrews. (2) Develop guidance concerning flight hazards associated with electromagnetic fields.
Failures of Aircraft Structures and Systems *– Develop knowledge, criteria, tools, technologies, and practices to improve reliability and prevent or reduce failures of aircraft structures systems.*	(1) Develop improvements in aircraft fuel tank explosion protection. (2) Develop knowledge, inspection tools, techniques, and strategies to address safety hazards associated with the aging of airframe structures, engine components, and mechanical and electrical systems. (3) Assess the use of improved processing and manufacturing techniques for critical engine components to eliminate engine failures. (4) Assess the use of advanced materials to protect aircraft critical systems and passengers in the event of catastrophic engine failures. (5) Assess the safety implications of changes to aviation fuels used for both commercial and general aviation.

Table 2.1-1: Goals, Challenges & Strategies – Aviation Safety R&D Program Area

R&D Challenges	R&D Strategies
Human Performance *– Develop knowledge, guidance, and standards to improve the performance and to structure the roles and working environments of the people who play critical roles in aviation safety.*	Develop knowledge, guidance and standards for: (1) Design and use of automated support systems (2) Personnel selection and training (3) Human performance assessment. (4) Information management and display (5) Bioaeronautical factors
Terminal Area Safety *– Develop technologies and evaluate strategies to increase pilot and controller situational awareness in the terminal area, reduce wildlife interactions, and assure compatibility of airport designs and infrastructure with new types of aircraft.*	(1) Develop technology and standards to increase pilot and controller awareness of potential runway incursions and other hazards. (2) Conduct evaluations and assessments of means to reduce birdstrike and other wildlife-related risks. (3) Conduct tests and analyses to assure compatibility of airport design with new larger aircraft.
Safety of Expendable and Reusable Launch Vehicles *– Determine best practices for commercial space transportation operations, develop criteria for assessing the safety of RLVs.*	(1) Assess non-traditional flight safety systems and integrated vehicle health systems. (2) Assess inspection techniques for thermally-protected commercial space vehicles. (3) Develop and calibrate launch and reentry vehicles hazard model. (4) Assess medical and equipment criteria for human spaceflight.
Derived Goal: Increase the survivability of aviation system accidents.	
Aircraft Fire Safety *– Develop standards and specifications for fire-resistant materials used in aircraft.*	(1) Develop materials and standards to increase aircraft fire resistance. (2) Develop improved fire detection and fire suppression systems.
Aircraft Crashworthiness and Crash Survival *– Develop knowledge, tools, and standards to improve the crashworthiness of aircraft structures and systems and the effectiveness of evacuation procedures.*	(1) Develop knowledge, tools, and standards to improve the crash characteristics of aircraft structures and systems. (2) Develop knowledge, design and procedural guidelines to enhance the effectiveness, speed, and safety of aircraft evacuation.
Airport Crash Response Capabilities *– Develop knowledge, tools, standards, information, and guidance to support regulatory actions and improved operational practices related to post-crash response to accidents.*	(1) Develop knowledge, tools, and standards to improve airport rescue and fire-fighting efforts. (2) Test and evaluate improved firefighting systems for use in controlling both external and internal cabin fires, and develop new methods, procedures, and chemicals to fight fires in future aircraft that use advanced materials.
Derived Goal: Prevent successful attacks on the integrity and availability of critical NAS information systems.	
Protection of NAS Information Infrastructure *– Develop the technological foundation for incorporation of high-performance cyberspace technology and procedures into the existing NAS and at the design level for new NAS elements.* This derived goal recognizes the need to prevent attacks upon the integrity and availability of all critical NAS information systems and the software on which they are based.	(1) Develop high-performance intrusion protection, detection and response capabilities for incorporation into the NAS. (2) Develop and incorporate into the NAS architectural approaches and improved cyber security capabilities design and modernization process. (3) Develop and evolve technologies to enhance reliability, integrity and confidentiality of wireless communications in the air-ground mobile environment.

Table 2.1-1 (Continued): Goals, Challenges & Strategies – Aviation Safety R&D Program Area

R&D Challenges	R&D Strategies
	(4) Undertake collaborative R&D with DoD, NSF, NASA, and others to identify new and emerging technologies that can be employed to reduce the risks to the integrity and availability of critical systems and data. (5) Conduct research to enhance the protection of GPS from unintentional or intentional interference.
Derived Goal: Prevent adverse health impact on air passengers and flight crews.	
Cabin Environment Health Impacts *– Develop understanding of health risks in the cabin environment sufficient to assess the need for remedial actions and provide the scientific basis for developing them.*	Develop knowledge, recommendations, and guidelines to minimize health risks to cabin occupants and aerospace crews and assure health maintenance of cabin occupants with respect to possible hazards, including poor air quality, disease transmission, cosmic and other radiation, and sudden decompression.

Table 2.1-1 (Continued): Goals, Challenges & Strategies – Aviation Safety R&D Program Area

Program Area Outputs

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

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

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

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

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

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

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

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

FAA/NASA Collaborative R&D (Safety)

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

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

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

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

- **Accident Precursor Identification and Safety Risk Management**—Accidents rarely have a single cause. The detection and mitigation of anomalous operating conditions can actually avoid many accidents. Jointly, the FAA and NASA are working to develop the Aviation Performance Measurement System (APMS) to help all segments of the aviation community achieve safety improvements from normally collected data.
- **Accident Prevention**—Together with DOD, the FAA and NASA are working to improve the effectiveness of their long-term commitment to aircraft safety. The FAA is working closely with industry in aviation safety areas including the improvement of propulsion and fuel systems, the prevention of aircraft catastrophic failure, the elimination or containment of in-flight fires, and the creation of safer airport materials and systems. NASA research is developing new technologies to afford better visibility to pilots and flight crews experiencing adverse conditions, to improve the overall health of pilots and crews, and to allow pilots to maintain control of their aircraft when engines or systems fail in flight.
- **Accident Mitigation**—When aviation accidents do occur, their effects can be lessened through attention to factors such as aircraft crashworthiness, occupant protection, fire safety, evacuation equipment and procedures, and airport emergency services. The FAA is conducting detailed and innovative aeromedical research to improve the chances that more passengers and crew members will survive aviation accidents. The agency also works to improve airport systems to provide better materials, methods and equipment to increase survival rates. NASA partners with the FAA on research to improve the structural crashworthiness and the fire resistance of aircraft and fuels.

Intended Outcomes

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

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

The Advanced Technology Development and Prototyping programs listed in the "Structure" section of this Program Area Description are associated in the current *FAA Capital Investment Plan* (CIP) with the achievement of the FAA Safety Goal. These programs develop technologies with high potential to reduce air carrier fatality rates, general aviation fatality rates, operational errors, and runway incursions.

Benefits derived from the Aircraft Safety Program include: the improved safety of aging aircraft; the prevention of catastrophic failure; the promotion of flight safety and reduction of the effects of atmospheric hazards; the improved safety of aircraft pro-

pulsion and fuel systems; the reduction of risk from aviation-related fires; the promotion of safer aviation materials and structures; and the improved risk assessment of aircraft, safety performance measurement, and the sharing of safety-related data.

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

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

The activities of the Information Security and Technology Program research activities are intended to improve the safety of the flying public, to better protect the nation's critical infrastructure, and to enable uninterrupted operations of FAA systems through the identification and development of available, emerging data technologies and the establishment of procedures for the optimal implementation and use of resulting systems.

The Safe Flight 21 Alaska Capstone Program is an excellent example of an FAA research project designed to demonstrate, validate, and implement advanced information handling technologies in a real world operational context.

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

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

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

Long-Range View

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

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

The Safe Flight 21 Program is intended to take a short- to medium-range approach to the validation of specific technological concepts with high potential to increase NAS efficiency and safety.

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

Commercial space transportation is a research-oriented concern of government and industry. As

space traffic continues to increase, the need for safety and safety-related research will continue indefinitely. Research in space safety must be continued to clarify the impact of technology changes on current regulatory and operational practices.

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

In the future, Human Factors research programs will continue to be directed at targets that have the greatest impact on aviation safety. They will be multi-year efforts requiring stabilized resources to plan, execute, and complete. In particular, new human-system performance measurement strategies will be developed to ensure that the envelope of human performance capabilities and limitations is commensurate with intended safety benefits of new systems, procedures and training.

The Aviation Medicine program will continue to emphasize the mitigation of accidents and reduction in the severity of injuries encountered in events such as the precautionary evacuation of passengers from an aircraft. Also, aeromedical research will be increasingly necessary to proactively interpret data derived from around the world and to assess whether the data are adequate and appropriate to use in support of regulatory and other actions.

WEATHER PROGRAM - SAFETY

GOALS:

Intended Outcomes: The FAA intends to provide weather observations, warnings, and forecasts that are more accurate, accessible, and efficient than existing services. These upgrades will enhance flight safety, reduce air traffic controller and pilot workload, improve flight planning, increase productivity, and enhance situational awareness. These efforts will also provide efficiency and capacity benefits.

The weather program directly supports the FAA Strategic Goal in the performance area of Safety: "Through research, identify methods that, when implemented would reduce the fatal accident rate, due to weather."

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

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

Agency Outputs: The weather program focuses on conducting applied research to solve operational problems through the development of new and improved weather algorithms. The algorithms are being developed for implementation on appropriate National Airspace System (NAS) platforms (including the weather and radar processor, the integrated terminal weather system), and on NWS systems. The algorithms also continue to be transferred to private weather service companies in support of the NAS. This transfer of technology enables industry to derive specialized aviation weather products from FAA research efforts. Algorithm development provides capabilities for dissemination to aviation weather users in support of air traffic control automation tools including:

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

Customer/Stakeholder Involvement: The weather research priorities and plans are consistent with user needs. The program works in concert with the Aerospace Weather Policy and Standards Staff (ARS), and Flight Standards (AFS) to derive research projects and priorities from the interagency National Aviation Weather Initiatives (1999), merged with other NAS drivers, such as "Safer Skies," free-flight implementation and the NAS operational concept documents. The weather program continually revalidates these priorities and plans by giving briefings in public forums such as the annual National Business Aircraft Association conference to the Friends/Partners in Aviation Weather Forum.

The weather program has also analyzed aviation weather service users' needs and requirements found in the Aviation Safety Action Plan. Additionally, it has addressed industry recommendations and requirements found in several related documents and publications.

Accomplishments: The following represent major accomplishments of the weather program:

- Completed rapid update cycle analyses and forecasts with capability to provide more accurate and higher resolution upper winds, temperature, and moisture data. Use of more accurate data on hazardous weather enhances safety.
- Issued the first-ever forecast of freezing precipitation aloft at the aviation weather center in Kansas City in response to FAA-proposed rulemaking for turboprops flying into conditions conducive to in-flight icing. These forecasts have increased airspace efficiency, aircraft utilization, and safety, especially for commuter aircraft.
- Completed a national convective weather forecast product that provides a one-hour forecast of convec-

tive weather that will impact NAS operations; the product was implemented operationally in March 2002.

- Completed upgrades to Next-Generation Weather Radar (NEXRAD) algorithms, storm cell identification and tracking, hail detection, and mesocyclone and tornado detection (leveraged with NWS). These upgrades have enabled better definition of location, timing, and severity of convective weather hazards resulting in enhanced flight safety.
- Transferred Weather Support to Deicing Decision Making (WSDDM) system technology to a commercial weather provider to provide ground deicing decision making information to airlines, airports and cities. WSDDM system information has resulted in increased safety (at time of takeoff) cost savings in use of deicing fluids/associated equipment/ personnel, and efficiencies in runway and off-airport plowing/ departures/arrivals. Awarded 1999 Government Technology Leadership Award.
- Enhanced the Aviation Digital Data Service (ADDS) via the implementation of a flight path tool depicting vertical cross sections of weather along user-specified flight routes. This tool is providing benefit to users, especially general aviation. Awarded 2000 Government Technology Leadership Award.
- Current icing potential product providing current in-flight icing conditions that will impact NAS operations declared operational by a joint FAA/NWS board in Dec. 2001.

R&D Partnerships: As required by the Federal Aviation Act of 1958, as amended, the FAA cooperates with the Department of Commerce in promoting and developing meteorological science, and in fostering support of research projects through the use of private and governmental research facilities. These duties are further amplified by recommendations contained in the National Aviation Weather Initiatives (1999), prepared by the Joint Action Group for Aviation Weather for the National Aviation Weather Program Council of the Office of the Federal Coordinator for Meteorology, and the final report of the Weather Joint Services Implementation Team (2000).

In addition to its partnerships with the FAA's Aviation Weather Policy and Standards Staff and Flight Standards, weather research activities are closely coordinated and leveraged with industry, academia, and other government agencies. This is done directly through inter-agency agreements, university grants and Memorandums of Agreement (MOAs). Principal partners include: the National Center for Atmospheric Research; NOAA's Forecast Systems Laboratory, Environmental Technology Laboratory, and National Severe Storms Laboratory; Massachusetts Institute of Technology's Lincoln Laboratory; NWS's Aviation Weather Center and Environmental Modeling Center; the Center for Wind, Ice, and Fog Research at the Mount Washington Observatory; NASA Dryden, Langley and Glenn; the Office of Naval Research; the U.S. Army Cold Regions Research and Engineering Laboratory; UPS; and several universities, airlines, port authorities, and cities.

Research results are transferred to the private sector via cooperative research and development agreements with DynCorp, DTN, WSI, Harris, Sonalyst, Freese-Notis, and TAP Publishing.

MAJOR ACTIVITIES AND ANTICIPATED FY 2003 ACCOMPLISHMENTS:

- Obtained FAA approval for an icing forecast algorithm for operational use.
- Obtained FAA approval for a turbulence forecasting algorithm for operational use.
- Tested two-hour regional convective weather forecast for corridor integrated weather system (CIWS) with growth and decay techniques.
- Implemented AWRP products on AWC testbed and operational servers.
- Completed development of "Web WSDDM" system.
- Completed testing of real-time radar mosaics for Corridor Integrated Weather System (CIWS) regions.
- Distributed research quality weather research & forecast (WRF) model to users.
- Evaluated preliminary National C&V forecast system.

KEY FY 2004 PRODUCTS AND MILESTONES:

- Test terminal-scale icing diagnosis techniques in field program.
- Conduct rapid prototyping of weather products for TMUs.
- Enhance turbulence forecasts to include convectively-induced and mountain wave turbulence.

- Complete development of 2-4 hour freezing precipitation forecast.
- Implement WRF model at NWS.
- Develop 3-D gridded multi-radar algorithm for NEXRAD.
- National C&V forecast approved by FAA board for experimental use.

FY 2004 PROGRAM REQUEST:

ONGOING ACTIVITIES

- Develop new algorithms for improved forecasts of freezing drizzle aloft.
- Integrate terminal, regional, and national convective weather forecast capability. Continue to develop automated data analysis and assimilation techniques.
- Complete evaluation of oceanic convective diagnosis product.
- Implement visibility nowcast product as part of northeast corridor efforts for Terminal C&V program.
- Transition weather research products to operations in the NWS, the FAA, and industry automation and weather systems.

NEW INITIATIVES

No new initiatives are planned in FY 2004.

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2002)	$ 175,930
FY 2003 Request	19,334
FY 2004 Request	20,852
Out-Year Planning Levels (FY 2005-2008)	86,150
Total	$ 302,266

Budget Authority ($000)	FY 2000 Enacted	FY 2001 Enacted	FY 2002 Enacted	FY 2003 Request	FY 2004 Request
Contracts:					
Weather Program - Safety	11,896	17,134	12,662	18,435	19,195
Personnel Costs	450	504	826	819	1,524
Other In-house Costs	26	62	275	80	133
Total	**12,372**	**17,700**	**13,763**	**19,334**	**20,852**

OMB Circular A-11, Conduct of Research and Development ($000)	FY 2000 Enacted	FY 2001 Enacted	FY 2002 Enacted	FY 2003 Request	FY 2004 Request
Basic	0	0	0	0	0
Applied	12,372	17,700	13,763	19,334	20,852
Development (includes prototypes)	0	0	0	0	0
Total	**12,372**	**17,700**	**13,763**	**19,334**	**20,852**

A11k – Weather Program –Safety Products and Activities	FY 2004 Request ($000)	Program Schedule					
		FY 2003	FY 2004	FY 2005	FY 2006	FY 2007	FY2008
041-110 Aviation Weather Analysis and Forecasting							
In-flight Icing	$2,935						
Icing Forecast Algorithm Approved by FAA for Operational Use		◆					
Automated Icing Intensity Info Delivered for Experimental Use		◆					
Test Terminal-Scale Icing Diag. Techniques in Field Program			◇				
Alaska Icing Algorithms Approved for Operational Use				◇			
Icing Algorithms with Icing Severity Approved for Operational Use					◇		
NEXRAD Algorithms	$564						
Completed Testing of Real-Time 3-D Mosaic Radar for CIWS Regions		◆					
Develop 3-D Gridded Multi-Radar Algorithms			◇				
Aviation Forecast & Quality Assessment	$2,337						
Implemented AERP Products on AWC Testbed and Operational Servers		◆					
Conduct Rapid Prototyping of WX Products for TMUs			◇				
Model Development and Enhancement	$2,114						
Distributed Research Quality WRF to Users		◆					
Operational implementation of WRF Model at NWS			◇				
Winter Weather Research	$728						
Completed Development of "Web WSDDM" System		◆					
Complete Development of 2-4 hr. Freezing Precip Forecast			◇				
Turbulence	$1,883						
Turbulence Forecasting Algorithm Approved by FAA for Operational Use		◆					
Enhance Turbulence Forecasts to Include Convectively-Induced and Mountain Wave Turbulence			◇				
National Ceiling and Visibility	$1,642						
Evaluated Preliminary National C&V Forecast System		◆					
National C&V Forecast Approved by FAA Board for Experimental Use			◇				
Ceiling, Visibility and Flight Category Products Approved for Operational Use					◇		
Convective Weather	$4,386						
Tested 2-hr reg. Conv Wx for CNS with Growth & Decay		◆					
Integrate Terminal, National, Regional Conv Wx Forecast Capability			◇				
4-Hour Terminal Forecast Product Approved for Operational Use							◇
Terminal Ceiling and Visibility	$1,549						
Implement Visibility Nowcast product			◇				
Oceanic Weather	$1,057						
Completed Evaluation of Oceanic Cloud Top Height Products		◆					
Complete Evaluation of Oceanic Convective Diagnosis Product			◇				
Turb. (Clear Air) forecast Product Approved for Operational Use						◇	
Personnel and Other In-House Costs	$1,657						
Total Budget Authority	$20,852	$19,334	$20,852	$21,030	$21,483	$21,613	$22,024

Note: **Out year numbers are for planning purposes only. Actual funding needs will be determined through the annual budget process.**

RUNWAY INCURSION REDUCTION

GOALS:

Intended Outcomes: With the Runway Incursion Reduction Program (RIRP), the FAA intends to develop technologies and other solutions that minimize the chance of injury, death and damage, or loss of property due to runway accidents or incidents within the civil aviation system. Key to achieving this objective is reducing the incidence of runway incursions in the NAS. To that end, current program initiatives are aimed at discovering and developing technologies that increase pilot/controller situational awareness.

Selected runway incursion reduction technologies will be evaluated in an operational setting to validate technical performance and operational suitability. Upon completion of these evaluations, system technical data packages will be prepared to support program implementation decisions.

Agency Outputs:

- Specification and qualification of low-cost airport surface detection equipment.
- Specification and qualification of airport surface visual guidance products to be integrated with airport surface detection equipment.
- Non-technology solutions such as improved airport markings/signage, education, training, and advisory circulars.

Customer/Stakeholder Involvement: The Air Traffic Requirements Office has been actively developing requirements to meet the objective of reducing runway incursions. Additionally, the FAA Administrator has made reducing runway incursion a priority within the agency. Reducing runway incursions is second on the National Transportation Safety Board's (NTSB) "Most Wanted" list of safety improvements.

Accomplishments: The following R&D projects were accomplished in FY 2002:

- Completed installation of an Airport Surface Detection Equipment Model X (ASDE-X) pre-production multilateration system, including a multi-sensor data processor and three displays, at Dallas-Ft. Worth (DFW).
- Installed displays and communication lines at the DFW Airport Authority, American Airlines ramp tower and operations center, and Delta Airlines ramp tower, to provide filtered radar ground traffic information at these locations.
- Completed six demonstrations of low cost technologies based on the Broad Agency Announcement contracts awarded in FY 2001 and pursued follow on efforts in two technology areas (ground markers and electronic message boards).

R&D Partnerships:

- Memorandum of agreement (MOA) with DFW Airport Authority to upgrade the facility's multilateration surface test bed to support an improved surveillance capability and facilitate continued runway safety application development.
- R&D project agreement with MIT Lincoln Laboratory (MITLL) to develop an automated system of runway status lights (RWSL).
- General working agreement with Volpe National Transportation Systems Center (VNTSC) for research and development of various surface technology projects.

MAJOR ACTIVITIES AND ANTICIPATED FY 2003 ACCOMPLISHMENTS:

- Completed RWSL shadow operations testing at DFW, and generated report with recommendations to stakeholders.
- Completed installation of selected technology tools at one high runway incursion airport.
- Completed demonstration of laser technology at Anchorage, Alaska airport.

KEY FY 2004 PRODUCTS AND MILESTONES

- Conduct demonstrations of technology tools at one high runway incursion airport.
- Conduct RWSL demonstration and operational evaluation at DFW.
- Implement Runway Safety Blueprint initiatives – including controller training, simulator/markings, an education and awareness program, technology continuations, human factors studies, and industry conferences.

FY 2004 PROGRAM REQUEST:

In FY 2004, funding will provide for:

- Continuation of ongoing technology demonstration and evaluation efforts in preparation for sponsor decisions.

- Demonstration and operational evaluation of RWSL, with related analysis of results and findings.
- Sharing of surface traffic information among air traffic controllers, pilots, and vehicle operators at selected sites.
- Development of simulation tools for training, modeling, and measuring improvements/impacts of technology on runway safety.
- Conduct of education, training, and awareness programs.

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2002)	$22,368
FY 2003 Request	6,700
FY 2004 Request	8,200
Out-Year Planning Levels (FY 2005-2008)	25,300
Total	$62,568

Budget Authority ($000)	FY 2000 Enacted	FY 2001 Enacted	FY 2002 Enacted	FY 2003 Request	FY 2004 Request
Contracts:					
Runway Incursion Reduction	2,000	11,500	5,700	6,700	8,200
Personnel Costs	0	0	0	0	0
Other In-house Costs	0	0	0	0	0
Total	**2,000**	**11,500**	**5,700**	**6,700**	**8,200**

OMB Circular A-11, Conduct of Research and Development ($000)	FY 2000 Enacted	FY 2001 Enacted	FY 2002 Enacted	FY 2003 Request	FY 2004 Request
Basic	0	0	0	0	0
Applied	0	0	0	0	0
Development (includes prototypes)	2,000	11,500	5,700	6,700	8,200
Total	**2,000**	**11,500**	**5,700**	**6,700**	**8,200**

Runway Incursion Reduction Products and Activities	FY 2004 Request ($000)	Program Schedule					
		FY 2003	FY 2004	FY 2005	FY 2006	FY 2007	FY2008
Runway Incursion Reduction	$8,200						
Runway Incursion Reduction Plan							
Develop Procedures		◆	◇	◇	◇	◇	◇
Dallas-Ft. Worth (DFW) Test Bed							
Installation of Test Bed		◆					
Upgrade of Test Bed			◇				
Runway Status Lights (RWSL)							
Conduct Engineering Tests			◇				
Conduct Shadow Operations			◇				
Install RWSL at DFW				◇			
Conduct Operational Evaluations				◇			
Conduct 6 BAAA Technology Demos		◆					
Continue R&D on Low Cost Techs							
Install at Selected Sites			◇				
Conduct Operational Evaluations				◇			
Flashing PAPI							
Proof of Concept Demo		◆					
Total Budget Authority	$8,200	$6,700	$8,200	$9,100	$6,300	$4,900	$5,000

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.

GENERAL AVIATION AND VERTICAL FLIGHT TECHNOLOGY (GA&VF)

GOALS:

Intended Outcomes: The General Aviation and Vertical Flight (GA&VF) Technology Program supports general aviation (GA) requirements for communications, navigation, surveillance (CNS) and avionics technologies through applied research and development. Resulting technologies, and associated implementation standards and regulations support cost-effective air traffic services, improve safety, and expand NAS capacity and efficiency – especially where CNS services are not currently available to GA users. GA&VF Technology Program products are integral to NAS modernization.

The GA&VF Technology Program supports research and development across the full spectrum of GA operations. The program's 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 to enable simultaneous non-interfering (SNI) operations between fixed-wing and vertical flight aircraft.

Development of new terminal instrument procedures (TERPS) criteria for GA and vertical flight aircraft based upon aircraft and avionics performance and new CNS capabilities will improve safety and efficiency and enable aviation services to be provided in new locations. Low-altitude CNS research develops critical data and enables evaluations of future low-altitude en route infrastructure to support Free Flight. These efforts are interrelated and support mutual requirements without duplication or added costs.

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

The program engages in a range of activities related to fixed-wing GA and vertical flight instrument flight rules (IFR) as well as to visual flight rules (VFR) procedures, pilot situation awareness, and infrastructure. It creates the following types of products:

Terminal Airspace

Criteria and design parameters for instrument approaches to hospital, corporate, and business district heliports. This development effort supports TERPS criteria, aircraft and avionics certification standards, IFR operations, emergency medical service (EMS) procedures and training guidance, as well as minimum aviation system performance standards (MASPS), minimum operational performance standards (MOPS), and technical standard orders (TSO).

Low Altitude Air Routes

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

Avionics and Cockpit Technology

Avionics, auxiliary equipment, procedures, and related testing to enable the safe, efficient integration of GA and vertical flight aircraft into the NAS. These efforts have become particularly important with the introduction of GPS-based navigation, landing and surveillance systems, and related work under the Free Flight initiative, and the Safer Skies initiative.

Low Altitude CNS Infrastructure

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

Homeland Security

The GA&VF Technology Program is responsive to Homeland Security initiatives through feasibility assessments of concepts and procedures related to GA and vertical flight aircraft operations, related avionics and security equipment requirements.

Customer/Stakeholder Involvement: The GA&VF Technology Program directly supports goals and programs delineated in Challenge 2000, the *Aviation Safety Action Plan*, the RTCA *Free Flight Action Plan*, Operation Evolution Plan, Terminal Area Operations Advisory Committee requirements and NAS architecture development. The program emphasizes direct needs related to light general aviation airplanes, helicopters and tiltrotors. Stakeholders include:

- Helicopter Association International (HAI)
- American Helicopter Society (AHS)
- National Business Aircraft Association (NBAA)
- Experimental Aircraft Association (EAA)
- Aircraft Owners and Pilots Association (AOPA)
- General Aviation Manufacturers Association (GAMA)
- Small Aircraft Manufactures Association (SAMA)
- National Association of State Aviation Officials (NASAO)
- Association of Aeronautical Medical Services
- National Emergency Medical Services Pilots Association
- Airborne Law Enforcement Association

Accomplishments:

- Completed evaluation of current technology to support precision IFR approaches to heliports and vertiports.
- Developed vertical flight satellite navigation (SATNAV) road map.
- 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.
- Developed a strategic plan and operations concept for vertical flight operations using advanced technology.
- Established criteria for the publication of mountain pass waypoints on VFR charts.
- Completed first and second phases of testing and data collection to support helicopter instrument landing system (ILS) approaches to lower minimum weather conditions.
- Completed a report on procedures for providing enhanced services for time critical (e.g., law enforcement or emergency medical services) VFR vertical flight operations.
- Developed enhanced rotorcraft specific guidance for instrument operations and for offshore operations. The guidance was published in the Aeronautical Information Manual and, internationally, in the Aeronautical Information Publication.

R&D Partnerships: Historically, the GA&VF Technology Program has maintained a unique R&D collaboration with industry. Projects requiring use of various types of aircraft or pilot experience levels are accomplished through industry partnerships. Where feasible, industry participates in review of test specifications and frequently provides pilots with required experience levels for experiments. This enables development of standards and criteria that reflect realistic industry performance capabilities.

MAJOR ACTIVITIES AND ANTICIPATED FY 2003 ACCOMPLISHMENTS:

- Completed testing and analysis to support helicopter ILS approaches to lower minimum weather conditions.
- Conducted tests to address human factors issues related to flying precision VFR (PVFR) routes
- Initiated simulation of northeast helicopter routes to determine benefits of route width reduction. Complete initial design of SNI routes in the northeast corridor.
- Completed an evaluation of helicopter performance through flight tests and data analysis to define aircraft performance and avionics requirements for steep angle approaches to heliports.
- Completed a report on standards for CFR Part 135 operators and Flight Standards Inspectors to use in developing and approving non-radar surveillance systems as a component of a flight locating system as required by CFR Part 135.79.
- Initiated research into lighting concepts and technology for IFR and VFR operations at heliports.

KEY FY 2004 PRODUCTS AND MILESTONES:

- Establish SNI Industry/FAA partnership for SNI demonstration in the northeast corridor. Initiate tests and demonstration of vertical flight and light general aviation SNI routes in the northeast corridor.
- Complete PVFR route criteria including advisory circular and FAA handbook development.
- Complete simulation of northeast helicopter routes to determine benefits of route width reduction. Complete initial design of SNI routes in the northeast corridor.
- Initiate development of heliport IFR steep angle approach, missed approach, and departure standards for helicopters and tiltrotor aircraft.

- Conduct tests and demonstration of proposed new lighting technologies for IFR and VFR operations at heliports.
- Develop advisory circular and Flight Standards Inspector Handbook information for GPS based devices to reduce controlled flight into terrain (CFIT) and enhanced vision technology.

FY 2004 PROGRAM REQUEST:

In FY 2004, the program continues to focus on the areas listed in the GOALS section above. Specific areas are SNI operations in the terminal area, precision approaches to heliports, heliport lighting, and reduction of CFIT for light general aviation aircraft and vertical flight aircraft.

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2002)	$5,302
FY 2003 Request	1,000
FY 2004 Request	1,400
Out-Year Planning Levels (FY 2005-2008)	7,000
Total	$14,702

Budget Authority ($000)	FY 2000 Enacted	FY 2001 Enacted	FY 2002 Enacted	FY 2003 Request	FY 2004 Request
Contracts:					
General Aviation and Vertical Flight Technology Program	500	900	1,000	1,000	1,400
Personnel Costs		0	0	0	0
Other In-house Costs		0	0	0	0
Total	**500**	**900**	**1,000**	**1,000**	**1,400**

OMB Circular A-11, Conduct of Research and Development ($000)	FY 2000 Enacted	FY 2001 Enacted	FY 2002 Enacted	FY 2003 Request	FY 2004 Request
Basic	0	0	0	0	0
Applied	0	0	0	0	0
Development (includes prototypes)	500	900	1,000	1,000	1,400
Total	**500**	**900**	**1,000**	**1,000**	**1,400**

General Aviation and Vertical Flight Technology Program Products and Activities	FY 2004 Request ($000)	Program Schedule					
		FY 2003	FY 2004	FY 2005	FY 2006	FY 2007	FY2008
Simultaneous Non Interfering Operations	$600						
Precision VFR Route Testing and Analysis		◆	◇				
Northeast Corridor (NEC) Using Existing Standards			◇	◇			
NEC Simulation/Modeling for Separation Standards Reduction		◆	◇				
NEC Simulation/Modeling for WAAS/LAAS Standards			◇	◇			
NEC Demonstration with WAAS/LAAS Standards				◇	◇	◇	◇
Recommendation for WAAS/LAAS SNI National Development						◇	
Instrument Operations at Heliports/Vertiports	$400						
Copter ILS Lighting Simulation, Test and Evaluation		◆					
Heliport IFR/VFR Lighting Research, Design, Test and Demonstration		◆	◇	◇	◇		
Helicopter Performance/Instrumentation for Heliport Approaches		◆					
Helicopter/Tiltrotor criteria for Steep Angle Approaches			◇	◇	◇	◇	
Helicopter/Tiltrotor criteria for Complex Approaches				◇	◇	◇	◇
Advanced Technology and Procedures Applications	$400						
Non Radar Surveillance For CFR Part 135.79 Flight Locating		◆					
Surveillance Options for Light GA Aircraft Pilot Guidance				◇	◇		
Enhanced Vision for Light GA Aircraft Pilot and Inspector Guidance			◇	◇	◇		
Copter CFIT GPWS/TAWS Pilot and Inspector Guidance			◇				
Copter/Light GA Synthetic Displays Pilot and Inspector Guidance				◇	◇	◇	◇
Improve Weather Distribution in the Gulf of Mexico					◇	◇	◇
Homeland Security							
Analysis of Options for GAVF Support of Homeland Security				◇	◇	◇	◇
Total Budget Authority	$1,400	$1,000	$1,400	$1,500	$1,500	$2,000	$2,000

Notes:

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NAS SAFETY ASSESSMENTS

GOALS:

Intended Outcomes: Safety Risk Management (SRM) research focuses on establishing an integrated safety risk management process for the NAS Modernization program. The safety risk management process facilitates the management of system safety activities, training of safety professionals, and execution of the safety risk management process for the FAA National Airspace System (NAS). Implementation of the SRM provides the following benefits to the NAS:

- Provides a consistent and well defined system safety methodology and terminology for application across programs.
- Provides guidance and training for new safety engineers to improve overall quality and technical accuracy of safety analyses.
- Provides a framework for definition and communication of residual risk to decision-makers.

Agency Outputs: The SRM process establishes and defines the FAA's plan for ensuring that system safety is effectively integrated into the NAS modernization program. Together the System Safety Management Plan (SSMP) and the individual program's System Safety Program Plan (SSPP) ensures execution of safety risk management throughout the entire program's life cycle and establishes a disciplined system engineering based methodology to achieve the safety risk management objectives in FAA orders and AMS policy. To achieve this, the following products will be produced:

- NAS Modernization System Safety Working Group Program Plan (NMSSWGPP)
- Integrated Safety Engineering Environment (ISEE) tool
- Hazard Tracking and Risk Resolution (HTTR) tool

MAJOR ACTIVITIES AND ANTICIPATED FY 2003 ACCOMPLISHMENTS:

The NMSSWGPP will establish the members' roles and responsibilities, standard operating procedures, and interfaces with other FAA efforts that are directed toward the elimination or control of system hazards.

The SRM process for the NAS Modernizaion program consists of Airborne and Ground-based elements. The ground-based SRM processes will be fully implemented by the end of FY2003. The ISEE tool will contain descriptions of all safety analysis processes such as Preliminary Hazard Analysis (PHA), System Hazard Analysis (SHA), Sub-system Hazard Analysis (SSHA), and Operations & Support Hazard Analysis (O&SHA). The ISEE tool will contain descriptions of analysis tools, such as Fault Tree Analysis (FTA), Failure Modes and Effect Analysis (FMEA), and similar analytical techniques.

The HTTR system will be fully operational in support of NAS Modernization projects including ASDE-X, ADS-B, ERAM, Capstone, and Nexcom.

KEY FY 2004 PRODUCTS AND MILESTONES:

The ISEE tool will add airborne equipment certification analyses in accordance with Society of Automotive Engineers (SAE) SAE-4761 standard. These analyses and reports include Functional Hazard Analysis (FHA), Preliminary System Safety Assessment (PSSA), and Common Mode Analysis (CMA).

The ISEE tool will incorporate a computer-based training capability to permit on-line system safety training on each component or module in ISEE.

ISEE tool will be fully operational by the end of FY20004.

FY 2004 PROGRAM REQUEST:

The FY2004 request provides for :

- The implementation of an effective and efficient Safety Management System in accordance with International Cival Aviation Organization (ICAO) Annex 11.
- A computer-based capability that will constitute an integral part of the FAA's Intellectual Capital Investment Planning (ICIP) training initiative.

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2002)	$0
FY 2003 Request	0
FY 2004 Request	1,000
Out-Year Planning Levels (FY 2005-2008)	4,200
Total	$5,200

Budget Authority ($000)	FY 1999 Enacted	FY 2000 Enacted	FY 2001 Enacted	FY 2002 Enacted	FY 2003 Request	FY 2004 Request
Contracts:						
NAS Safety Assessment	0	0	0	0	0	1,000
Personnel Costs	0	0	0	0	0	0
Other In-house Costs	0	0	0	0	0	0
Total	**0**	**0**	**0**	**0**	**0**	**1,000**

OMB Circular A-11, Conduct of Research and Development ($000)	FY 1999 Enacted	FY 2000 Enacted	FY 2001 Enacted	FY 2002 Enacted	FY 2003 Request	FY 2004 Request
Basic	0	0	0	0	0	0
Applied	0	0	0	0	0	0
Development (includes prototypes)	0	0	0	0	0	1,000
Total	**0**	**0**	**0**	**0**	**0**	**1,000**

NAS Safety Assessment Products and Activities	FY 2004 Request ($000)	Program Schedule					
		FY 2003	FY 2004	FY 2005	FY 2006	FY 2007	FY2008
NAS Safety Assessment							
Integrated Safety Engineering Environment (ISEE)	$900						
Incorporate Ground-Based Safety Analysis Descriptions			◇	◇	◇	◇	◇
Incorporate Airborne-Based Safety Analysis Descriptions			◇	◇	◇	◇	◇
Develop a Computer-Based Training Capability			◇	◇	◇	◇	◇
Maintain ISEE Tool			◇	◇	◇	◇	◇
Hazard Tracking and Risk Resolution	$100						
Achieve a Fully-Operational System			◇	◇	◇	◇	◇
Capture Incident Data and Convert to Hazards				◇	◇	◇	◇
Align HTTR with ISEE Tool			◇	◇	◇	◇	
Total Budget Authority	$1,000		$1,000	$1,000	$1,000	$1,000	$1,200

Notes:

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SAFE FLIGHT 21 — ALASKA CAPSTONE

GOALS:

Intended Outcomes: Capstone is a joint government/industry initiative designed to prototype, demonstrate, validate and implement, in a real-world environment, the capabilities of advanced surveillance systems and air traffic procedures associated with "Free Flight," using enabling technologies such as Automatic Dependent Surveillance-Broadcast (ADS-B), Flight Information Services-Broadcast (FIS-B), and Traffic Information Service-Broadcast (TIS-B). Capstone's first priority is to improve aviation-system safety in Alaska through the introduction of new Communications, Navigation, and Surveillance (CNS) technologies. Capstone initiatives are to provide weather, terrain, and traffic information; flight following and locating capabilities; Global Positioning System (GPS) en route IFR infrastructure and non-precision instrument approaches; and training for pilots with Capstone avionics equipment. The Capstone initiative is a visible program providing tangible benefits. Capstone is building an infrastructure that is consistent with NAS modernization plans, and it is identifying the transition path for procedure development and technology implementation, while providing near-term safety benefits.

Agency Outputs: Capstone is essential to risk mitigation related to the evolutionary process of bringing emerging technologies into the NAS. The program will address the risks and challenges of fielding advanced communications, navigation, and surveillance systems, such as GPS, ADS-B, FIS-B, and TIS-B that can be implemented to provide weather, terrain, traffic, and navigation information.

These objectives will be achieved through the following:

- Evaluating the Universal Access Transceiver (UAT) link.
- Conducting operational tests of the following operational enhancements:
  - FIS-B, weather, wind-shear, Notices To Airmen (NOTAMs), and Pilot Reports (PIREPs)
  - Cost-effective Controlled Flight Into Terrain (CFIT) avoidance through graphical position display
  - Surveillance using ADS-B in non-radar airspace
  - Multi-lateration for runway safety and terminal surveillance
  - Improved navigation through the use of GPS
  - TIS-B

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

Accomplishments:

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

- Continued to add Ground Based Transceivers into the Bethel area for operational use in providing aircraft information to controllers and aircraft operations dispatchers and for providing weather information (text and graphics) to the cockpit.
- Installed Certified Capstone avionics in over 190 commercial aircraft operating in the Bethel area.
- Completed installation and commissioning of ten Automated Weather Observation Systems (AWOS) with weather cameras in the Bethel area and one in Southeast Alaska.
- Published 19 first-time GPS approaches for 10 airports.
- Trained over 100 pilots and associated personnel on Capstone avionics through the University of Alaska.

R&D Partnerships: The Capstone program is based on the principle that government and industry will share in the development and implementation of new communications, navigation, and surveillance technologies as the nation enters the Free Flight era.

The FAA is a partner with the aviation industry in supporting Safe Flight 21 – Alaska Capstone. This will allow the FAA and industry to share the funding of avionics and ground systems and to build on ongoing industry initiatives. Safe Flight 21 will build on Alaska Capstone activities by:

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

MAJOR ACTIVITIES AND ANTICIPATED FY 2003 ACCOMPLISHMENTS:

In FY 2003, the FAA anticipates accomplishing the following activities in support of Capstone in Alaska:

- Completed ADS-B avionics installation in remaining Capstone-participating aircraft in Bethel area.
- Demonstrated incorporation of WAAS technology with Capstone avionics in southeast Alaska.
- Continued to evaluate FIS-B products and capabilities in the cockpit.
- Initiated the use of RNAV en route procedures and arrival/departure procedures.
- Installed and commissioned three additional AWOS in the Bethel area.
- Conducted a Capstone Joint Resource Council (JRC) for Southeast Alaska Phase II Operations and Maintenance (O&M) requirements in 2nd quarter FY 2003.
- Continued planning for the provision of ADS-B surveillance services, navigation capabilities via Wide Area Augmentation System (WAAS), additional voice communications, and surface monitoring and terminal surveillance through multilateration in southeast Alaska.
- Procured second generation GBTs and ADS-B avionics for up to 200 aircraft for use in southeast Alaska, and begin installation of the new primary flight displays and Navigation Displays.

KEY FY 2004 PRODUCTS AND MILESTONES:

Key FY 2004 products and milestones involve activities related to the limited implementation of ADS-B applications in Alaska that prove beneficial in meeting the intended outcome of improving flight safety.

- Perform ADS-B avionics installation in Capstone-participating aircraft in southeast Alaska. Continue to conduct tests and demonstrations of prototype avionics with multifunction displays and TIS-B and FIS-B products.
- Initiate installation of ADS-B ground-based transceivers in southeast Alaska.
- Conduct end-to-end evaluations.

FY 2004 PROGRAM REQUEST:

FY 2004 funding completes procurement of avionics and ground systems necessary to conduct operational evaluations. The funding also provides for additional test and evaluation, procedures development, certification tasks, and simulation activities.

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2002)	$49,200
FY 2003 Request	15,000
FY 2004 Request	21,100
Out-Year Planning Levels (FY 2005-2008)	50,200
Total	$135,500

Budget Authority ($000)	FY 2000 Enacted	FY 2001 Enacted	FY 2002 Enacted	FY 2003 Request	FY 2004 Request
Contracts:					
Safe Flight 21 - Alaska Capstone	6,000	12,200	20,000	15,000	21,100
Personnel Costs	0	0	0	0	0
Other In-house Costs	0	0	0	0	0
Total	**6,000**	**12,200**	**20,000**	**15,000**	**21,100**

OMB Circular A-11, Conduct of Research and Development ($000)	FY 2000 Enacted	FY 2001 Enacted	FY 2002 Enacted	FY 2003 Request	FY 2004 Request
Basic	0	0	0	0	0
Applied	0	0	0	0	0
Development (includes prototypes)	6,000	12,200	20,000	15,000	21,100
Total	**6,000**	**12,200**	**20,000**	**15,000**	**21,100**

Safe Flight 21 – Alaska Capstone Products and Activities	FY 2004 Request ($000)	Program Schedule					
		FY 2003	FY 2004	FY 2005	FY 2006	FY 2007	FY2008
Safe Flight 21 – Alaska Capstone							
Operational Enhancements	$21,100						
Provide Weather and Other Information to the Cockpit		◆	◇	◇	◇	◇	
Provide Affordable Means to Reduce Controlled Flight Into Terrain (CFIT)		◆	◇	◇	◇	◇	
Improve Capability for Approaches in Low Visibility Conditions		◆	◇	◇	◇	◇	
Improve Capability of Pilots to Navigate Airport Taxiways		◆	◇	◇	◇	◇	
Provide Surveillance Coverage in Non-Radar Airspace		◆	◇	◇	◇	◇	
Program Management and Support		◆	◇	◇	◇	◇	
Safety Assessment		◆	◇	◇	◇	◇	
Total Budget Authority	$21,100	$15,000	$21,100	$19,100	$14,500	$16,600	$0

Notes:

– Out year numbers are for planning purposes only. Actual funding needs will be determined through the annual budget process.

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SAFER SKIES

GOALS:

Intended Outcomes: The White House Commission on Safety and Security set a goal of sharply reducing fatal aviation accidents within ten years. In response, the FAA, other government agencies, and industry launched Safer Skies in April of 1998. The goal of this initiative is to significantly reduce commercial and general aviation accident rates by 2007.

Agency Outputs: The implementation of the Safer Skies initiative will result in the development of guidance materials and/or revisions to Advisory Circulars (AC), Aeronautical Information Manuals (AIM), 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 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 and implementing interventions to reduce the commercial accident rate. Their focus lies in reducing commercial aviation accidents attributed to uncontained engine failure, controlled flight into terrain (CFIT), approach and landing, loss of control, runway incursions and weather.

The General Aviation Joint Steering Committee has identified the following focus areas to reduce the leading causes of accidents in general aviation: CFIT, weather, runway incursions, pilot decision-making, loss of control, and survivability.

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 for approach and landing accidents and is beginning the implementation phase. Government and industry CAST participants continue to develop intervention strategies for runway incursions, loss of control, and weather.

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

MAJOR ACTIVITIES AND ANTICIPATED FY 2003 ACCOMPLISHMENTS:

No funding available in FY 2003.

KEY FY 2004 PRODUCTS AND MILESTONES:

During FY 2004, reports on technical aspects of existing non-aeronautical spectrum communication systems and potential communication link applications as applied to specific mountainous locations will be produced. Draft guidance on use of non-aeronautical spectrum communications will be produced for general aviation and air carrier and operating certificate holders. Training courses on airport surface movement operations and digital data link pilot usage will be developed for aviation safety inspectors.

FY 2004 PROGRAM REQUEST:

For FY 2004, the $3,000,000 requested will permit the implementation of Safer Skies interventions that have been identified through the FAA's working with other government agencies, industry representatives, and employee groups. This request will focus primarily on accident causes related to Runway Incursion and Weather focus areas for commercial and general aviation. These funds will be used for development of criteria and standards for the use of private sector communications/spectrum in mountainous terrain and course development on airport surface movement operations and digital data link pilot usage.

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2002)	$0
FY 2003 Request	3,000
FY 2004 Request	3,400
Out-Year Planning Levels (FY 2005-2008)	10,900
Total	$17,300

Budget Authority ($000)	FY 2000 Enacted	FY 2001 Enacted	FY 2002 Enacted	FY 2003 Request	FY 2004 Request
Contracts:					
Safer Skies	0	0	0	3,000	3,400
Personnel Costs	0	0	0	0	0
Other In-house Costs	0	0	0	0	0
Total	**0**	**0**	**0**	**3,000**	**3,400**

OMB Circular A-11, Conduct of Research and Development ($000)	FY 2000 Enacted	FY 2001 Enacted	FY 2002 Enacted	FY 2003 Request	FY 2004 Request
Basic	0	0	0	0	0
Applied	0	0	0	0	0
Development (includes prototypes)	0	0	0	3,000	3,400
Total	**0**	**0**	**0**	**3,000**	**3,400**

Note: Out year funding is under review.

Safer Skies Products and Activities	FY 2004 Request ($000)	Program Schedule					
		FY 2003	FY 2004	FY 2005	FY 2006	FY 2007	FY2008
Safer Skies Implementation	**$3,400**						
Identify operational requirements for mountainous and remote operating area communication links		◆	◇				
Develop test plans					◇	◇	◇
Conduct evaluations		◆	◇		◇	◇	◇
Develop course materials		◆	◇		◇	◇	◇
Identify AIM and AC guidance appropriate for inclusion in FAA handbooks			◇	◇	◇	◇	◇
Develop handbook materials			◇	◇	◇	◇	◇
Personnel and Other In-House Costs							
Total Budget Authority	**$3,400**	**$3,000**	**$3,400**	**$2,600**	**$2,500**	**$2,800**	**$3,000**

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.

FIRE RESEARCH AND SAFETY

GOALS:

Intended Outcomes: The FAA intends to improve aircraft fire safety by: developing technologies, procedures, test methods, and criteria for preventing accidents that result from hidden in-flight fires and fuel tank explosions. The fire research and safety program focuses principally on near-term improvements in aircraft fuel tank explosion protection, fire detection and suppression systems and interior materials fire test methods and criteria.

Agency Outputs: The FAA establishes rules for aircraft fire safety in terms of material selection, design criteria, and operational procedures. The agency also provides advisory material on methods of compliance with fire safety regulations and guidelines. The fire research and safety program is the major source of technical information used to develop this regulatory material. These products are typically embodied in new test methods, reports, and journal publications.

Customer/Stakeholder Involvement: The FAA has encouraged broad industry and government participation in each aspect of the fire research and safety program.

- The Aircraft Safety Subcommittee of the FAA Research, Engineering and Development Advisory Committee has repeatedly endorsed the fire research and safety program and placed high priority on its activities.
- The FAA created an Aviation Rulemaking Advisory Committee (ARAC) on fuel tank inerting to recommend viable methods of fuel tank protection. This industry-working group is supported by the FAA and impacts related research.
- FAA and Boeing are sharing resources to develop and evaluate a fuel tank inerting system.
- The aircraft manufacturers and airlines share a need to improve fire detection and suppression systems and interior material fire tests. Recognizing the FAA's unique capabilities in fire safety, the aviation industry actively participates in international systems fire protection and material fire tests working groups headed by the FAA. Foreign airworthiness authorities are active participants, as well, to ensure harmonization of outputs.
- Recommendations issued by the Canadian Transportation Safety Board (TSB) and National Transportation Safety Board (NTSB), related to the investigation of the Swiss Air MD-11 fatal in-flight fire (by TSB) and a number of other in-flight fire incidents, are addressed by this program.
- NTSB relies heavily on program personnel for on-site accident investigation and related testing.

Accomplishments: Results of fire research and safety were provided to FAA certification and inspection personnel for use in fire safety regulations and advisory material, approval of regulatory fire test procedures, and approval of aircraft fire protection installations. Recent program accomplishments include:

- Completed the design and fabrication of an on-board ground based inerting system for installation in the center wing tank of the 747SP.
- Derived an equation and validated it through use of experimental data that relates the volume of nitrogen enriched air required to inert a fuel tank to a given oxygen concentration (report published).
- Issued a Technical Standard Order (TSO) proposing a flammability test standard (currently nonexistent) for airline blankets.
- Developed a new hybrid fire suppression system and, during full-scale cargo compartment fire tests, demonstrated its effectiveness through use of environmentally friendly water and nitrogen gas (report published).
- Developed and patented a new nozzle that extends the usefulness of hand-held extinguishers, and, employing carbon dioxide or gaseous halon replacement agents, by reducing the discharge temperature and pressure (report published).
- Transferred Microscale Combustion Calorimeter technology to Dow Chemical Company in first-ever licensing of FAA/DOT patented technology.
- Demonstrated the superior fire resistance and low heat release performance of epoxy resins derived from chlorobisphenols, while maintaining good mechanical properties (report published).
- Developed a methodology for calculating the flammability (heat release capacity) of a polymer on the basis of its chemical structure that was shown to be accurate to within $\pm$15% (report published).

- Conducted approximately 150 small and large-scale fire tests in support of the Canadian TSB accident investigation of the fatal Swiss Air MD-11 in-flight fire.

In addition, approximately two dozen reports and published papers are generated yearly from the in-house activity. Fire test laboratories are used annually to train FAA certification engineers; and, at the request of the NTSB, program personnel participate in major accident and incident investigations involving fire. The FAA operates the most extensive aircraft fire test facilities in the world.

R&D Partnerships: The FAA sponsors an international systems fire protection working group that collaborates in research and development related to fuel tank protection, fire/smoke detectors and halon replacement. The FAA also sponsors an international aircraft materials fire test working group. This group strives to improve material fire tests standardization, such as engaging in round robin testing to ensure that the lab-to-lab variation in results is acceptably small. FAA and NASA have instituted an integrated program to conduct research on gas generation systems for fuel tank protection and emergency oxygen, advanced fire/smoke detectors and ultra fire resistant materials. The FAA organized an inter-agency working group on fire and materials to provide a vehicle for technology exchange among U.S. Government agencies and to prevent unwarranted duplication of work. The FAA has an inter-agency agreement with the National Institute of Standards and Technology (NIST) to research fire retardant mechanisms and develop rapid screening tools for flammability. The agency has a memorandum of cooperation with the British Civil Aviation Administration (CAA) for a variety of fire safety research efforts and separate letters of cooperation with Canadian, Japanese, and European aviation authorities. The fire research and safety program also has grant programs with many educational institutes. Several Fortune 100 companies share costs of developing new fire resistant materials at university-based FAA research consortia. FAA licensed a patented heat release calorimeter to Dow Chemical Co. to foster the development of fire resistant materials.

MAJOR ACTIVITIES AND ANTICIPATED FY 2003 ACCOMPLISHMENTS:

Fire Resistant Materials

- Demonstrated thermoplastic for cabin passenger service units, seat tray backs and other molded parts with order of magnitude reduction in heat release rate.
- Completed flammability, mechanical, and physical and chemical property tests on laminates and composites constructed of ultra-fire resistant (order or magnitude heat release rate reduction) thermoset resins.

Fire Safety Improvements

- Completed testing and development of an on-board fuel tank inerting system in fully operational 747SP.
- Also with the 747P, demonstrated the ability of a fuel tank inerting system to provide cargo compartment inerting in the event of an in-flight fire, in order to reduce the weight and cost penalty of the aircraft.
- Evaluated current flammability requirements for electrical wiring and developed improved fire test criteria.
- Developed and evaluated hardware improvements for fighting inaccessible in-flight fires with hand-held extinguishers.
- During extended operation of the air conditioning system (air packs), determined the effect of ambient temperature and fuel quantity on the attainment of flammable conditions in a heated center wing tank.
- Drafted the revised Advisory Circular (AC) 25-92 with improved, standardized approval testing criteria for cargo detector response time.
- Conducted full-scale fire tests in a new Very Large Transport Aircraft (VLTA) test article to characterize fire hazards associated with the upper deck.

KEY FY 2004 PRODUCTS AND MILESTONES:

Fire Safety and Improvement

- Initiate in-flight testing of an effective, reliable and relatively simple on-board fuel tank inerting system.
- Publish report describing effectiveness and weight/cost penalty of an on-board ground-based fuel tank inerting system evaluated in the 747SP.
- Develop improved fire test criteria for Heating, Cooling, Ventilation, Air Conditioning, Refrigeration (HVAC) ducting and foam materials, completing upgrading of all hidden materials.

- Develop and evaluate, under full-scale conditions, a fire detection and extinguishing system located in the attic above the cabin ceiling.
- Develop a user-friendly mathematical model of the transport of heat, smoke and gases during a cargo compartment fire.
- Complete full-scale fire tests to determine the benefit of improved fire resistant materials in a VLTA.

FY 2004 PROGRAM REQUEST:

ONGOING ACTIVITIES

In FY 2004, preparation will begin for flight testing an on-board fuel tank inerting system. The goal is an effective, high reliability inerting system with minimum impact on the airplane. To achieve this goal, the system will have no compressor, few moving parts, and low weight. Also, a final report will be published describing the design, performance, weight, and cost of an on-board ground based inerting system that was previously evaluated in the 747SP. Finally, work will continue on the development and validation of a fuel tank flammability model that is an important tool for assessing the risk of aircraft fuel tank explosions.

In FY 2004, further improvements will be identified to safeguard against hidden in-flight fires in inaccessible areas. Improved fire test criteria for ducting and foams will be developed, building upon previously completed test criteria for thermal acoustic insulation and wiring. Full-scale tests on a detection and extinguishing system installed in the "attic" above the cabin ceiling will be conducted. Also, final reports will be published describing the development of an improved electical wiring fire test method and of hardware improvements for fighting hidden fires with hand-held extinguishers.

In FY 2004, full-scale tests will be conducted on advanced cargo smoke detectors developed by NASA to reduce or eliminate false alarms. The development of a user-friendly mathematical model of the transport of heat, smoke and gases during a cargo fire will be completed. Also, in FY 2004, full-scale tests will be undertaken to examine fire safety improvements in VLTA's such as the new Airbus A380.

In FY 2004, ongoing research into technologies tol enable the development of ultra-fire resistant aircraft interior materials will be terminated.

NEW INITIATIVES

No new initiatives are planned in FY 2004.

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2002)	$ 106,058
FY 2003 Request	6,125
FY 2004 Request	7,725
Out-Year Planning Levels (FY 2005-2008)	32,963
Total	$ 152,871

Budget Authority ($000)	FY 2000 Enacted	FY 2001 Enacted	FY 2002 Enacted	FY 2003 Request	FY 2004 Request
Contracts:					
Fire Research and Safety	1,292	1,671	2,340	3,077	4,368
Personnel Costs	3,116	2,856	2,621	2,796	3,043
Other In-house Costs	342	213	281	252	314
Total	**4,750**	**4,740**	**5,242**	**6,125**	**7,725**

OMB Circular A-11, Conduct of Research and Development ($000)	FY 2000 Enacted	FY 2001 Enacted	FY 2002 Enacted	FY 2003 Request	FY 2004 Request
Basic	0	0	0	0	0
Applied	4,750	4,740	5,242	6,125	7,725
Development (includes prototypes)	0	0	0	0	0
Total	**4,750**	**4,740**	**5,242**	**6,125**	**7,725**

A11a – Fire Research and Safety Products and Activities	FY 2004 Request ($000)	Program Schedule					
		FY 2003	FY 2004	FY 2005	FY 2006	FY 2007	FY2008
061-110 Fire Research & Safety							
Fire Resistant Materials	$0						
Demonstrate Resins Thermoplastic, Elastomer & Fiber with Order of Magnitude Reduction in Heat Release		◆					
Complete Property Tests on Laminates and Composites Constructed of Ultra-Fire Resistant Thermoset Resins		◆					
Fire Safety Improvement	$4368						
Tested and Developed On-Board Fuel Tank Inerting System in 747SP		◆					
Flight Test Fuel Tank Inerting System			◇				
Recommend Design Criteria for a Fuel Tank Protection System				◇			
Developed Improved Fire Test Criteria for Electrical Wiring		◆					
Develop & Standardize Improved Fire Test Criteria for All Hidden Materials				◇			
Recommend Fire Detection & Suppression Systems for All Hidden Areas				◇	◇		
Develop User Friendly Math Model to Predict Transport of Cargo Fire Products			◇				
Drafted Revised Advisory Circular for Smoke/Fire Detection		◆					
Characterize Cabin & Fuselage Fires in VLTA		◆					
Define VLTA Fire Protection Methodology				◇	◇		
Improved Oxygen System Design Guidelines/Requirements						◇	
Examine Aircraft Vulnerability to Hydraulic Fluid Fires							◇
Personnel and Other In-House Costs	$3,357						
Total Budget Authority	**$7,725**	**$6,125**	**$7,725**	**$7,902**	**$8,149**	**$8,330**	**$8,582**

Note: **Out year numbers are for planning purposes only. Actual funding needs will be determined through the annual budget process.**

PROPULSION AND FUEL SYSTEMS

GOALS:

Intended Outcomes: The FAA intends to improve system safety by enhancing the airworthiness, reliability, and performance of civil turbine and piston engines, their propellers, fuels, and fuel management systems. The major outcomes from this program include:

- Continued reliability and safety of general aviation operations by providing a safe transition to a new high octane unleaded aviation gasoline.
- Reduced the number of intrinsic turbine rotor failures by improved and standardized design and life management procedures.
- Improved melt processes for premium quality titanium alloys used for turbine rotor components.
- Improved manufacturing and quality practices to eliminate manufacturing induced anomalies in turbine rotor components.
- Continued reliability and safe use of Jet A fuel containing red dye contamination.

Agency Outputs: The FAA maintains the airworthiness of aircraft engines, fuels, and airframe fuel management systems by issuing certification and advisory standards, and by supporting technical society specifications and recommended practices. The FAA also publishes technical information in various forms in the public domain. Technology may also be provided to the industry through hardware and software prototype demonstrations, technology workshops or other training and technology transfer methods. This research program provides the resources and oversight to deliver the necessary propulsion, fuel, and fuel transfer system technology in support of these agency outputs.

Customer/Stakeholder Involvement:

- The FAA collaborates with the engine industry to identify and implement cost-effective safety improvements that address incidents and accidents caused by in-service engine failures. This collaboration was initiated by the FAA Titanium Rotating Components Review Team. This team advises on the adequacy of industry standards and procedures to ensure the safety of the titanium alloy, high energy rotating components of turbine engines. Industry participation is through working committees under the Aerospace Industries Association (AIA), including the Materials and Structures Committee, Rotor Integrity Subcommittee, Rotor Manufacturing Subcommittee and the Jet Engine Titanium Quality Committee.
- The AIA committees identify potential improvements in manufacturing process control, manufacturing and in-service inspection, and design and life management of failure critical rotating engine parts. These improvements are the basis for identifying specific research already underway or planned for this program.
- The FAA participates and provides leadership in testing capability for the Coordinating Research Council (CRC) Unleaded Aviation Gasoline Development Group. This group was formed in February 1995 to oversee research and testing for the development of the next generation of high octane unleaded aviation gasoline. The Clean Air Act of 1990 mandated the removal of lead from all gasoline. The critical need for the development of this fuel is reflected by the list of participants on the CRC group. Active participants and members of this group include: most major oil companies (U.S. and worldwide); general aviation airframe and engine manufacturers; general aviation user groups such as the Aircraft Owners and Pilots Association (AOPA), Experimental Aircraft Association (EAA), and General Aviation Manufacturers Association (GAMA); the research sponsor, the FAA Engine and Propeller Directorate in New England Region; and the FAA Small Airplane Directorate in Central Region.
- The Subcommittee on Aircraft Safety of the FAA Research, Engineering and Development Advisory Committee was briefed on the propulsion program, an initiative that the subcommittee strongly supports.
- The FAA/industry initiative on turbine engine rotor integrity research in this program addresses National Transportation Safety Board (NTSB) recommendations A-90-89 and A-90-90.
- The program addresses recommendations of the FAA Titanium Rotating Components Review Team Report, which was presented to industry in a public meeting held in May of 1991.
- The Aerospace Industries Association convened an ad hoc group to study the effects of red dye contamination of Jet A fuel and to identify solutions to this problem. This effort has resulted in a program

funded by the FAA, Defense Energy Support Center, Internal Revenue Service (IRS), Air Transport Association, and engine and airframe manufacturers,and oil refiners.

Accomplishments: Results of the propulsion and fuels research program provided to engine and aircraft regulatory and industry stakeholders:

- Drafted an advisory circular on the correlation, operation, design, and modification of turbofan/jet engine test cells, which provide guidance on the testing of aircraft engines.
- Completed a training video production entitled; "Aircraft Turbine Engine Test Cell Correlation."
- Hosted and sponsored five annual joint FAA/U.S. Air Force public workshops with published proceedings on the application of probabilistic design methodology to gas turbine rotating components.
- Demonstrated integrated probabilistic rotor design and life management code (DARWIN™ version 3.5) for titanium alloys to provide commercial aircraft turbine engine manufacturers a tool to augment their current "safe life" management philosophy approach.
- Conducted DARWIN™ Code version 3.2 FAA/ Industry training workshop.
- Industrialized the DARWIN™ rotor design and life management code.
- Demonstrated and delivered the DEFORM™ defect deformation micro code for analysis of titanium alloy defects during the turbine disk forging process.
- Determined the fleet octane requirement to be the single most critical parameter for development of high-octane unleaded aviation gasoline.
- Completed validation of ground-based procedures for determining octane requirements to be used in the development of a new high octane unleaded aviation gasoline.
- Participated in establishing matrix components to be used in developing candidate fuel formulations.
- Completed motor octane tests on 202 fuel formulations from candidate matrix.
- Completed engine endurance test on an industry-supplied fuel formulation.
- Completed report on engine octane requirements.
- Determined and defined detonation detection procedures for proposed American Society for Testing and Materials (ASTM) method to test unleaded replacement fuel(s).
- Issued final determination of fleet octane requirements for unleaded fuel replacement in high performance piston engines showing them to be greater than 100 octane.
- Completed draft final report on in-service Jet A fuel sample analysis volatility survey.
- Completed report on the results of titanium melting enhancements.
- Completed validation of DEFORM™ forging microcode for tracking subsurface anomalies.
- Demonstrated DARWIN™ code version for surface anomalies.
- Completed feasibility demonstration of safety net unleaded fuel.

R&D Partnerships:

A cooperative grant was awarded to the Southwest Research Institute, which has teamed with major engine manufacturers Pratt and Whitney, General Electric, Honeywell, and Rolls Royce. This work develops probabilistic-based turbine rotor material design and life management tools for improved rotor integrity. This work is closely coordinated with the U.S. Air Force Wright Laboratory, and NASA Glenn, which conducts complementary research, and with ongoing research activities of the FAA Engine Titanium Consortium sponsored under budget item A11e, Aging Aircraft. The FAA transfers the completed probabilistic engine design code versions for use by the industry by license through SWRI via training workshops.

A research partnership has been initiated with the Specialty Metals Processing Consortium (SMPC) based at the Sandia National Laboratory; SMPC includes the Sandia Liquid Metals Processing Laboratory, Allvac, Oremet Titanium Co., RMI Titanium Co., Timet Co., General Electric Aircraft Engines, and Pratt & Whitney.

The partnership exhibited by the CRC Unleaded Aviation Gasoline Development Group provides an arena to conduct research that is unprecedented in the aviation gasoline industry. The proprietary and competitive forces inhibiting progress, in the high- octane aviation gasoline development, have been set aside. This allows the transfer of technology to and from government and industry to benefit all participants. Industry participants in-

clude Texaco, Exxon, Phillips Petroleum, Chevron, British Petroleum, Cessna, Raytheon (Beech), Teledyne Continental, and Textron Lycoming.

Under a contract to FAA with the Southwest Research Institute, determined an acceptable level of fuel dye contamination, which allowed continuous safe turbine engine operation. The following organizations contributed funding to this effort: the FAA, Defense Energy Support Center, IRS, Air Transport Association, American Petroleum Institute, General Electric, Pratt & Whitney, Rolls Royce, Honeywell and Boeing.

Research to demonstrate the feasibility of a temporary (safety net) fuel has been conducted in partnership with the Cessna Aircraft Co.

The program is benefiting from a close working relationship with the Airworthiness Assurance Center of Excellence (AACE). The research performed under this program is leveraged by the monetary and intellectual contributions of its university members.

Academic partnerships have been initiated through the AACE, General Aviation Center of Excellence and direct grants with the University of North Dakota, South Dakota State University and Baylor University conducting feasibility studies for ethanol fuel blends as an unleaded piston fuel replacement for 100 low-lead avgas.

An AACE partnership exists with the University of Dayton Research Institute to investigate Jet A fuel low temperature flight operations.

MAJOR ACTIVITIES AND ANTICIPATED FY 2003 ACCOMPLISHMENTS:

- Completed development and population of the rotor manufacturing induced anomaly database.
- Continued laboratory characterization and engine ground testing of industry-supplied candidate unleaded fuels using FAA test facilities.
- Published final report that defines an acceptable concentration of red dye contamination in Jet A fuel for continuous engine operation.
- Completed endurance demonstration of a temporary safety net, high octane, unleaded piston fuel.
- Continued investigation of turbine fuel, low temperature-freeze point operations.
- Expanded research effort on the use of blended fuels containing ethanol for general aviation piston engines.
- Began research, test, and evaluation on using compression ignition engines in general aviation.
- Drafted report on cold dwell fatigue in titanium alloy microstructure.
- Completed vacuum fatigue crack growth tests on nickel rotor disk material.
- Completed rotor disk nickel super alloy anomaly database.
- Validated DARWIN ™code for surface anomalies.
- Completed development of advanced first generation vacuum arc remelt controllers.

KEY FY 2004 PRODUCTS AND MILESTONES:

- Continue development of advanced remelt controllers.
- Continue evaluation of candidate unleaded fuels.

FY 2004 PROGRAM REQUEST:

ONGOING ACTIVITIES

In FY 2004, the ongoing development of a probabilistically based turbine engine rotor design code with damage tolerance assessment will be terminated.

The program will continue the ongoing research on industry-provided lead free fuel formulation candidates to replace the low lead aviation gasoline currently in use. In-house staff will continue to evaluate industry supplied formulations.

Research to develop rotor disk alloy material melt process improvements to establish commercial

manufacturing standards will continue with funding from prior years. The standards will result in premium quality rotor grade materials.

In FY 2004, the program will terminate ongoing research to establish an improved understanding of the metallurgical, cold dwell time load factors that can shorten fatigue life in titanium rotor disk alloys.

NEW INITIATIVES

No new initiatives are planned in FY 2004.

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2002)	$ 62,962
FY 2003 Request	5,590
FY 2004 Request	1,146
Out-Year Planning Levels (FY 2005-2008)	5,138
Total	$ 74,836

Budget Authority ($000)	FY 2000 Enacted	FY 2001 Enacted	FY 2002 Enacted	FY 2003 Request	FY 2004 Request
Contracts:					
Propulsion and Fuel Systems	1,754	6,994	7,344	4,279	0
Personnel Costs	1,230	1,114	1,079	1,224	1,052
Other In-house Costs	142	74	145	87	94
Total	**3,126**	**8,182**	**8,568**	**5,590**	**1,146**

OMB Circular A-11, Conduct of Research and Development ($000)	FY 2000 Enacted	FY 2001 Enacted	FY 2002 Enacted	FY 2003 Request	FY 2004 Request
Basic	0	0	0	0	0
Applied	3,126	8,182	8,568	5,590	1,146
Development (includes prototypes)	0	0	0	0	0
Total	**3,126**	**8,182**	**8,568**	**5,590**	**1,146**

A11b – Propulsion and Fuel Systems Products and Activities	FY 2004 Request ($000)	Program Schedule					
		FY 2003	FY 2004	FY 2005	FY 2006	FY 2007	FY2008
063-110 Propulsion and Fuel Systems Research							
Turbine Engine Research	$0						
Validated Probabilistic Integration Design Code for Surface Anomalies		◆					
Completed Rotor Manufacturing Induced Anomaly Database		◆					
Drafted Report on Cold Dwell Fatigue in Titanium Microstructure		◆					
Develop Advanced Vacuum Arc Remelt Controllers		◆	◇				
Unleaded Fuels and Fuel System Safety Research	$0						
Continue Lab Characterization and Engine Ground Testing of Candidate Unleaded Fuels		◆	◇	◇	◇	◇	◇
Published Report on the Acceptable Concentration of Red Dye Contamination in Jet A Fuel		◆					
Complete Endurance Demonstration of Safety Net Unleaded Fuel		◆					
Evaluated Ethanol Based Piston Fuel		◆					
Personnel and Other In-House Costs	$1,146						
Total Budget Authority	**$1,146**	**$5,590**	**$1,146**	**$1,199**	**$1,254**	**$1,312**	**$1,373**

Note: **Out year numbers are for planning purposes only. Actual funding needs will be determined through the annual budget process.**

ADVANCED MATERIALS/STRUCTURAL SAFETY

GOALS:

Intended Outcomes: The FAA intends to ensure the safety of U.S. and foreign-made civil aircraft constructed of advanced materials as well as to improve passenger survival in the event of an accident. The study of advanced materials focuses on the following technical areas:

- Standardization of analysis and test methods for worldwide harmonization.
- Better understanding of effects of repeated loads, damage, and joint configurations on remaining strength and life of composite aircraft structures.
- Reliability methods, as they apply to the design of composite aircraft components, and criteria for acceptable risk.

The study of structural safety focuses on the following technical areas:

- Enhanced occupant survivability and reduced personal injury in the event of an accident.
- Improved crash characteristics of aircraft structures, cabin interiors, auxiliary fuel tank systems, and occupant seat/restraint systems.
- Improved analytical modeling capabilities to develop understanding of aircraft crash events in support of more efficient certification.

Agency Outputs: The FAA establishes rules for aircraft certification and operation and publishes Advisory Circulars (AC) to provide acceptable means of achieving compliance with those rules. While the rules are the same for composite or metal structure, the means of compliance reflect behavioral differences in the structural materials. AC 20-107A, "Composite Structure" has been published, but advances in technologies and materials lead to periodic updates and expansion of the AC. Technical information is disseminated by the FAA National Resource Specialist to regulatory personnel through technical reports, handbooks, and guidance. The goal of this exchange of data is to increase the development of pertinent data, so that the regulatory processes can keep pace with industry advances, including-the best possible test and evaluation for state-of-the-art technology and design. The advanced materials/structural safety program provides support in rulemaking and the development of guidance material for industry compliance. In structural safety, the FAA revises or updates Federal Aviation Regulations to accommodate new information for overhead stowage bins, auxiliary fuel tanks, aircraft configurations, and seat/restraint systems.

Customer/Stakeholder Involvement: The FAA has demonstrated the need for the advanced materials/ structural safety program through consensus building activities including:

- The Aviation Rulemaking Advisory Committee (ARAC) is a FAA/industry forum established to ensure that agency rulemaking achieves intended results. ARAC is also effective in identifying requirements and priorities for supporting R&D activities.
- A National Research Council report highlights the needs related to advanced materials and urges the FAA to step up advanced materials research for aircraft community benefits.
- The 1994 DOT Strategic Plan established Goal 3.3, "support the use of advanced materials in manufacturing and constructing transportation facilities and equipment."
- The advanced materials/structural safety program is responsive to Public Law 100-591, Aviation Safety Research Act of 1988, and House of Representatives Report 100-894, to develop technologies, to conduct data analysis for current aircraft, and to anticipate problems of future aircraft.

Accomplishments: Results of this program are provided to aircraft manufacturers, maintainers, and operators in the form of technical reports, handbooks, ACs, and guidance in the process of certification.

In the advanced materials area, the program has updated or issued two ACs and four handbooks, resulted in an FAA policy memo, published more than 55 technical reports, articles, and papers; and cosponsored three technical conferences attended by approximately 1,200 experts. A three-volume report on test methods for composites was disseminated to industry and government: it provides an authoritative compendium on state-of-the-art composites testing with recommendations for its use. The report also identified gaps, one of which was rectified by developing an American Society for Testing and Materials (ASTM) standard for

compression testing. An alternative compliance method to demonstrate repeated load life was developed and now significantly reduces fatigue-testing time to ensure required service life. This method has been used successfully in the certification process of many aircraft components and has been adopted as a worldwide practice.

In the structural safety area, eight reports on in-house aircraft crash testing, as well as reports on aircraft ditching and flotation, have been widely disseminated. Rulemaking has been proposed for commuter seat/restraint systems. Also, in-service overhead stowage bins have been made more resilient to crash impact. A workshop on an FAA-developed crash impact modeling code was held for certification engineers and industry participants.

R&D Partnerships: In the advanced materials area, the FAA coordinates with NASA to leverage research expenditures. The FAA concentrates on safety and certification issues, including testing, while NASA has the lead in analysis and design issues. The FAA supported NASA's efforts to develop a composite material property database for General Aviation (GA) aircraft under the NASA Advanced GA Transport Experiments (AGATE)/ Integrated Design and Manufacturing (IDM) Program. The FAA is also in a partnership with the Rotorcraft Industry Technology Association (RITA) to share in rotorcraft composite materials research.

With the U.S. Army, the FAA co-sponsors MIL-HDBK-17, a primary and authoritative handbook for statistically based characterization data of current and emerging composite materials. This international reference tool reflects the best available data and technology for testing and analysis, and includes data development and usage guidelines. FAA officials use the handbook as a primary supporting document in structural substantiation in the certification process. On recommendations by the ARAC, material data contained in this handbook will be acceptable for use in the certification process. In the structural safety area, there are agreements for cooperative programs with the National Highway Traffic Safety Administration (NHTSA), with the U.S. Army and Navy, and with NASA Langley Research Center.

There has been coordination with the French and Italian Governments through memoranda of cooperation and an exchange of personnel in the crash testing area. A cooperative research program in the development of crash modeling software tools is underway with the United Kingdom. The program has also worked closely with Wichita State University and Drexel University to develop crash dynamic models.

The advanced materials and structural safety areas are benefiting from a close working relationship with the Airworthiness Assurance Center of Excellence. The research performed under this program is leveraged by the monetary and intellectual contributions of its core universities.

MAJOR ACTIVITIES AND ANTICIPATED FY 2003 ACCOMPLISHMENTS:

Advanced Materials

- Established criteria for surface preparation of adhesive joints.
- Developed criteria for control of materials and process specifications.
- Developed analytical methodology to characterize damage tolerance of composite sandwich structures for small aircraft and rotorcraft.
- Developed validated analytical methods for bonded joints.

Structural Safety

- Conducted a vertical drop test of currently in-service high-wing ATR42-300 commuter aircraft.
- Published technical reports of overhead stowage bin and auxiliary fuel tank research.
- Published data on crash resistance of transport aircraft stowage bins.

KEY FY 2004 PRODUCTS AND MILESTONES:

Advanced Materials

- Develop standardized materials and process specifications to better control material properties.
- Develop software and establish guidelines for in-flight loads and environmental criteria to be used in certification of general aviation airplanes.
- Validate developed analytical methodology to predict residual strength of composite sandwich structures after an impact event.

Structural Safety

- Publish technical report on the vertical drop test of an ATR42-300 regional transport airplane.

FY 2004 PROGRAM REQUEST:

ONGOING ACTIVITIES

In FY 2004, the program continues to focus on the areas listed at the beginning of the GOALS section above. Specific areas are standardization of material and process specifications and developing software to predict concurrently in-flight aircraft loads and environment. The goal is to better define these parameters for certification of general aviation airplanes. Modeling and characterization of textiles will continue in order to understand their load resistance and damage tolerance characteristics. In addition, the program will continue to develop data applicable to rotorcraft and fan blades, including high-cycle fatigue.

In FY 2004, research in occupant injury protection criteria applicable to side-facing seating in business jets will continue. Ongoing research on analytical modeling of crash events and on crash resistant fuel systems will be terminated.

NEW INITIATIVES

In FY 2004, new initiatives involve the aging composite control surfaces on transport aircraft, their repair, repairmen and inspector training with linkage to control surface performance as it affects aircraft safety. In the future, several new initiatives are envisioned in advanced materials. These would address the use of ceramics and nanomaterials in aircraft parts, particularly in aircraft engines, and will be based on previous work on polymer composites. These applications will involve standardization of testing at elevated temperatures. Research on certification methodology for new materials and applications will continue.

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2002)	$ 65,557
FY 2003 Request	2,949
FY 2004 Request	2,766
Out-Year Planning Levels (FY 2005-2008)	11,859
Total	$ 83,131

Budget Authority ($000)	FY 2000 Enacted	FY 2001 Enacted	FY 2002 Enacted	FY 2003 Request	FY 2004 Request
Contracts:					
Advanced Materials	596	975	962	971	1,210
Structural Safety	493	819	808	845	211
Personnel Costs	1,109	937	1,091	1,058	1,234
Other In-house Costs	140	60	113	75	111
Total	**2,338**	**2,791**	**2,974**	**2,949**	**2,766**

OMB Circular A-11, Conduct of Research and Development ($000)	FY 2000 Enacted	FY 2001 Enacted	FY 2002 Enacted	FY 2003 Request	FY 2004 Request
Basic	0	0	0	0	0
Applied	2,338	2,791	2,974	2,949	2,766
Development (includes prototypes)	0	0	0	0	0
Total	**2,338**	**2,791**	**2,974**	**2,949**	**2,766**

A11c – Advanced Materials/Structural Safety Products and Activities	FY 2004 Request ($000)	Program Schedule					
		FY 2003	FY 2004	FY 2005	FY 2006	FY 2007	FY2008
062-111 Advanced Materials Structures							
Advanced Materials	$1,210						
Established Criteria for Surface Preparation of Adhesive Joints		◆					
Develop Criteria for Control of Materials and Process Specs.		◆					
Developed Analytical Methods for Bonded Joints		◆					
Developed Analytical Methods for Sandwich Structures		◆					
Develop Software and Criteria for Environment and Loads			◇				
Develop Standard Specifications to Better Control Material Properties			◇				
Develop Certification Methodology for New Materials and Forms				◇			
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	$211						
Published Technical Reports of Overhead Storage Bin and Fuel Tank Research		◆					
Concluded a Vertical Drop Test of high-Wing ATR42-300 Commuter Aircraft		◆					
Develop Occupant Protection Criteria for Side-Facing Seats					◇		
Personnel and Other In-House Costs	$1,345						
Total Budget Authority	$2,766	$2,949	$2,766	$2,835	$2,928	$3,000	$3,096

Note: **Out year numbers are for planning purposes only. Actual funding needs will be determined through the annual budget process.**

FLIGHT SAFETY/ATMOSPHERIC HAZARDS RESEARCH

GOALS:

Intended Outcomes: The FAA intends to improve aircraft safety by developing technologies, technical information, procedures, and practices. These measures help ensure safe operation of the civil fleet in icing conditions and in the electromagnetic environment, and address safety issues pertaining to aircraft software, digital flight controls and avionics systems.

In the area of aircraft icing, the program focuses on establishing operating rules and procedures for deicing and anti-icing to ensure a clean aircraft at takeoff. It also focuses on developing technology to determine the existence of frozen contamination and the failure of anti-icing fluids on critical aircraft surfaces. It addresses characterization of the atmospheric icing environment by collecting and analyzing supercooled cloud and precipitation data. The program also develops technology (ice protection and detection), data packages to support certification requirements, advisory material to ensure that aircraft meet performance, stability, and control safety standards during or after in-flight operation in icing conditions.

The software and digital systems safety program addresses aircraft safety and certification issues. These issues involve the use of emerging, highly complex, software based digital flight controls and avionics systems in flight essential and flight critical applications.

The electromagnetic hazards to aircraft systems program focuses on protecting aircraft electrical and electronic systems against the effects of lightning and High Intensity Radiated Fields (HIRF). HIRF effects may come from airborne, shipborne and ground based emitters. The program also focuses on the effects of spurious emissions from portable electronic devices; i.e., tape players, laptop computers, cellular phones, etc.

Customer/Stakeholder Involvement: The program directly supports the FAA Strategic Plan Mission Goal for Safety: By 2007, reduce U.S. aviation fatal accident rates by 80 percent from 1996 levels. It does this through enhancements to aircraft certification, inspection, and maintenance relative to atmospheric hazards and advanced software and digital systems. It also supports the free flight initiative, addressing highly integrated avionics and ground-based systems safety and certification issues, using very complex software. In addition, it provides key support to the Aviation Rulemaking Advisory Committee (ARAC) Electromagnetic Effects Harmonization Working Group (EEHWG).

The ARAC Ice Protection Harmonization Working Group (IPHWG) addresses definition of an icing environment that includes Supercooled Large Droplets (SLD) and means, such as ice detectors, to warn flight crews of ice accumulation on critical surfaces. This ARAC WG is supported by FAA icing research. An SAE committee also addresses aircraft lightning protection (AE-2). This committee develops ACs, test standards, and related users manuals to improve flight safety. The FAA provides leadership to the SAE G-12 Aircraft Ground Deicing Committee in the area of holdover time guideline updates, standards establishment for de/anti-icing methodologies, deicing fluids and ground ice detection.

Accomplishments: The icing program provided aircraft icing regulatory guidance and operating procedures to aircraft manufacturers and operators. This consisted of technical reports, handbooks, information bulletins, ACs and rules. Since 1992, the program has updated or issued two ACs, seven technical bulletins, and the Aircraft Icing Handbook (thrice), and it has published more than 50 technical reports or papers. It has held international conferences on aircraft ground deicing, aircraft in-flight icing, and mixed-phase and glaciated icing conditions. It has also issued holdover time guidelines for aircraft anti-icing fluids, which are employed by many of the world's airlines.

In the area of software and digital systems safety, a Modified Condition Decision Coverage (MCDC) tutorial was published addressing structural coverage testing of aircraft software. A Commercial-off-the-Shelf (COTS) software and hardware report was published where guidelines, verification methods and assessment criteria, for both aircraft software and hardware, were developed. As part of a complex electronic hardware case study, detailed design data and a hardware implementation plan were developed. A handbook was published on acceptance criteria for using Software Service

History (SSH) on certification projects. In addition, an interim Advanced Flight Control Systems report was published.

In the electromagnetic hazards area, the program published advisory material and SAE lightning documents addressing the aircraft lightning environment and related test waveforms, certification of aircraft electrical systems and aircraft lightning zoning. This program through the EEHWG has completed a draft HIRF Rule awaiting FAA approval. The program also published HIRF guidance material and reported on in-service lightning strikes and continued lightning strike characterization to better define the lightning environment.

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

- ARAC, EEHWG international certification authority/industry forum – HIRF environment, User's Guide for AC 20-1317.
- SAE–AE2 Lightning Protection of Aircraft, Lightning Environment, Waveforms and Testing Standard, Aircraft Zoning Standard, and User's Manual for AC 20-136.
- RTCA Special Committee-135, "Environmental Conditions and Test Procedures for Airborne Equipment."
- Multiyear FAA/NASA inter-agency agreement with Langley Research Center to cooperate in the assessment of software-based digital flight controls and avionics systems and electromagnetic hazards research.
- Letter of agreement to leverage HIRF certification research with Sandia Corporation, Army Directorate for Applied Technology, Test and Simulation, and ORION International Technologies, Incorporated.
- Certification Authorities Software Team (CAST) consisting of avionics software systems certification authorities from U.S., Europe and Canada.
- Cooperative efforts on aircraft icing activities with the NASA Glenn Research Center.
- More than six grants and agreements in support of aircraft icing initiatives are in place with academia and other government agencies to "leverage" interests and capabilities.
- An international agreement exists with Transport Canada on research on aircraft ground deicing issues.
- An international memorandum of cooperation exists with the Meteorological Service of Canada for research on in-flight icing conditions.
- An inter-agency agreement with the Air Force for development of a new inflight icing test capability at the McKinley Environmental Laboratory.
- ARAC IPHWG directly supported with data on and analysis of SLD conditions in the atmosphere.

MAJOR ACTIVITIES AND ANTICIPATED FY 2003 ACCOMPLISHMENTS:

Aircraft Icing

- Continued investigation of atmospheric icing environment.
- Evaluated time effectiveness and aerodyna-mic performance of environmentally friendly and other modern fluids.
- Reported on global atmospheric icing environment.
- Reported on acquisition of atmospheric icing data from operational aircraft.
- Reported on the investigation of certification standards for Type IV anti-icing fluids.

Software and Digital Systems Safety.

- Published a report on architectural strategies with COTS component insertion, Phase 4.
- Completed a Handbook for Object-Oriented Technology in Aviation (OOTiA).
- Completed work in the complex electronic hardware case study and published report.
- Completed studies and published reports on:
  - Advanced Flight Control Systems, Phase 1
  - Real Time Scheduling Analysis (RTSA)
  - Ethernet as an Aviation Databus
  - COTS Ground Systems Verification

Electromagnetic Hazards to Aircraft Systems

- Completed interim NASA report on emissions from wireless devices and the effects on aircraft navigation equipment.
- Completed Final report from lightning strike characterization study for definition of air-craft lightning environment.
- Completed revision to RTCA DO-160 and prepared draft advisory circular with updated electromagnetic compatibility test methods and requirements for large systems.

- Completed continued Protection Integrity Study investigating Aircraft wiring shielding effectiveness over the life of the aircraft.
- Completed study investigating appropriate methods to assess HIRF attenuation data.
- Completed 1st phase of study investigating neutron particle effects on flight critical systems.

KEY FY 2004 PRODUCTS AND MILESTONES:

Aircraft Icing

- Evaluate time effectiveness and aerodynamic performance of environmentally friendly and other modern fluids.
- Report on the development of new test standards and procedures for Type II and Type IV anti-icing fluids.

Software and Digital Systems Safety

- Complete research in COTS software and hardware with work in component integration.
- Complete phase 2 for a study of OOT for issues other than verification.
- Publish interim reports on research of software development tools and software verification tools.
- Complete research in Advanced Flight Control Systems, Phase 2.
- Complete additional research in RTSA.

Electromagnetic Hazards to Aircraft Systems.

- Report on:
  - Emissions from wireless devices and the effects on aircraft navigation equipment
  - Phase 3 study investigating aircraft continued protection integrity
  - Appropriate methods to assess HIRF attenuation data

FY 2004 PROGRAM REQUEST:

ONGOING ACTIVITIES

Aircraft Icing

- Continue to investigate atmospheric icing environment, including steps to acquire data from operational aircraft.
- Continue investigation of procedures and methods for laboratory determination of fluid holdover times.
- Continue investigation and assessment of ice detection technologies.
- Development of inflight icing capability at McKinley Environmental Laboratory

Software and Digital System Safety

- Continue research relative to emerging flight safety and certification issues identified by CAST and RTCA subcommittee efforts.
- Continue research in:
  - COTS software and hardware with work in component integration, Phase 5
  - Object-Oriented Technology
  - Software Development Tools and Software Verification Tools
  - Advanced Flight Control Systems, Phase 2

Electromagnetic Hazards to Aircraft Systems

- Continue work on emissions from wireless devices and the effects on aircraft navigation equipment.
- Continue studying:
  - The effects of lightning to aircraft structures and systems
  - Aircraft continued protection integrity issues
  - Appropriate methods to assess HIRF attenuation data
  - Neutron particle effects on flight critical systems

NEW INITIATIVES

Aircraft Icing

- Assess risk of airplane takeoff operations with inadvertent ice accumulation between deicing/anti-icing and takeoff.
- Research to establish threshold sensitivity and performance criteria for ground ice detector systems.
- Investigate new technology ice protection system and ice phobics.

Software and Digital System Safety

- Research COTS wrappers as a likely protection scheme against software faults.
- Research the partitioning and projection of the Avionics Computer Resource concept.
- Research safety engineering in software as an important method to prevent systems failures.
- Investigate tool qualification of complex electronic hardware for development and verification purposes.

Electromagnetic Hazards to Aircraft Systems

- Determine risk assessment to current and future Single Event Effects (SEE) avionics systems.
- Research SEE design and analysis to determine appropriate FAA regulations.

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2002)	$ 64,823
FY 2003 Request	4,301
FY 2004 Request	4,595
Out-Year Planning Levels (FY 2005-2008)	19,551
Total	$ 93,270

Budget Authority ($000)	FY 2000 Enacted	FY 2001 Enacted	FY 2002 Enacted	FY 2003 Request	FY 2004 Request
Contracts:					
Flight Safety	345	167	165	788	1,325
Atmospheric Hazards	1,598	2,490	4,722	1,990	1,416
Personnel Costs	1,744	1,349	1,388	1,417	1,707
Other In-house Costs	157	94	145	106	147
Total	**3,844**	**4,100**	**6,420**	**4,301**	**4,595**

OMB Circular A-11, Conduct of Research and Development ($000)	FY 2000 Enacted	FY 2001 Enacted	FY 2002 Enacted	FY 2003 Request	FY 2004 Request
Basic	0	0	0	0	0
Applied	3,844	4,100	6,420	4,301	4,595
Development (includes prototypes)	0	0	0	0	0
Total	**3,844**	**4,100**	**6,420**	**4,301**	**4,595**

A11d – Flight Safety/Atmospheric Hazards Research Products and Activities	FY 2004 Request ($000)	Program Schedule					
		FY 2003	FY 2004	FY 2005	FY 2006	FY 2007	FY2008
064-110 Flight Safety							
Software and Digital Systems Safety	$1,325						
Published Report on COTS Component Insertion		◆					
Evaluate COTS Software and Hardware Integration and Wrappers		◆	◇	◇			
Published Handbook for Object Oriented Technology in Aviation		◆	◇	◇			
Published Report on Complex Electronic Hardware Case Study		◆					
Published Report on Advanced Flight Control Systems, Phases 1 and 2		◆	◇				
Published Report on Real-Time Scheduling Analysis		◆					
Published Reports on Research of Software Development & Verification Tools		◆	◇	◇			
Published Reports on Ethernet as an Aviation Databus & Ground-Based COTS Components		◆	◇	◇			
Evaluate Avionics Computer Resource Concepts			◇	◇	◇	◇	◇
Evaluate Safety Engineering in Software			◇	◇	◇	◇	
Evaluate Tool Qualification of Complex Electronic Hardware			◇	◇	◇		
Evaluate Internet Aviation Data Transfer				◇	◇		
064-111 Atmospheric Hazards							
Aircraft Icing	$942						
Continue Investigation of Atmospheric Icing Environment Aloft		◆					
Evaluate Time of Effectiveness & Aerodynamic Performance of Modern Fluids		◆	◇				
Report on Acquisition of Atmospheric Icing Data from Operational Aircraft		◆					
Report on Global Atmospheric Icing Environment		◆					
Report on New Test Standards and Procedures for Type II and IV Anti-Icing fluids			◇				
Report on Icing Simulation Improvement for SLD Conditions (FAA/JAA/TC)				◇			
Icing Test Capability for In-Flight Conditions at McKinley Environmental Laboratory					◇		
Report on Investigation and Assessment of Ice Detection					◇		◇
Report on Airplane Takeoff Operations and Performance in Icing Conditions							◇
Electromagnetic Hazards to Aircraft Systems	$474						
Published Report on Characterization of Aircraft Lighting		◆	◇				
Updated Guidance Material on Electromagnetic Capability		◆					
Publish Protection Integrity Reports		◆	◇	◇	◇		
Publish Reports on Single Event Effects and Upset					◇	◇	◇
Personnel and Other In-House Costs	$1,854						
Total Budget Authority	$4,595	$4,301	$4,595	$4,694	$4,837	$4,938	$5,082

Note: **Out year numbers are for planning purposes only. Actual funding needs will be determined through the annual budget process.**

AGING AIRCRAFT

GOALS:

Intended Outcomes: The FAA intends to improve aviation safety by developing technologies, technical information, procedures, and practices that ensure the continued airworthiness of aircraft structures and components in the civil transport fleet. The Aging Aircraft Research Program has several main thrusts:

- Development and validation of analytical methodologies to predict the onset of widespread fatigue damage and to assess residual strength of aging aircraft structures.
- Development and validation of nondestructive inspection techniques to detect and quantify damage including cracking, corrosion, disbonding, and material processing defects.
- Flight and landing loads surveys to update and validate airworthiness standards.
- Development of enhanced maintenance and repair procedures for airframes.
- Development of damage tolerance methodologies and tools for rotorcraft and commuter airplanes.
- Development of information, technologies, and techniques to ensure the continued safe operation of aircraft electrical and mechanical systems.

Agency Outputs: The FAA establishes rules for aircraft design, construction, modification, inspection, maintenance, and repair. The FAA also publishes guidance and advisory material detailing acceptable means of compliance with its rules. Technical and policy information internal to the agency educates FAA field personnel regarding both technical and regulatory issues. The Aging Aircraft Research Program produces information and other products in support of all of these functions.

The Aging Aircraft Research Program produces technical data supporting the establishment of rules and develops technologies and processes that facilitate implementation of the rules. Often the products are utilized directly by aircraft operators or manufacturers responsible for complying with FAA regulations. The fundamental objective of all Aging Aircraft Research products is to improve flight safety by enhancing the airworthiness of aging aircraft.

Customer/Stakeholder Involvement: The FAA has established an extensive network for collaboration in aging aircraft research, including:

- Technical Community Representative Groups (TCRG) that establish and prioritize the requirements for each of the projects in the Aging Aircraft Research Program. The TCRGs operate under formal guidelines that ensure that FAA R&D projects support rulemaking and compliance with rules. The TCRGs are composed of representatives from FAA directorates and headquarters.
- The Aviation Rulemaking Advisory Committee (ARAC) is an FAA/industry forum established to ensure that the agency's rulemaking achieves intended results in the most expeditious and cost effective manner possible. ARAC also identifies and prioritizes requirements for R&D activities. The flight loads program area works closely with two ARAC subcommittees dealing with touchdown sink speed and ground lateral acceleration loads.
- The Subcommittee on Aircraft Safety (SAS) of the FAA Research, Engineering and Development Advisory Committee (REDAC) periodically reviews the Aging Aircraft Research Program. The committee members are from industry, academia, and other government agencies.

The Aging Aircraft Research Program directly supports the Aviation Safety Research Act of 1988 (Public Law 100-591). This act increased the scope of the FAA's mission to include research on methods for improving maintenance technology and detecting the onset of cracking, delamination, and corrosion of aircraft structures. In particular, this legislation directed the FAA to focus attention on maintaining the airworthiness of the aging commercial fleet.

The Aging Aircraft Program is the primary vehicle for supporting the safety recommendations of the White House Commission on Safety and Security, which recommended that the FAA's Aging Aircraft Program be expanded to cover non-structural systems.

Accomplishments: A series of four panel tests were completed at the Full-Scale Aircraft Structural Test Evaluation and Research (FASTER) facility, located at the FAA William J. Hughes Technical Center. The tests were designed to characterize the effects of multiple-site damage on aircraft structural integrity. In general the results showed

that multiple small cracks in the fuselage panels reduced the time needed to grow a fatigue crack to a predetermined length by about a third. The presence of these multiple cracks reduced the residual strength of the panels by approximately 20%. In addition to their valuable experimental results, the tests confirmed the ability of advanced computational models developed by the FAA and NASA to simulate crack growth and residual strength in panels with multiple-site damage.

The FAA's Airworthiness Assurance Nondestructive Inspection Validation Center (AANC), located in Albuquerque, NM, specializes in the performance of independent evaluations of new and enhanced inspection systems and maintenance and repair techniques. The hangar facility contains several aging aircraft, large fuselage sections, and a sample structural defect library. Aircraft test articles include a B-747, B-737, DC-9, HU-25A, Fairchild Metro II, UH-1H, and TH-57 aircraft.

Researchers at AANC generated probability of detection (POD) data for typical second- and third-layer crack inspection procedures that demonstrated that the originally assumed POD at the targeted crack size was inaccurate. Analysis of the data indicated several probable causes for the inaccuracy. These results have been used to update existing procedures, and will ensure the adequacy of similar procedures yet to be issued.

Working in conjunction with ARAC's Airworthiness Assurance Working Group, FAA researchers are developing and validating inspection technologies necessary for practical implementation of up-coming rulemaking aimed at preventing the occurrence of widespread fatigue damage in aged aircraft. Promising techniques include an eddy-current system that detects changes in the residual stress state preceding the development of cracking and a hybrid thermal-ultrasonic technique that identifies cracks by their ultrasonically-induced thermal emissions.

Civil transport flight and ground loads data collection programs are underway for both large and small transport aircraft. To collect flight loads data, optical quick access recorders have been installed on several B-737, B-747, B-767, MD-82, and A-320 aircraft, and usage data is being analyzed. Similar recording technology is being employed to collect data on BE-1900D, Cessna 172 and CRJ aircraft.

The FAA is conducting a series of video landing parameter surveys at high capacity commercial airports to better characterize touchdown loads for a wide variety of aircraft and airports. To date, six such surveys have been completed and data collection is continuing at the four-camera video landing survey facility that was established at the Atlantic City International Airport.

FAA researchers developed repair assessment sofware that automatically determines the critical locations for cracks and assesses continuing crack growth through multiple rivet holes using a two-dimensional finite element analysis. A fully-detailed design report is automatically generated to assist users in the development of documents required for FAA airworthiness approval. To date, hundreds of copies of the software (RAPID and RAPIDC) have been requested and furnished to FAA ACO engineers, the aviation industry (operators, manufacturers, and maintenance and repair facilities), and United States Air Force users.

To encourage commuter aircraft operators and manufacturers to adopt the superior design and maintenance practices employed by larger transport operators and manufacturers, the FAA sponsored the creation of two Supplemental Structural Inspection Documents (SSIDs). These documents specify a damage tolerance-based maintenance program for aircraft nearing or exceeding their design service objectives (originally expected service life). SSIDs were developed for the Cessna 402, a non-pressurized airplane, and the Fairchild SA226/SA227 airplane, a pressurized turboprop seating approximately 20 passengers.

In collaboration with the rotorcraft industry, academia, and other government agencies, the FAA developed a Rotorcraft Damage Tolerance Roadmap identifying ten research areas necessary to bring rotorcraft design and maintenance practices into conformance with more sophisticated practices used by large transport airplane operators and manufactuers. These research areas address the FAA and rotorcraft industry need for advisory material and compliance with damage tolerance requirements.

In partnership with the Naval Air Systems Command and the Office of Naval Research, the FAA began development of Arc Fault Circuit Breakers (AFCB) to replace thermal circuit breakers currently in use. Unlike thermal breakers, AFCBs can detect electrical arcing and rapidly remove power to the affected circuit, drastically reducing the chances of fire and related damage. AFCB prototypes were successfully tested aboard the FAA 727.

In support of the Aging Transport Systems Rulemaking Advisory Committee (ATSRAC), the FAA completed intrusive wiring inspections of six recently retired transport aircraft. The objectives of the study were to determine the state of wire on aged aircraft and to assess the efficacy of visual inspection. Samples were removed from the aircraft and subjected to an extensive battery of laboratory tests. Results of the inspections are documented in a report prepared for the ATSRAC.

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

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

- The FAA Center of Excellence for Airworthiness Assurance (AACE), a consortium consisting of twenty-eight core universities, Sandia National Laboratories, and numerous affiliates from government and industry.
- The Center for Aviation Systems Reliability (CASR), a consortium of three lead universities, Iowa State University, Northwestern University, and Wayne State, and several adjunct institutions. CASR is chartered to develop advanced inspection technologies for aircraft applications.
- The Airworthiness Assurance Nondestructive Inspection Validation Center (AANC), and FAA partnership with Sandia National Laboratory to test and evaluate inspection techniques in a realistic hangar environment and to enhance technology transfer.
- The Engine Titanium Consortium (ETC), comprised of Iowa State University, Pratt & Whitney, General Electric, and Honeywell, formed to develop methods for the inspection of engine components.

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

MAJOR ACTIVITIES AND ANTICIPATED FY 2003 ACCOMPLISHMENTS:

- Published a major technical report on the analysis of widespread fatigue damage. The report contains guidance regarding the analysis of the effects of widespread fatigue damage on the residual strength of aircraft structure.
- Completed modification of the fuselage panel test facility to accommodate specimens taken from retired aircraft.
- Completed AAWG-requested round-robin assessment of emerging nondestructive inspection systems for crack detection. Completed development of field prototype thermo-sonic inspection system for small crack detection.
- Completed development of an advanced prototype ultrasonic inspection system for the inspection of metal and composite bonds.
- Completed draft Advisory Circular on the use of composite patches for the repair of metallic fuselage structure.
- Published operational loads monitoring report for the Boeing 747 airplane.
- Published a usage data report on lateral acceleration during ground turning.
- Published commuter SSID Handbook with instructions for developing maintenance programs for aircraft at or near their design service objectives.
- Installed enhanced flight data recorders on Cessna 172 model aircraft.
- Released an enhanced version of a user-friendly software tool (RAPIDC) for damage tolerance analysis and design of aircraft repairs for commuter aircraft.
- Completed collection and analysis of helicopter usage data and certification test data, to support the development of a damage tolerance methodology for rotorcraft.
- Developed improved cleaning and drying processes for fluorescent penetrant inspection.

- Completed laboratory demonstration and factory evaluation of multizone inspection for nickel billet.
- Completed laboratory demonstration of high sensitivity forging inspection utilizing sophisticated techniques for curved entry surface inspection.
- Initiated work on second generation arc-fault circuit breakers with self-diagnostic features.
- Characterized and configured AANC 747 test-bed aircraft for testing of select electrical and mechanical systems.
- Completed development of first prototype risk assessment algorithms for in-service evaluation of original and modified aircraft wiring installations.
- Completed testing of aged power control relays and remotely controlled circuit breakers to determine whether the performance of these devices has degraded below original manufacturer specifications.

KEY FY 2004 PRODUCTS AND MILESTONES:

- Update Mil-Handbook 5 or publish commercial equivalent.
- Complete fatigue test and recommend mix mission load spectra for fatigue life prediction of typical commuter aircraft. Results will be used for AC 23-13 revision.
- Complete first field validation of pulsed eddy current technology for use on a DC-10 multi-layer application (crown splice).
- Complete Visual Inspection Reliability Study that examines how recognition criteria of different flaws can affect performance.
- Publish a revised specification, with SAE, for high-speed bolthole eddy current inspection (AS4787).
- Publish a report assessing the detectability of high-density inclusions in billets and forgings.
- Publish final report on the destructive testing of flight control mechanisms.

FY 2004 PROGRAM REQUEST:

ONGOING ACTIVITIES

In FY 2004, the program continues to focus on the areas listed at the beginning of the GOALS section above. The near-term emphasis will be on collecting more comprehensive data on large transport aircraft loads and developing and validating enhanced inspection techniques. Application specific efforts continue in the areas of commuter aircraft, and turbine engines.

In FY 2004, the following ongoing research will be terminated:

- Destructive evaluation of a high time large transport aircraft.
- Enhancements of a user-friendly software tool for damage tolerance analysis and design of aircraft repairs for commuter aircraft.
- Collection and analysis of commuter flight load data.
- Collection and analysis of large and small aircraft landing loads.
- Development of requirements for certification of Health and Usage Monitoring Systems (HUMS) for commercial rotorcraft.

NEW INITIATIVES

New tasking in the area of electrical systems research includes assessments of the effects of corrosion inhibitor and accidental abuse on electrical wiring. Electrical and Mechanical Systems tasking continues to evolve as requirements emerge from preliminary studies and the recommendations of ATSRAC.

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2002)	$ 267,678
FY 2003 Request	25,837
FY 2004 Request	17,920
Out-Year Planning Levels (FY 2005-2008)	75,352
Total	$ 386,787

Budget Authority ($000)	FY 2000 Enacted	FY 2001 Enacted	FY 2002 Enacted	FY 2003 Request	FY 2004 Request
Contracts:					
Aging Aircraft	17,714	29,250	27,351	21,429	13,055
Personnel Costs	3,547	3,451	4,041	4,100	4,478
Other In-house Costs	333	610	608	308	387
Total	**21,594**	**33,311**	**32,000**	**25,837**	**17,920**

OMB Circular A-11, Conduct of Research and Development ($000)	FY 2000 Enacted	FY 2001 Enacted	FY 2002 Enacted	FY 2003 Request	FY 2004 Request
Basic	0	0	0	0	0
Applied	21,594	33,311	32,000	25,837	17,920
Development (includes prototypes)	0	0	0	0	0
Total	**21,594**	**33,311**	**32,000**	**25,837**	**17,920**

A11e – Aging Aircraft Products and Activities	FY 2004 Request ($000)	Program Schedule					
		FY 2003	FY 2004	FY 2005	FY 2006	FY 2007	FY2008
065-110 Aging Aircraft							
Structural Response Simulation and Modeling	$422						
Continue Support for Mill-Handbook 5 (Standard Reference)		◆	◇	◇	◇	◇	◇
Inspection Systems Research and Development	$3,763						
Develop Crack Detection Technologies Including Pulsed Eddy Current for DC-10 Crown Splice		◆	◇	◇			
Develop Corrosion and Disbond Inspection Systems		◆	◇	◇	◇		
Perform Validation of Inspection Technologies		◆	◇	◇	◇	◇	
Conduct Visual and Fluorescent Penetrant Inspection Research		◆	◇	◇	◇		
Develop Enhanced Aircraft Repair Techniques		◆	◇	◇			
Airborne Data Monitoring Systems	$526						
Publish Reports on Large Transports and Commuter Loads Surveys		◆	◇	◇	◇		
Structural Integrity of Commuter Aircraft	$526						
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	$518						
Develop Rotorcraft Damage Tolerance Methodologies		◆	◇	◇	◇		
Continued Airworthiness of Aircraft Engines	$3,037						
Develop Enhanced Production Inspection Systems Including Multizone and Forging Inspection Systems		◆	◇	◇			
Assess and Verify Inspection Systems Performance		◆	◇	◇	◇		
Conduct Propeller Damage Tolerance Evaluation			◇	◇	◇	◇	
Aging Mechanical Systems	$684						
Publish Report on Destruction Testing of Flight Control		◆	◇				
Conduct Risk Assessment for Aging Mechanical Systems		◆	◇	◇	◇	◇	
Aging Electrical Systems	$3,579						
Conduct Wire Degradation Assessment		◆	◇	◇	◇		
Develop Wire Testing Equipment		◆	◇	◇			
Develop Advanced Circuit Protection Devices		◆	◇	◇	◇		
Conduct Risk Assessment for Aging and Modified Wire		◆	◇	◇	◇	◇	
Personnel and Other In-House Costs	$4,865						
Total Budget Authority	**$17,920**	**$25,837**	**$17,920**	**$18,212**	**$18,702**	**$18,980**	**$19,458**

Note: **Out year numbers are for planning purposes only. Actual funding needs will be determined through the annual budget process.**

AIRCRAFT CATASTROPHIC FAILURE PREVENTION RESEARCH

GOALS:

Intended Outcomes: The FAA intends to improve system safety by developing technologies and methods to assess risk and prevent potentially catastrophic defects, failures, and malfunctions in aircraft, aircraft components, and aircraft systems.

The Aircraft Catastrophic Failure Prevention Program focuses principally on using historical accident data and National Transportation Safety Board (NTSB) recommendations to examine and investigate known problem areas, such as:

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

Agency Outputs: The FAA establishes certification criteria for aircraft and publishes Advisory Circulars (AC) to outline acceptable means for meeting these rules. The program's objective is to ensure safe aircraft operation in the public domain.

The Aircraft Catastrophic Failure Prevention Program provides the technical information necessary to support these agency outputs.

Customer/Stakeholder Involvement: The FAA continues to establish collaborative efforts with organizations such as the following to ensure a balanced, responsive Aircraft Catastrophic Failure Prevention Program:

- The Aviation Rulemaking Advisory Committee (ARAC) is a FAA-industry forum established to ensure that agency rulemaking achieves intended results, and that the resources of industry are fully utilized in accomplishing these results. ARAC also identifies requirements and priorities for supporting R&D activities. The ARAC Powerplant Installation and Harmonization Working Group (PPIHWG) provide guidance to this program for the update of AC20-128.
- The FAA sponsors a series of workshops on turbine engine uncontainment characterization, modeling, and mitigation. This forum brings together industry and government (civil and military) to review progress on this subject and to recommend future courses of action.
- The FAA has developed partnerships with industry through the ARAC PPIHWG to collaborate in developing a modeling toolkit for the modeling of engine uncontainment events.
- The FAA supports the Aerospace Industries Association (AIA) – Transport Committee (TC) report examining propulsion system malfunctions and inappropriate crew response. This project brings industry and the FAA together to recommend courses of action to foster safety and to develop associated regulations and advisory materials.
- FAA is supporting pre-ARAC AIA effort to study propulsion indications with the intent of follow-on ARAC work on FAR 25.1305.
- The program also responds to 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.

Accomplishments: Results of the catastrophic failure prevention program research are provided to certification officials to form the technical basis for rule changes as well as new or modified ACs. Results are also provided to airframe and engine manufacturers and designers. Recent accomplishments include:

Engine Uncontainment Research

- Delivered a prototype aircraft vulnerability model for evaluation of uncontained engine debris hazards in cooperation with ARAC.
- Continued cooperative evaluation of vulnerability models with the U.S. Air Force and commercial airframe manufacturers.
- Continued modifications to vulnerability code based on airframe manufacturers' evaluations.
- Developed FAA, NASA, U.S. Navy, U.S. Air Force collaborative effort to perform the first full-scale engine disk crack detection demonstration in September 2002.
- Completed dry bay mitigation test for uncontained engine failure.
- Continued expansion of the advanced material DYNA-3D model to include failure modes and fabric interaction identified in system impact testing.

- Performed full-scale tests of advanced armor design concepts.

Propulsion Malfunction

- Developed a plan, in conjunction with sponsors for supporting ARAC. Initiate work on Indications of Propulsion System Malfunctions.
- Participate in NASA program reviews on Containment efforts and Propulsion Health Management.

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

- Inter-agency agreement with Naval Air Warfare Center Weapons Division (NAWCWD), China Lake, which partners with Boeing to modify military vulnerability analysis tools. These tools are used in examining the vulnerability of commercial transport aircraft to turbine engine uncontainment events.
- Inter-agency agreement with NAWCWD China Lake to conduct dry bay mitigation tests for uncontained engine failure. A Cooperative Research Development Agreement (CRDA) has been issued with industry to supply technologies that will be evaluated in the dry bay simulation test at China Lake.
- Airworthiness Assurance Center of Excellence (AACE) Grant with Arizona State University, which partners with Honeywell Engines and SRI International to develop "An Explicit Finite Element Model of Multi-layer Composite Fabric for Gas Turbine Engine Containment Systems.
- Inter-agency Agreement with NASA Glenn for cooperation on turbine engine uncontainment. NASA provides test support to the AACE Grant with Arizona State University for Engine Containment.
- AACE Grant with UC Berkeley which partners with Boeing and SRI International to develop "Lightweight Ballistic Protection of Flight-Critical Components on Commercial Aircraft."
- NAVAIR, U.S. Air Force, and NASA Glenn partnership in developing engine disk crack detection technologies.

MAJOR ACTIVITIES AND ANTICIPATED FY 2003 ACCOMPLISHMENTS:

Engine Uncontainment Research

- Completed the Uncontained Engine Debris Damage Assessment Model (UEDDAM) release 1.2 vulnerability code with composite material penetration equations.
- Completed work on a calibrated design tool to model engine uncontainment debris impact with thick plate shielding of titanium and aluminum aircraft materials.
- Reported results of engine disk crack detection demonstration test to determine what technologies are most effective in detecting a disk crack before catastrophic engine failure occurs.
- Completed reports on tests to study mitigation for severed pressurized fuel line fires in dry bays.
- Completed initial AACE Grant with ASU on advanced multi-layer composite fabric turbine engine containment DYNA-3D model for designers.
- Completed initial AACE Grant with UC Berkeley on "Lightweight ballistic protection of flight-critical components on commercial aircraft."

Propulsion Malfunction

Initiated phase 2 to expand on the definitions and recommendations for the three top engine malfunctions that trigger incidents (surge, asymmetric thrust and engine failure) that were developed in phase I.

KEY FY 2004 PRODUCTS AND MILESTONES:

Propulsion Malfunction

Continue research in propulsion malfunction indications and monitoring. This effort is updating the reference material for minimum requirements for cockpit indications and researching annunciation capabilities for engine emergencies.

FY 2004 PROGRAM REQUEST:

ONGOING ACTIVITIES

In FY 2004, all ongoing research on uncontained engine failures will be terminated.

The program will develop engine malfunction materials to better define a variety of propulsion malfunctions, including turbine engine surge.

NEW INITIATIVES

No new initiatives are planned in FY 2004.

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2002)	$ 25,380
FY 2003 Request	1,881
FY 2004 Request	762
Out-Year Planning Levels (FY 2005-2008)	3,314
Total	$ 31,337

Budget Authority ($000)	FY 2000 Enacted	FY 2001 Enacted	FY 2002 Enacted	FY 2003 Request	FY 2004 Request
Contracts:					
Aircraft Catastrophic Failure Prevention	1,308	2,131	2,101	1,391	263
Personnel Costs	607	610	621	463	468
Other In-house Costs	66	35	72	27	31
Total	**1,981**	**2,776**	**2,794**	**1,881**	**762**

OMB Circular A-11, Conduct of Research and Development ($000)	FY 2000 Enacted	FY 2001 Enacted	FY 2002 Enacted	FY 2003 Request	FY 2004 Request
Basic	0	0	0	0	0
Applied	1,981	2,776	2,794	1,881	762
Development (includes prototypes)	0	0	0	0	0
Total	**1,981**	**2,776**	**2,794**	**1,881**	**762**

A11f – Aircraft Catastrophic Failure Prevention Research Products and Activities	FY 2004 Request ($000)	Program Schedule					
		FY 2003	FY 2004	FY 2005	FY 2006	FY 2007	FY2008
066-110 Aircraft Catastrophic Failure Prevention Research							
Engine Uncontainment Research	$0						
Completed Engine Disk Crack Detection Test Reports		◆					
Completed Report on Phase 1 on the Dry Bay Mitigation Testing		◆					
Delivered Release 1.2 of UEDDAM Vulnerability Model to Industry		◆					
Completed Initial AACE Grant with UC Berkley on "Lightweight Ballistic Protection of Flight-Critical Components on Commercial Aircraft"		◆					
Completed Initial AACE Grant with SU on Advanced Multi-Layer Composite Fabric Turbine Engine Containment DYNA-3D Model for Designers		◆					
Complete the UEDDAM Vulnerability Code with Advanced Material Penetration equations			◇				
Complete Containment Modeling Development for Metal/Multi-Layer Fabric Structure				◇			
Develop Prototype Engine Crack Detection System						◇	
Develop Dry Bay Mitigation Recommendations				◇			
Propulsion Malfunction	$263						
Develop Recommendations for Propulsion Malfunction Indications		◆	◇				
Demonstrate Advanced Monitoring Capabilities				◇			
Develop Recommendations for Propulsion Monitoring System					◇		
Conduct Propulsion Monitoring Flight Test							◇
Personnel and Other In-House Costs	$499						
Total Budget Authority	$762	$1,881	$762	$786	$815	$841	$872

Note: **Out year numbers are for planning purposes only. Actual funding needs will be determined through the annual budget process.**

AVIATION SAFETY RISK ANALYSIS

GOALS:

Intended Outcomes: The FAA will continue to increase its collaboration with industry in their mutual search for programs and systems with true potential for increasing aviation safety. Accordingly, the partners will build on their previous collaboration to improve risk identification/assessment/ management, safety performance measurement and the shared use of safety-related data. The Aviation Safety Risk Analysis (ASRA) Program focuses primarily on:

- Design/development and/or enhancement of risk management/decision support tools embedded in FAA analytical systems, e.g., flight standards service Safety Performance Analysis System (SPAS), and the aircraft certification service safety management program products. These tools encompass particulars about air carriers, aircraft design, aircraft maintenance, discrepancy reports, repair stations (both domestic and foreign) aviation training schools, and air personnel.
- Development of advanced risk assessment indicators/safety performance measures and analytical methods. These allow the FAA to more effectively and efficiently use information contained in various FAA and industry databases.
- Development of hazard/risk identification and prioritization methodologies.
- Establishment of a forum with industry to exchange aviation risk assessment/risk management and safety performance measures models and methodologies.
- Development of an improved safety analysis methodology that will be used to certify new products by including human factors and operational issues.
- Development of a risk-based process to improve aircraft certification oversight activities and promote synergy with policy development.
- Development and/or enhancement of the Maintenance Malfunction Information Reporting (MMIR) System with capabilities to track critical helicopter parts, to capture part utilization/performance data, and to perform trend analysis on the captured data.
- Development of continuing analysis surveillance system/quality assurance models that can be applied/used by FAA certificate holders.
- Development, with input from the industry, new procedures, recommendations, tools and techniques to optimize air carrier and general aviation operations at our nation's airports.

Agency Outputs: The Federal Aviation Act of 1958 and the Federal Aviation Regulations (FAR) provide the FAA the statutory authority and responsibility to conduct surveillance of air operators, air agencies, aircraft, and airmen to ensure conformance with the FARs and aviation safety standards. The outputs from the Aviation Safety Risk Analysis research program will lead to effective, efficient and targeted FAA oversight processes (certification, surveillance, investigation, and certification management) through improving risk identification/assessment/ management, data gathering techniques, analysis, and risk management/decision support tools. These outputs enable systematic risk assessment and safety performance measurement to take proactive steps to reduce the rate of aviation related accidents and incidents. Based on insights from risk analysis, the FAA targets and increases its leverage of aviation safety inspector and certification engineering resources.

Customer/Stakeholder Involvement: In 2001, the Flight Standards Service introduced the System Approach to Safety Oversight (SASO). The goal of SASO is to put in place an integrated suite of AFS business applications necessary to support a system approach to oversight by emphasizing cooperative problem solving, and proactive identification and mitigation of risks. This goal will be achieved by using a well-trained workforce equipped with reengineered business processes, comprehensive safety data and risk management/decision support tools and models in an automated environment. In support of this effort, the ASRA program will provide: systems engineering; analyses in the form of design of safety performance measure and risk indicators, identification of data sources, analytical methodologies, information presentation; and system safety risk assessment research (such as hazard analysis, design of risk indicators, use of failure modes, effects, and criticality analysis [FMECA], and Aviation System Risk Models).

The ASRA Program responds directly to the Safer Skies Agenda, recommendations in the Challenge 2000 Report and the FAA 90-day Safety Review.

Maximum information sharing alerts both the FAA and industry to pending aviation safety-related problems. Developing a certification and surveillance program built on targeting resources to address safety risks ensures that corrective action is taken much sooner. Thus, the primary beneficiaries of this effort are the general flying public.

The FAA worked with Helicopter Association International (HAI) to develop and release the maintenance malfunction information reporting system. This software tool has improved the collection, storage, and transfer of service difficulty reports and part warranty information. Data improvement and standardization efforts respond to recent Congressional hearings and the General Accounting Office (GAO) report that recommends the FAA increase the quality and timeliness of their aviation safety data. More importantly, analytical and decision support tools rely on high quality data to identify potential safety risk areas.

Accomplishments: With the focus on "system safety," functional models of air carrier operations, repair station operations, and training simulators were completed and new models to address other FAR parts will be developed. Initial studies on decision support system (DSS) tools have been completed. In addition, the FAA and NASA have co-sponsored workshops on risk analysis and safety performance measures. The focus of these workshops is to promote the sharing of knowledge philosophies, approaches, models, and methodologies among representatives from the aviation industry including various air operators, DoD, and general aviation.

R&D Partnerships: The U.S. Air Force Air Mobility Command provides technical support and assistance in developing safety critical performance measures. A memorandum of cooperation exists between the FAA and the Netherlands Civil Aviation Authority to partner on aviation system safety initiatives. The Air Carrier Operations System Model (FAR Part 121), Repair Station Functional Model, and Training Center models were developed with assistance from several major air carrier, manufacturers and maintenance facilities. The Workshop on Risk Analysis and Safety Performance Measurement is co-hosted with NASA. HAI continues to work with the FAA to develop and enhance the Web-based MMIR system that now accepts data from helicopter on-board health, usage and monitoring systems (HUMS) for safety analysis and condition based maintenance monitoring. Several university grants have been awarded to support the development and testing of aviation safety risk models. For example, Ohio State University is conducting a cognitive task analysis of the decision-making process of managers and aviation safety inspectors.

MAJOR ACTIVITIES AND ANTICIPATED FY 2003 ACCOMPLISHMENTS:

Risk Management Decision Support

- Continued development of systems engineering models of FAA-certificated entities (or FAR parts) within the air transportation system.
- Continued to develop risk/hazard/accident models and tools derived from FAA and industry accepted system safety models of FARs related to safety oversight.
- Continued the design of next generation safety critical performance measures and risk indicators based on system engineering and system safety models.
- Initiated integration of the system models, performance and risk indicators for use by the FAA and industry.
- Continued development of new and enhanced risk analysis models and capabilities.
- Continued the development of an oversight evaluation tool to determine the effectiveness and efficiency of the oversight system.
- Continued a cognitive task analysis of the decision-making processes of managers and aviation safety inspectors.
- Continued a decision support system requirements study.
- Continued workshops with industry to discuss aviation risk analysis and safety performance measurement methodologies and tools.
- Initiated the development of methodologies and operations research studies to ascertain the target level of safety for relevant safety parameters for air carrier operations.

Aircraft Maintenance - Maintainability and Reliability

- Continued the development of a web-based information system prototype that facilitates the collection/ dissemination of aircraft maintenance related data.

- Completed the development of guidance and course material recommendations for training/recurrent training on the capability/usage of aircraft on-board built-in test equipment (BITE) and the use/misuse of BITE in aircraft maintenance.
- Continued the development of the Safety Through Accurate Technical Statistics (STATS) software module and integrated into the web-based Maintenance Malfunction Information Reporting (MMIR) system to track actual flight hours/flight profiles of helicopters.
- Continued the development continuing analysis and surveillance (CASS) generic models – to be applied on FAR Part 145 repair stations and FAR Part 135 operators.

Safety Analysis Methodology

- Continued the analysis of airworthiness information to identify unsafe conditions and assess their relative impact on continued airworthiness.
- Continued the analysis of operational information to establish the standard probability values of encountering the subject conditions as addressed in Advisory Circular 25.1309-1B, Appendix 4.
- Initiated the development of a methodology that would provide an appropriate level of certification credit for design features intended to reduce the effect of system errors.
- Continued the review of FAA-maintained certification and continued airworthiness data and commence development of methods for sorting and evaluating certification and continuous airworthiness data in ways that identify technical areas that pose a fleet-wide safety risk.

Runway Capacity Analysis

- Initiated studies that identified and prioritized tasks needed to maintain and improve safety and efficiency in flight and ground operations in the terminal area not specifically addressed by other FAA programs.
- Initiated studies that identify operational problems associated with Terminal Area Operations, conduct appropriate research, operational evaluation programs and human factors studies on the identified areas, and produce procedures, advisory material and equipment recommendations aimed at mitigating the problems.
- Initiated studies on the use of runways, by type of aircraft.

KEY FY 2004 PRODUCTS AND MILESTONES:

Risk Management Decision Support

- Continue development, testing, and validation of new and enhanced risk analysis models and capabilities.
- Continue development of systems engineering models of FAA-certificated entities (or FAR parts) within the air transportation system.
- Continue development of risk/hazard/accident models and tools derived from FAA and industry accepted system safety models of FAR parts related to safety oversight.
- Continue design of next generation safety critical performance measures and risk indicators based on system engineering and system safety models. These tasks will be accomplished in conjunction with industry.
- Continue integration of the system models, performance and risk indicators for use by the FAA and industry.
- Continue workshops with industry to discuss aviation risk analysis and safety performance measurement models and methods.
- Continue design of decision support system options analysis.
- Continue development of Risk/Hazard/ Accident models and tools.
- Continue development of methodologies and operations research studies to ascertain the target level of safety for relevant safety parameters for air carrier operations.

Aircraft Maintenance - Maintainability and Reliability

- Continue development of the Safety Through Accurate Technical Statistics (STATS) software module and integrated into the web-based Maintenance Malfunction Information Reporting (MMIR) system to track actual flight hours/flight profiles of helicopters.
- Complete development of a web-based information system prototype that facilitates the collection/ dissemination of aircraft maintenance related data.
- Develop training materials for both FAA and industry personnel in the use and understanding of CASS.

Safety Analysis Methodology

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

Runway Capacity Analysis:

- Continue studies that identify operational problems associated with Terminal Area Operations, conduct appropriate research, operational evaluation programs and human factors studies on the identified areas, and produce procedures, advisory material and equipment recommendations aimed at mitigating the problems.
- Continue studies on the use of runways, by type of aircraft.
- Develop a program plan to expand the use of operations on intersecting runways.
- Develop air traffic and flight procedures for conducting operations on intersecting runways.

FY 2004 PROGRAM REQUEST:

ONGOING ACTIVITIES

In FY 2004 research continues to focus on the areas listed at the beginning of the GOALS section above. Data assimilation, analysis, and tool development will continue in support of program initiatives. The analysts will work with government, industry, and academia aviation safety subject matter experts. This cooperation will ensure that risk management/decision support tools, including safety critical performance measures and risk indicators are properly defined, developed, tested, and evaluated prior to implementation. The program will investigate, test, and recommend improvements, including standardization, to the quality (and quantity) of data used in the performance measures. It will also complete studies to identify and verify flight standards and aircraft certification safety information requirements.

NEW INITIATIVES

No new initiatives are planned in FY 2004.

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2002)	$ 36,262
FY 2003 Request	6,815
FY 2004 Request	7,898
Out-Year Planning Levels (FY 2005-2008)	33,021
Total	$ 83,996

Budget Authority ($000)	FY 2000 Enacted	FY 2001 Enacted	FY 2002 Enacted	FY 2003 Request	FY 2004 Request
Contracts:					
Aviation Safety Risk Analysis	5,286	5,150	4,377	5,400	6,241
Personnel Costs	1,393	1,414	1,253	1,317	1,528
Other In-house Costs	145	78	154	98	129
Total	**6,824**	**6,642**	**5,784**	**6,815**	**7,898**

OMB Circular A-11, Conduct of Research and Development ($000)	FY 2000 Enacted	FY 2001 Enacted	FY 2002 Enacted	FY 2003 Request	FY 2004 Request
Basic	0	0	0	0	0
Applied	6,824	6,642	5,784	6,815	7,898
Development (includes prototypes)	0	0	0	0	0
Total	**6,824**	**6,642**	**5,784**	**6,815**	**7,898**

A11h – Aviation Safety Risk Analysis Products and Activities	FY 2004 Request ($000)	Program Schedule					
		FY 2003	FY 2004	FY 2005	FY 2006	FY 2007	FY2008
060-110 Aviation Safety Risk Analysis							
Risk Management Decision Support	$3,576						
Develop System Engineering Models of FAA Certified Entities		◆	◇	◇	◇		
Develop Risk/Hazard/Accident Models and Tools		◆	◇	◇	◇		
Design Next Generation Safety Critical Performance Measures and Indicators Based on System Engineering and System Safety Models on FAR Parts 142, and 145		◆	◇	◇	◇		
Initiate Integration of System Model, Performance and Risk Indicators		◆	◇	◇	◇	◇	
Develop, Test, Validate and Enhance Risk Analysis Models and Capabilities		◆	◇	◇	◇		
Develop and Implement Safety Critical Performance Measures		◆	◇	◇	◇	◇	◇
Conduct a Decision Support System Requirements Study		◆	◇	◇	◇		
Conduct Workshops with Industry to Discuss Aviation Risk Analysis and Safety Performance Measurement Methodologies and Tools		◆	◇	◇	◇	◇	◇
Aircraft Maintenance – Maintainability & Reliability	$105						
Develop Continuous Analysis Surveillance System Model and Training Materials		◆	◇				
Continue the Development of the Safety Through Accurate Technical Statistics (STATS) Software Module and Integrated in to MMIR		◆	◇				
Complete Criteria for Utilizing Built-In Test Equipment (BITE) and the Develop of Guidance and Course Material Recommendations for Training/Recurrent Training on the Capability/Usage of Aircraft (BITE)		◆					
Complete Web-Based Information System for Aircraft Maintenance		◆	◇				
Identify Methods, Techniques, Etc. to Improve Certification and Maintenance Processes that are Currently in Place Throughout the Airplane's Service Life				◇	◇	◇	
Total Budget Authority							

Note: **Out year numbers are for planning purposes only. Actual funding needs will be determined through the annual budget process.**

A11h – Aviation Safety Risk Analysis (cont.) Products and Activities	FY 2004 Request ($000)	Program Schedule					
		FY 2003	FY 2004	FY 2005	FY 2006	FY 2007	FY2008
Safety Analysis Methodology	$600						
Continue the Analysis of Airworthiness Information to Identify Unsafe Conditions and Assess their Relative Impact on Continued Airworthiness		◆	◇	◇			
Continue Analysis of Operational Information to Establish the Standard Probability of Value of Encountering the Subject Conditions as Addressed in Advisory circular 25.1309-1B, Appendix 4		◆	◇	◇			
Complete the Development of Methods for Sorting and Evaluating Certification and Continous Airworthiness Data in ways that Identify Technical Problems that Pose a Fleet-Wide Safety Risk			◇				
Runway Capacity Analysis	$1,960						
Conduct Studies on the use of Runways, by Type of Aircraft		◆	◇	◇	◇		
Conduct Studies that Identify Operational Problems Associated with Terminal Area Operations		◆	◇	◇	◇		
Develop a Program Plan to Expand the Use of Operations of Intersecting Runways				◇	◇		
Develop Air Traffic and Flight Procedures for Conducting Operations on Intersecting Runways				◇	◇		
Personnel and Other In-House Costs	$1,657						
Total Budget Authority	$7,898	$6,815	$7,898	$8,006	$8,208	$8,307	$8,500

Note: **Out year numbers are for planning purposes only. Actual funding needs will be determined through the annual budget process.**

AIRPORTS TECHNOLOGY - SAFETY

Goal:

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

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

Agency Outputs: The FAA is required by law to develop standards and guidance material for airport design, construction, and maintenance. The agency uses the airport Advisory Circular (AC) system as its principal means of communicating with a user community consisting of U.S. airport planners, designers, operators, and equipment manufacturers. ACs cover airport geometric design, pavement design, safety areas, visual aids, access roads, rescue and firefighting, ice and snow control, and wildlife control. The FAA and its regional offices enforce standards and guiding material when administering the Airport Improvement Program (AIP).

The Airport Technology program provides the technical information necessary to support and update these agency outputs in a timely manner.

Customer/Stakeholder: Achieving the overall FAA goal of reducing accidents requires improvement in airport safety as well as aircraft safety. Airports need new technology for improving airport lighting and marking to help reduce surface accidents and runway incursions. The increasing numbers of wildlife require new techniques for airports to modify wildlife habitats and control wildlife on or near the airport. The introduction of new large aircraft will require improvements in aircraft rescue and fire fighting to address double decked aircraft carrying up to 800 passengers.

Accomplishments: During the past five years, 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. Some major accomplishments are:

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

R&D Partnerships:

- FAA-U.S. Air Force, Tyndall Air Force Base *
- FAA-USDA, National Wildlife Research Center, Sandusky, Ohio *
- FAA-Agencies of Canadian Government (for pavement technology and winter operations safety) **
- FAA-NASA (for joint runway traction research) *
- FAA-Port Authorities of New York and New Jersey (for design and construction of aircraft arrestor bed) *
- FAA-industry (to test and develop infrared deicing facilities and soft-ground arrestor materials) **

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

** Cost Sharing

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

MAJOR ACTIVITIES AND ANTICIPATED FY 2003 ACCOMPLISHMENTS:

Airport safety technology

- Produced report on taxiway centerline deviations of B-747 wide body aircraft at JFK and Anchorage.
- Conducted evaluation of improved airport lighting.
- Competed research on next generation elevated boom technology.
- Developed specifications for prototype Interior Intervention Vehicle (IIV).
- Initiated research for replacement primary fire extinguishing agent.
- Continued wildlife habitat studies in the Southwest and Pacific Northwest, at Chicago O'Hare Airport, and at USDA Plum Brook Station.
- Continued evaluation of wildlife dispersion techniques.
- Began development of the National Advisory Wildlife Strike System for Airports.
- Continued populating the National Wildlife Strike Database.
- Initiated the following studies on wildlife habitats: habitat study in the Pacific Northwest (focusing on vegetation); relocation of raptors at Chicago O'Hare Airport; grass height at USDA Plum Brook Station; habitat study in the southwest.
- Investigated airport wildlife control and detection techniques including use of bird effigies, laser, and microwave as wildlife dispersion methods, and evaluation of radar for wildlife detection.
- Continued to develop bird-strike risk assessment factors for civilian airports.
- Set up comprehensive web site on wildlife mitigation methods and techniques, and continued to populate the National Strike Database.
- Continued development means to acquire and report runway surface friction values for pilot use.
- Completed evaluation of Light-Emitting Diode (LED) light strips for movement and non-movement areas.
- Completed evaluation of fiber-optic runway-distance-remaining signs at Pittsburgh International Airport.
- Completed initial development of the full-scale post crash interior fire suppression facility.
- Published testing standards for airport firefighting extinguishing agents.
- Completed wildlife habitat study at John F. Kennedy International Airport focusing on grass height and vegetation types.
- Published specifications for aircraft infrared deicing system.
- Initiate research for replacement primary fire extinguishing agent.

KEY FY 2004 PRODUCTS AND MILESTONES:

- Complete Technical Note on Radio Frequency Identification system (RFID) In-Service Evaluation.
- Complete Technical Note on Waterborne Paint and Bead Evaluation.
- Update U.S. Air Force System with Civilian Bird Strikes Data.
- Produce Interim Report on DUST Program-Basic RADAR.
- Complete Construction of Two-Level Passenger Fuselage Mockup for Aircraft Rescue Fire Fighting (ARFF) Testing.
- Publish Report on Acquisition/Reporting of Runway Surface Friction Values.
- Publish Advisory Circular on Non-Chemical Methods for Deicing Aircraft.

FY 2004 PROGRAM REQUEST:

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

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2002)	$14,457
FY 2003 Enacted	7,600
FY 2004 Request	9,667
Out-Year Planning Levels (FY 2005-2008)	55,900
Total	$87,624

Budget Authority ($000)	FY 2000 Enacted	FY 2001 Enacted	FY 2002 Enacted	FY 2003 Enacted	FY 2004 Request
Contracts:					
Airport - Safety	2,712	6,068	2,450	7,600	9,667
Personnel Costs		0	0	0	0
Other In-house Costs		0	0	0	0
Total	**2,712**	**6,068**	**2,450**	**7,600**	**9,667**

OMB Circular A-11, Conduct of Research and Development ($000)	FY 2000 Enacted	FY 2001 Enacted	FY 2002 Enacted	FY 2003 Enacted	FY 2004 Request
Basic	0	0	0	0	0
Applied	0	0	0	0	0
Development (includes prototypes)	2,712	6,068	2,450	7,600	9,667
Total	**2,712**	**6,068**	**2,450**	**7,600**	**9,667**

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

Airports Technology – Safety Products and Activities	FY 2004 Request ($000)	Program Schedule					
		FY 2003	FY 2004	FY 2005	FY 2006	FY 2007	FY2008
Airport Technology – Safety Goal	* $9,667						
Conduct Evaluation of Improved Airport Lighting		◆		◇	◇	◇	◇
Publish Specifications for Aircraft Infrared Deicing System		◆		◇	◇	◇	
Develop Standards for Anti-Rollover and Stability Requirements for Heavy Airport Rescue Vehicles		◆	◇		◇	◇	◇
Develop Full-Scale Interior Fire Suppression Facility to Perform Next Generation Aircraft Requirements Research		◆		◇			◇
Publish Testing Standards for Airport for Fire Fighting Extinguishing Agents		◆	◇		◇		◇
Continue Populating the National Strike Data Base		◆		◇			
Perform Wildlife Habitat Modeling at Selected Airports		◆	◇		◇		◇
Evaluate Radar Systems for Bird Detection and Alerting Near Airports			◇	◇	◇		
Conduct Research to Improve Runway Safety and Reduce Runway Incursion		◆	◇	◇	◇	◇	◇
Produce Report on Taxiway Centerline Deviations of B-747 Wide Body Aircraft		◆	◇	◇	◇		
Total Budget Authority	* $9,667	$7,600	* $9,667	$13,767	$13,905	$14,044	$14,184

Note: Out year numbers are for planning purposes only. Actual funding needs will be determined through the annual budget process.
* These funds are included in the FY 2004 budget request and reflect only the contract dollars.

COMMERCIAL SPACE TRANSPORTATION SAFETY

GOALS:

Intended Outcomes:

Non-traditional Flight Safety Systems and Integrated Vehicle Health Monitoring

To effectively license launch and reentry vehicles, the FAA has the responsibility of becoming technically knowledgeable of proposed vehicle designs and the significant differences between those designs and the designs of presently licensed vehicles. Accordingly, research must be conducted to keep the FAA aware of the safety related issues associated with new technologies and techniques. The commercial launch industry anticipates the need for non-traditional flight safety systems and integrated vehicle health monitoring (IVHM) systems to be used during reusable launch vehicle (RLV) launch and reentry activities to reduce operational costs and enhance flight safety capability. Flight safety systems are those systems that minimize the threat to public safety posed by a malfunctioning vehicle. Non-traditional versions of these systems will include fully autonomous systems and semi-autonomous systems that interface with pilots and/or the range.

IVHM systems are onboard systems that will detect, report, and isolate malfunctioning units and sub-systems of a vehicle to ensure safety and mission success. The FAA recognizes that the utility of these safety systems could be crucial to the development of an RLV capable of maintaining a consistent level of safety at a variety of ranges and spaceports. To that end, the major outcomes from this program will include:

- Research of the design, qualification, and integration of past, current, and proposed non-traditional flight safety systems and IVHM systems.
- A plan of demonstrations of the enabling capabilities, technologies, and systems that can lend to the development of standards for public safety for these systems.

Inspection Technique for Thermally-Protected Commercial Space Vehicle

The FAA intends to improve public safety regarding space launch vehicle by investigation improvement to the techniques and methods associated with the inspection of space launch vehicles that are thermally protected with thermal protection systems (TPS). Thermal protection systems are used to protect critical aerospace structures exposed to severe heat environments. Given the criticality the TPS function with respect to mission success that translates into ensuring public safety, FAA will embark on a research geared toward new Non-Destructive Evaluation (NDE) methods for use with TPS.

Development and Calibration of a Launch and Reentry Vehicle Hazard Model

The FAA intends to improve public safety regarding commercial space launch vehicle by investigating improvement to methods of analyzing debris survivability. This task will develop and calibrate an acceptable stochastic model of estimating a vehicle's breakup process. The model will be used to identify public safety issues associated the AST-licensed launch and reentry activities, and the public safety issues associated with the mitigation of risk posed by debris to people on the ground.

Medical and Equipment Criteria for Human Spaceflight

The FAA intends to investigate issues and develop standards associated with the carriage of humans on board commercial space transportation vehicles. Major objectives of these studies and efforts are to develop:

- Medical criteria for human survival during commercial space transportation operations.
- Minimum requirements for environmental control and life support systems on manned commercial space transportation vehicles.

Agency Outputs:

Non-traditional Flight Safety Systems and Integrated Vehicle Health Monitoring

The FAA maintains public safety associated with RLV launch and reentry activities through the development of regulations that identify the requirements for safe RLV operations. This research program provides the resources to address the concerns regarding public safety issues associated with non-traditional flight safety systems and IVHM systems. This research could

develop and frame the criteria and/or methodology that can be applied to RLV concepts utilizing these systems to provide a method for determining their safety on a case-by-case basis.

Inspection Technique for Thermally-Protected Commercial Space Vehicle

The FAA maintains public safety associated with Commercial Space Launch Vehicles by development of safety standards, regulations and guidelines that identify the requirement for safe launch. This research program provides the technical support needed to develop requirements or guidelines for inspecting components of space vehicles that are protected by thermal protection systems.

Development and Calibration of a Launch and Re-entry Vehicle Hazard Model

The FAA maintains public safety associated with commercial launch vehicle activities by developing safety standards and acceptable methods of verification. This research program will provide a probabilistic breakup model that will allow the Commercial Space Transportation industry to mitigate risk to the public during the launch and/or reentry of their licensed operations.

Medical and Equipment Criteria for Human Spaceflight

The Commercial Space Act of 1998, Public Law 105-303, extended the FAA's licensing authority to reentry of a reentry vehicle, including a reusable launch vehicle, and operation of a reentry site by a non-federal entity. The FAA has developed regulations for licensing RLV missions and the conduct of commercial space reentry activities. FAA regulations do not specifically address the safety of humans aboard commercial RLVs. Prospective commercial RLV operators are proposing diverse design and operational concepts that may involve transport of crew and passengers, which may require the FAA to address safety issues and establish regulations for the transportation of humans into and from space. The results of these studies will be utilized to provide inputs to support potential or future rulemaking.

Customer/Stakeholder Involvement:

Non-traditional Flight Safety Systems and Integrated Vehicle Health Monitoring

The non-traditional flight safety systems and IVHM systems research is intended to produce guidelines for safety standards that will provide the public with a sufficient level of safety during launch and reentry activities of vehicles utilizing these systems. This research initiative is the product of a suggestion for study by the FAA Commercial Space Transportation Advisory Committee (COMSTAC) Reusable Launch Vehicle Working Group (RLVWG). This group, composed of industry representatives, provides the FAA with insight into systems and methodologies capable of protecting the public from hazards associated with the operation of RLVs. The results of this research will be presented to the RLVWG for comment and suggestions for further investigation. The resulting guidelines will be prepared with the intent of providing the industry with a less burdensome but equally effective approach to the regulation of the launch and reentry of vehicles utilizing these systems.

Inspection Technique for Thermally-Protected Commercial Space Vehicle

The COMSTAC RLVWG has provided comments and suggestions on this effort.

Development and Calibration of a Launch and Re-entry Vehicle Hazard Model

Comments and suggestions will be provided by the COMSTAC RLVWG on this project.

Medical and Equipment Criteria for Human Spaceflight

Because there are currently no federal regulations that specifically address the safety of humans on board commercial space transportation vehicles, this program will facilitate advances in the development and the commercialization of space transportation systems that propose to carry humans.

Accomplishments:

Non-traditional Flight Safety Systems and Integrated Vehicle Health Monitoring

FY 2003 is the first year of funding for this R&D effort.

Inspection Technique for Thermally-Protected Commercial Space Vehicle

FY 2003 is the first year of funding for this R&D effort.

Development and Calibration of a Launch and Re-entry Vehicle Hazard Model

FY 2003 is the first year of funding for this project.

Medical and Equipment Criteria for Human Spaceflight

The FAA has produced draft documents on:

- The Role of the FAA Office of Aerospace Medicine in Support of Manned Commercial Space Transportation.
- Proposed Medical Certification Standards for Commercial Aerospace Crews.
- Recommended Guidelines for Medical Screening of Commercial Space Passengers.

R&D Partnerships:

Non-traditional Flight Safety Systems and Integrated Vehicle Health Monitoring

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

Inspection Technique for Thermally-Protected Commercial Space Vehicle

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

Development and Calibration of a Launch and Re-entry Vehicle Hazard Model

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

Medical and Equipment Criteria for Human Spaceflight

The FAA and NASA are in the process of developing an MOA to establish an expanded working relationship between NASA and the FAA, and to provide a mechanism for collaborating and sharing information to assist in developing minimum launch vehicle and human flight safety requirements, which would facilitate the development of commercial reusable launch vehicles for human transport.

MAJOR ACTIVITIES AND ANTICIPATED FY 2003 ACCOMPLISHMENTS:

Non-traditional Flight Safety Systems and Integrated Vehicle Health Monitoring

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

Inspection Technique for Thermally-Protected Commercial Space Vehicle

Provided a report on the results of tests to gauge the effectiveness of a Narrow Band Eddy Current method for inspecting thermally protected components.

Development and Calibration of a Launch and Re-entry Vehicle Hazard Model

Developed a stochastic model for use in estimating launch/reentry vehicle debris breakup characteristics.

Medical and Equipment Criteria for Human Spaceflight

Developed a draft interim report on the research findings.

KEY FY 2004 PRODUCTS AND MILESTONES:

Non-traditional Flight Safety Systems and Integrated Vehicle Health Monitoring

Follow-on tasks in FY 2004 may be proposed if unresolved issues involving these systems are identified during FY 2003 efforts.

Inspection Technique for Thermally-Protected Commercial Space Vehicle

Provide a report on the results of tests to gauge the effectiveness of Capacitance methods for inspecting thermally protected components.

Development and Calibration of a Launch and Re-entry Vehicle Hazard Model

Continue studies to understand the debris breakup process and to develop a model to accurately predict debris survivability. The major product of this follow-on research will focus on the relationship of the debris survivability analysis and

the Expected Causality (Ec) calculation required by the FAA.

Medical and Equipment Criteria for Human Spaceflight

Develop a report on the research findings.

FY 2004 PROGRAM REQUEST:

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

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2002)	$0
FY 2003 Request	0
FY 2004 Request	0
Out-Year Planning Levels (FY 2005-2008)	0
Total	$0

Budget Authority ($000)	FY 2000 Enacted	FY 2001 Enacted	FY 2002 Enacted	FY 2003 Request	FY 2004 Request
Contracts:					
Commercial Space Transportation Safety	0	0	0	0	0
Personnel Costs	0	0	0	0	0
Other In-house Costs	0	0	0	0	0
Total	**0**	**0**	**0**	**0**	**0**

OMB Circular A-11, Conduct of Research and Development ($000)	FY 2000 Enacted	FY 2001 Enacted	FY 2002 Enacted	FY 2003 Request	FY 2004 Request
Basic	0	0	0	0	0
Applied	0	0	0	0	0
Development (includes prototypes)	0	0	0	0	0
Total	**0**	**0**	**0**	**0**	**0**

Notes:

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

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

- Out year funding is under review.

Commercial Space Transportation Safety Products and Activities	FY 2004 Request ($000)	Program Schedule					
		FY 2003	FY 2004	FY 2005	FY 2006	FY 2007	FY2008
Non-Traditional Flight Safety Systems and Integrated Vehicle Health monitoring	*						
Create Guidelines to Develop Public Safety Standards		◆	◇				
Inspection Techniques for Thermally Protected Commercial Space Vehicles	*						
Provide Report on Effectiveness of Narrow Band Eddy Current Method for Inspecting Thermally Protected Components		◆					
Report on Effectiveness of Capacitance Methods			◇				
Report on Effectiveness of Ultrasonic/EMATs Methods				◇			
Develop and Calibrate a Launch and Reentry Vehicle Hazard Model	*						
Program Management Plan							
Develop Model to Estimate Launch/Entry Debris Breakup Characteristics		◆					
Continue Studies to Understand Debris Breakup Process and Develop Model to Accurately Predict Debris Survivability			◇				
Assess Medical and Equipment Criteria for Human Spaceflight	*						
Program Management Plan							
Develop a Draft Interim Report on the Research Findings		◆					
Develop a Report on the Research Findings			◇				
Total Budget Authority	*	*	*	*	*	*	*

Notes:

– Commercial Space Transportation Safety Research Funding is Included in the Operations Appropriation.

– Programs and Projects are not separately budgeted in the Operations Appropriation.

* Funding requests for all years are under review.

FLIGHTDECK/MAINTENANCE/SYSTEM INTEGRATION HUMAN FACTORS

GOALS:

Intended Outcomes: The FAA intends to improve aviation safety by:

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

Agency Outputs: The FAA is concerned with ensuring the safety and efficiency of operator performance through guidelines, handbooks, advisory circulars, rules, and regulations. It provides industry with human performance information and guidance critical to the design, operation, regulation, and certification of equipment, training, and procedures. The Human Factors Research and Engineering Division conducts and manages research that provides the technical information necessary to generate these products and services.

Customer/Stakeholder Involvement: The human factors research program directly supports a number of aviation community initiatives:

- *FAA Strategic Plan Mission Goal for Safety*. By FY 2007, reduce U.S. aviation fatal accident rates by 80% from 1996 levels.
- ARA FY 2003 Performance Goal for Safety:
  - Reduce the fatal accident rate by developing and deploying those capabilities and systems needed to address aircraft failure, pilot decision-making, controller decision-making, aircraft survivability, and aviation weather.
- The FAA/Industry *Safer Skies* initiative, which will use the latest technology to help analyze U.S. and global data to find the root causes of accidents and determine the best actions to break the chain of events that lead to accidents.
- The *National Plan for Civil Aviation Human Factors: An Initiative for Research and Application* published in March 1995, with FAA, NASA, and DOD as signatories. This document, which had extensive aviation community participation in its development, outlines a coherent national agenda for human factors research and application leading to significant improvements in NAS safety and efficiency. The Flight Deck, Maintenance, System Integration Human Factors research program is developed around the following research thrust areas identified in the National Plan:
  - Information Management and Display – Determine optimal display information (what, when, and how) through the computer-human interface; design the system to reduce the frequency of information transfer errors; and minimize the impact when such errors do occur. Display designs are optimized to reduce information overload.
  - Human-Centered Automation – Keep the operator in the loop and situationally aware of automated system performance while balancing operator workload; resolve issues related to the degradation of basic skills, should the automation fail.
  - Human Performance Assessment – Improve the quality of critical decisions; assess cognitive and contextual factors leading to human error; develop effective countermeasures to reduce errors and performance inefficiencies; assess the impact of organizational culture on performance; and improve and standardize methods for measuring human performance.
  - Selection and Training – Understand the relationship between human abilities and aviation task performance; develop a scientific basis for the design of training programs, devices and aids; enhance the measures and methods for prediction of job/task performance; assess the knowledge, skills and abilities needed to excel in highly automated environments; identify methods by which to select aviation system personnel.
- NASA's Aviation Safety Program.
- The FAA report entitled The Interfaces Between Flight Crews and Modern Flight Deck Systems.
- Public Law 100-591, which establishes requirements for human factors research and its application.

- The Advanced Qualification Program (AQP), which has been adopted by every major U.S. carrier, incorporating human factors training into pilot qualification and recurrent training programs.
- Crew Resource Management (CRM) training procedures, a variant of which has been adopted by virtually every major domestic air carrier.

Accomplishments: The program output of data packages, models, and regulatory documents includes:

Information Management and Display

- Developed a manual that addresses appropriate human factors considerations in designing flight deck operating documents. The International Civil Aviation Organization (ICAO) has adopted this manual for distribution to its member states.
- Published the Aviation Maintenance Human Factors Guide.
- Developed (with industry) the first industry standard and guidance document on implementing an Aviation Maintenance Human Factors Program.
- Developed the Aviation Maintenance Document Design Aid to standardize aviation maintenance documentation.
- Completed human factors guidelines for assessing advanced general aviation transportation experiment (AGATE) cockpit controls/ displays.
- Developed human factors design and evaluation considerations for Electronic Flight Bags.
- Completed assessment of human factors issues and current knowledge concerning use of head-up displays in air transports.
- Addressed human factors issues for Cockpit Head Motion Box associated with air transport head-up displays.
- Completed data link lessons learned compendium for inclusion in RTCA DO-238A, Human Factors Requirements and Guidance for Controller/Pilot Data Link Communications Systems.

Human-Centered Automation

- Completed human factors Certification Job Aid for FAR Part 25 flightdeck displays.
- Developed aircraft certification human factors and operations checklist for stand-alone global positioning system receivers.
- Developed initial performance models for automation usage in air carrier cockpits.

Human Performance Assessment

- Developed a prototype automated performance measurement system (APMS) that allows air carriers to gather and analyze flight data from aircraft data recorders.
- Provided industry and FAA with preliminary reports on the antecedents of flight deck error.
- Completed the job task analysis of the aviation maintenance technician workforce.
- Developed guidance and standardized shift turnover procedures for use in aviation maintenance.
- Developed pilot performance profile, through flight simulation, for use in establishing certification standards for general aviation auto-navigation and control systems.
- Developed initial mapping of flight data parameters onto AQP qualification standards.
- Completed utility assessment of PC-based aviation training devices in maintaining general aviation pilot instrument proficiency.
- Completed a comprehensive human factors analysis of scheduled air carrier and fatal general aviation accidents using the Human Factors Analysis and Classification System.

Selection and Training

- Developed and validated a proceduralized pilot CRM training and assessment system.
- Developed the Model AQP to support regional air carrier participation. AQP is a proficiency-based approach to pilot training considered to be highly effective and efficient for aircrew training.
- Developed air carrier training data analysis tools used by carriers and the FAA for quality assurance efforts.
- Provided Flight Standards guidance for developing pilot training regulations based on data from a study of 30,000 domestic air carrier pilots. The study examined pilots' perceptions of training effectiveness across the entire U.S. aviation industry.
- Developed line operations safety audit (LOSA) methodology used by air carriers to help determine safety vulnerabilities. This methodology has been adopted by ICAO and was distributed to member states.

- Developed a system to allow air carriers to reconfigure FAA approved flight scenarios to unique training segments and developed a generic line-oriented evaluation event set database to be used by any air carrier.
- Provided FAA and Industry preliminary guidelines on managing pilot skill degradation through innovative training schedules.
- Provided Industry and FAA preliminary training guidelines for automated flight decks.
- Provided FAA and Industry guidance on approaches to incorporating realistic radio communications into simulators to train pilots for the complex operating environment.
- Completed the prototype MRM distance-learning project that will be implemented and used by the U.S. Navy for training their aviation maintenance technicians.
- Developed technical data on training, qualification, and certification of nondestructive inspection personnel.
- Developed a prototype automated system of self instruction for specialized training for the industry aviation maintenance inspector workforce.
- Developed a CD-ROM training program that guides general aviation pilots through the creation of a personal checklist that incorporates minimum operating conditions and procedures based upon their own personal capabilities and experience.
- Defined critical flight task performance that decays over time in air carriers.
- Developed advanced data analysis methods for linking FOQA and simulator training data.

R&D Partnerships: Collaboration has continued between the FAA and industry partners to develop intervention strategies and reduce aviation accidents through the various Joint Safety Analysis Teams (JSAT) and Joint Safety Implementation Teams (JSIT) developed as part of the Safer Skies agenda. The program is coordinated with NASA through the NASA Aviation Safety Program's emphasis on human factors concerns associated with air carrier and general aviation pilot training, aviation maintenance, human performance modeling, and weather displays. DOD joint efforts are in automation and enhanced vision. Additionally, the FAA is represented on the DOD Human Factors Engineering Technical Advisory Group, a forum for the coordination of research across a variety of technical areas. A collaborative research effort is underway with the Joint Aviation Authorities and Transport Canada to produce human factors input for the harmonization of regulatory guidance material.

Through aviation maintenance partnerships, the FAA and industry are receiving real world applied research results. Aviation maintenance human factors is also working with other countries (such as Transport Canada) for globalization of aviation maintenance and inspection human factors. The FAA participates on all of the Society of Automotive Engineers G-10 subcommittees related to human factors research areas, ensuring transition of the results to standards, guidelines, etc. The FAA also has extended seventeen 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 2003 ACCOMPLISHMENTS:

Information Management and Display

- Initiated development of guidance on human factors improvements to Notice to Airmen (NOTAM) effectiveness.
- Completed initial computational model to assess information accessibility for air transport head-up display/head-down display combinations.
- Completed human factors guidance on integrating multiple weather information features on weather displays.
- Identified an inexpensive and reasonably reliable field methodology to make general aviation night vision goggles compatible with cockpit lighting.
- Conducted human factors investigations of advanced terrain and weather displays.
- Expanded the evaluation of broadband applications to aviation maintenance safety.

Human-centered Automation

- Completed human factors Certification Job Aid Version 4.0 for FAR Part 25 flight deck displays and controls.
- Provided human factors technical information on airport surface maps and vertical profile displays for

FAA Technical Standard Order on moving map displays.

Human Performance Assessment

- Initiated analysis of the safety implications of monitored approaches.
- Examined simultaneous non-interfering operations for visual flight rules (VFR) helicopter and fixed wing visual flight rules/instrument flight rules (IFR).
- Expanded analysis to provide guidance regarding specific types, and frequency of, general aviation errors.
- Initiated development of guidance on determining whether language barriers result in maintenance deficiencies.
- Continued examination into acceptable vision standards and procedures for personnel involved in nondestructive inspection and testing (NDI/NDT) and visual inspection of aircraft and aircraft components.
- Expanded research into causal factors of amateur-built aircraft incidents attributed to maintenance and/or pilot error.
- Continued examination of navigation performance of VFR helicopter pilots using IFR-qualified Global Positioning System (GPS) receivers, required navigation performance (RNP) measurement.
- Continued development of a prototype (APMS) that allows air carriers to gather and analyze flight data from aircraft data recorders. This information and analysis capability provides the backbone for the FOQA, a joint FAA, industry and labor initiative to enhance aviation safety.
- Initiated development of guidance on general aviation pilot decision-making when flying into instrument meteorological conditions (IMC).

Selection and Training

- Initiated development of guidance on a revision to FAR 61.141 to allow substitution of credit hours earned with various flight training devices (FTD) and personal computer aviation training devices (PCATD) for actual flight.
- Continued research comparing the effectiveness of a Personal Computer Aviation Training Device, a Flight Training Device, and actual flight experience in conducting general aviation instrument proficiency checks.
- Initiated development of guidance on new air carrier CRM training post 9/11.
- Initiated development of guidance on training air carrier flight crews for unexpected events.
- Enhanced rapidly reconfigurable line oriented evaluations (RRLOE) scenario generation software and expanded collection of air carrier user data.
- Expanded Realistic Radio Communications in simulator training to include data link and other forms of nonverbal communication.
- Expanded the Knowledge Assessment software tool to be capable of assessing knowledge structures and mental models necessary for the operation of automated aircraft.
- Distributed a report on tools and methods to support the training of cognitive skills for automation performance in air carrier cockpits.
- Distributed training development guidelines to the FAA and industry for the integration of crew resource and technical skills in air carrier AQP training programs.
- Developed methodologies to link performance data to curriculum modification procedures in AQP programs.
- Developed a report on methodology for integrating Aviation Safety Action Program (ASAP), FOQA and AQP data.
- Developed a report on training guidelines to handle interruptions, distractions, and lapses of attention in air carrier cockpits.
- Completed validation of training intervals for air carrier pilot training programs.
- Developed training guidelines for error management in air carrier cockpits.
- Developed an analytic strategy to build ASAP enhancements to the reporting of factors contributing to aviation incidents.
- Completed validation of simulator requirements for air carrier pilot training.
- Initiated development of guidance on how to use advanced technology for inspection training aimed at reducing general aviation maintenance errors.

KEY FY 2004 PRODUCTS AND MILESTONES:

Information Management and Display

- Complete guidance on human factors improvements to NOTAMs.
- Complete initial human factors guidelines for instrument procedure design.

- Complete guidelines regarding multiple weather sources on a multi-function display.

Human-centered Automation

- Complete development of certification job aid for FAR Part 25 considerations and applications.
- Provide human factors guidance for certification of non-profile RNP navigation displays.

Human Performance Assessment

- Complete guidance on the types of maintenance and/or pilot errors attributed to amateur-built aircraft incidents.
- Complete guidance on pilot error associated with general aviation accidents.
- Complete guidance on specific causal factors that influence general aviation pilots' decision to fly into IMC.
- Complete guidance on acceptable vision standards and procedures to be used by NDI/NDT and visual inspection personnel of aircraft and aircraft components.

Selection and Training

- Expand LOSA cockpit threat and error management methodology.
- Develop ASAP enhancements to reporting of factors contributing to aviation incidents.
- Develop guidance on new air carrier CRM training post 9/11.
- Develop guidance on training air carrier flight crews for unexpected events.
- Expand Knowledge Assessment software tool for assessing knowledge structures and mental models necessary for the operation of automated aircraft.
- Develop software enhancements to RRLOE scenario generation tools and collect air carrier user data.

FY 2004 PROGRAM REQUEST:

The program continues to focus on providing technical information and advice to improve aircrew, inspector, maintenance technician, and aviation system performance. Emphasis is 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 flight decks and equipment.

ONGOING ACTIVITIES

Information Management and Display

- Develop human factors guidance for instrument procedures design.
- Develop human factors guidance for certification of weather displays.
- Develop flight data recording and analysis capability for flight simulators.
- Determine the extent to which human-centered design contributes to the successful application of emerging technologies that include training-on-demand, video-on-demand, and wireless access to technical aviation maintenance documentation..

Human-centered Automation

- Evaluate human factors issues regarding RNP information on navigation displays.
- Provide expanded guidance addressing training for automated cockpits.
- Develop the human factors Certification Job Aid.

Human Performance Assessment

- Develop improved guidelines for accident investigation and reporting.
- Refine air carrier flight and simulator data analysis tools.
- Develop guidance on pilots' visual detection, recognition and identification of objects at different distances during low-visibility flight conditions.
- Provide guidance to the Aviation Safety Program regarding the precursors of general aviation pilot error.
- Refine critical variables associated with general aviation pilots' decision to continue flight into IMC.
- Continued developing guidance on the possible effects of language barriers upon maintenance deficiencies.

Selection and Training

- Continue research comparing the effectiveness of a Personal Computer Aviation Training Device, a Flight Training Device, and actual flight experience in conducting general aviation instrument proficiency checks.
- Provide guidance on simulator motion requirements for recurrent pilot training.

- Assess expansion of realistic radio communications in simulator training.
- Standardize and codify essential line operations safety audit (LOSA) elements and training guidelines for cockpit error management in support of transferring LOSA technology to ICAO air carriers.
- Develop advanced analysis methods linking FOQA and simulator data.
- Develop methodologies to link air carrier pilot performance data to curriculum modification.
- Develop guidelines for air carrier pilot training intervals.
- Continue developing guidance on how advanced technology can be used for inspection training aimed at reducing errors for the general aviation maintenance industry.

NEW INITIATIVES

No new initiatives are planned in FY 2004.

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2002)	$ 157,964
FY 2003 Request	10,138
FY 2004 Request	8,394
Out-Year Planning Levels (FY 2005-2008)	35,838
Total	$ 212,334

Budget Authority ($000)	FY 2000 Enacted	FY 2001 Enacted	FY 2002 Enacted	FY 2003 Request	FY 2004 Request
Contracts:					
Flightdeck/Maintenance/System Integration Human Factors	6,289	7,016	6,617	6,711	4,697
Personnel Costs	2,367	2,283	2,398	2,582	2,856
Other In-house Costs	486	779	891	845	841
Total	**9,142**	**10,078**	**9,906**	**10,138**	**8,394**

OMB Circular A-11, Conduct of Research and Development ($000)	FY 2000 Enacted	FY 2001 Enacted	FY 2002 Enacted	FY 2003 Request	FY 2004 Request
Basic	0	0	0	0	0
Applied	9,142	10,078	9,906	10,138	8,394
Development (includes prototypes)	0	0	0	0	0
Total	**9,142**	**10,078**	**9,906**	**10,138**	**8,394**

A11g – Flightdeck/Maintenance/System Integration Human Factors Products and Activities	FY 2004 Request ($000)	Program Schedule					
		FY 2003	FY 2004	FY 2005	FY 2006	FY 2007	FY2008
081-110 Flightdeck/Maintenance/System Integration Human Factors							
Selection and Training	$1,879						
Develop Automation Reconfigurable Event Sets		◆	◇	◇			
Provide Guidance for Simulator Motion Requirements		◆	◇	◇			
Develop/Distribute Advanced Data Analysis Methods Linking FOQA and Simulator Data		◆	◇	◇			
Develop Training Guidelines for Flightdeck Error Management		◆	◇	◇			
Develop Guidance on Information Required to Revise FAR 61.141 that Specifies Credit Hour for which FTDs and PCATDs may be used in Lieu of Actual Flight		◆	◇	◇	◇		
Develop Error Avoidance Strategies in Aviation Maintenance and Inspection		◆	◇	◇	◇	◇	◇
Initiate Development of Guidance on How Advanced Technology can be used for Inspection Training and Reducing Errors in General Aviation Maintenance		◆	◇	◇			
Human Performance Assessment	$329						
Provide Expanded APMS Methodologies and Analysis Capabilities		◆	◇				
Provide Guidance on Effectiveness of Realistic Radio Communications in Line-Oriented Evaluations		◆	◇				
Continue Examination on Acceptable Vision Standards and Procedures for Personnel Involved in NDT/NDI and Visual Inspection of Aircraft and Aircraft Components		◆	◇	◇			
Develop Improved Guidelines for Accident Investigations		◆	◇				
Human Centered Automation	$1,362						
Provide Industry and FAA Guidance Addressing Training for Automated Cockpits		◆	◇				
Complete Certification Job Aid Version 2.0/3.0 for FAR Part 25 Flight Deck Displays		◆	◇				
Develop Certification Guidelines for Integrated Technology in General Aviation Cockpits		◆	◇				
Information Management and Display	$1,127						
Complete Software Tools for Enhanced Maintenance Documentation		◆	◇				
Complete Human Factors Design and Evaluation for Electronic Flight Bage, Version 2.0/3.0		◆	◇				
Develop/Analyze General Aviation "Head Up" Display Information/Symbology Recommendations		◆	◇				
Address Human Factors issues in Cockpit Head Motion Box in Air Transport "Head Up" Displays; Complete Computational Model to Assess Information Accessibility		◆	◇				
Determine Operational Criteria/Training Guidance for Night Vision Goggles in Rotorcraft Operations		◆	◇				
Determine Information Requirements for Situational Awareness to Avert CFIT in General Aviation		◆	◇	◇			
Define Display Location Boundaries that Correspond to Eye/Head Position for General Aviation Aircraft		◆	◇				
Personnel and Other In-House Costs	$3,697						
Total Budget Authority	**$8,394**	**$10,138**	**$8,394**	**$8,588**	**$8,859**	**$9,058**	**$9,333**

Note: **Out year numbers are for planning purposes only. Actual funding needs will be determined through the annual budget process.**

AIR TRAFFIC CONTROL/AIRWAY FACILITIES HUMAN FACTORS

GOALS:

Intended Outcomes: The FAA intends to improve air traffic control (ATC) safety by:

- Developing more effective methods for investigating, reporting, analyzing, and mitigating ATC operational errors and Airway Facilities (AF) incidents.
- Developing human factors training aids to mitigate controller performance issues associated with operational incidents and runway incursions.
- Developing human factors educational aids and assessing fatigue countermeasures to mitigate degradation in controller and maintenance specialist performance resulting from shift work.
- Increasing human-system integration in the acquisition and design of ATC automation systems through development of guidelines and standards.
- Improving techniques for forecasting hiring requirements and selecting applicants for Air Traffic (AT) and AF positions.

Agency Outputs: Human performance constraints and other human-system integration issues associated with the acquisition, design, operation, and maintenance of ATC systems are addressed through human factors research that develops guidelines and standards to ensure effective integration of product improvements including communication and surveillance technologies. Human factors analysis of operational errors including runway incursions identifies improvements in how errors are investigated and reported, which in turn will lead to more effective safety interventions. The study of the relationship between shift work schedules and fatigue identifies techniques for mitigating degradations in controller and AF specialist performance. Tests and criteria for the selection of operational personnel will improve applicant selection efficiency and validity, and reduce costs associated with attrition and training failures.

Customer/Stakeholder Involvement: The ATC/AF Human Factors Research Program is directly tied to ARA Performance Goal 1, *Aviation Safety:* In support of the FAA's mission goal related to system safety, contribute to the FAA goal to reduce the fatal aviation accident rate 80% by FY 2007 as compared to 1994-1996 baseline data. Goal 1 implementation involves safety performance measures and safety strategies leveraging human factors research on operational errors/deviations and runway incursions as part of an overall system engineering effort to mitigate the risk of safety hazards.

The ATC/AF Human Factors Research Program is the product of continued coordination between the Office of the Chief Scientific and Technical Advisor for Human Factors (AAR-100) and its Air Traffic and Airway Facilities customer base through the Air Traffic System Requirements Service (ARS).

This program is addressing the highest priority human factors issues among the 70 recommendations identified by the National Research Council in its 1997 and 1998 reports on current and future ATC automation. Research will assess human performance issues associated with National Airspace System advances identified in the Operational Evolution Plan (OEP). The program examines advanced automation and technologies integrated as part of FAA and industry Concepts of Operations for the National Airspace System (NAS), the AF maintenance concept for NAS Infrastructure Management, and the NAS Architecture Version 4.0. Applied research provides the information necessary to understand human performance limitations, enabling human factors practitioners to identify and resolve risks, and to assess costs, benefits, and trade-offs. The ATC/AF Human Factors Research Program addresses the recommendations of the congressionally mandated Research, Engineering, and Development Advisory Committee (REDAC).

The FAA human factors program is coordinated with NASA through the Inter-Agency Air Traffic Management Integrated Product Team (IAIPT), and with the DOD through the Human Factors Engineering Technical Advisory Group. This program is developed around the research thrusts identified in the 1995 joint FAA-NASA-DOD *National Plan for Civil Aviation Human Factors: An Initiative for Research and Application* consisting of the following:

- Information Management and Display – Determine what, when, and how to best display information

through the computer-human interface (CHI); design the system to reduce the frequency of information transfer errors; and minimize the impact when such errors do occur. Display designs are optimized to reduce information overload.

- Human-Centered Automation – Keep the operator in the loop and situationally aware of automated system performance while balancing operator workload; resolve issues related to the degradation of basic skills should the automation fail.
- Human Performance Assessment – Improve the quality of critical decisions; assess cognitive and contextual factors leading to human error; develop effective countermeasures to reduce errors and performance inefficiencies; assess the impact of organization culture on performance; and improve and standardize methods for measuring human performance.
- Selection and Training – Assess the knowledge, skills and abilities needed to excel in highly automated environments; assess retirement and attrition patterns to predict hiring requirements.

Accomplishments: The program has supported the following research with resulting products:

Information Management and Display

- Human Factors Design Standard (HFDS) – Updated and formalized design information into the HFDS to provide Integrated Product Teams with standards and guidelines for effective human factors design of automation and advanced technologies.
- Human-system integration – Performed a risk assessment identifying inconsistencies in the design of user interfaces between terminal radar baseline systems and their anticipated product improvements and other subsystems to be integrated as part of the NAS evolution.
- Maintenance user interface standardization – Assessed inconsistencies in display symbology and aural tones in monitor and control legacy and acquisition systems.
- Standard Terminal Automation Replacement System (STARS) – Developed recommendations addressing issues with the STARS radar display and maintenance control workstations.

Human-Centered Automation

- Flight strip studies – Identified operational functions in controller use of paper flight progress strips to support transition to Free Flight decision support automation.
- Multitool interoperability analysis – Adapted a cognitive walkthrough methodology to identify human factors, operational, and functional issues with en route decision support and data link capabilities collocated in controller workstations.
- Controller performance using decision aids – Completed a complex human-in-the-loop simulation to develop recommendations for improved controller performance and team communications in use of a conflict probe.

Human Performance Assessment

- ATC operational errors – Completed initial field beta testing and validation of a new methodology called JANUS for reporting and analyzing causal factors associated with ATC operational errors.
- Controller fatigue – Completed the congressionally mandated fatigue study through surveys and field and lab biomedical studies, and distributed an informational CD on countermeasures to fatigue resulting from shift work.
- Impact of shared separation on controller situation awareness – Conducted a study of impacts from distributed air/ground separation responsibility on air traffic controller performance.
- Dynamic airspace boundaries – Assessed the impact of airspace restructuring on controller performance through modeling and simulation.

Selection and Training

- Prototype air traffic applicant screening system – Developed a prototype biographical assessment tool for screening job applicants.
- Computerized selection test battery – Completed concurrent validation of a new computerized Air Traffic Selection and Training (AT-SAT) test battery for ATC.
- Statistical Attrition and Retirements Model (SCRAM) – Developed a prototype model for projecting retirements and attrition from AT/AF critical occupations from historical data.
- Runway safety training aid – Developed an aid for controllers and pilots containing relevant human factors information on communications, attention, and memory to help prevent runway incursions.

- Human factors training aid for controllers - Prepared aid providing information controllers can use to enhance job performance.

R&D Partnerships: Research is coordinated with NASA in the areas of distributed air/ground separation responsibility, decision support automation, and controller task load measurement through the IAIPT, which also provides a framework for coordination with MITRE. University grants are addressing tower controller use of paper flight strips, human factors with advanced surveillance technology, and collaborative decision making in Air Traffic Management (ATM). Internationally, collaborative research with EUROCONTROL and the Icelandic Civil Aviation Administration addresses human error in the design and operation of ATC systems and assessment of human factors in advanced oceanic technologies and procedures.

MAJOR ACTIVITIES AND ANTICIPATED FY 2003 ACCOMPLISHMENTS:

Information Management and Display

- HSI integration – Detailed assessments of HSI inconsistencies and other human factors risks in the integration of enhanced capabilities in en route ATC legacy systems to ensure compatibility with design standards and human performance considerations.
- Human Factors Design Standard – Updated design information and an initial prototype on-line search capability for efficient use of the Human Factors Design Standard.
- Maintenance user interface consistency – Identified inconsistencies and developed recommendations to effectively integrate acquisition programs into legacy systems.

Human-centered Automation

- Multitool interoperability simulation – Completed a controller simulation to assess interoperability issues with decision support and data link capabilities collocated in en route controller workstations.
- Tower paper flight strips – Evaluated controller information requirements for use of flight progress strips in control towers.
- Centralized maintenance communications – Examined lessons learned from the design of centralized maintenance procedures in relation to mitigating human error and improving coordination with Air Traffic operations.

Human Performance Assessment

- Incident investigation methodology refinements – Conducted field beta testing of the JANUS technique to verify refinements in identifying causal factors of operational errors and to initially assess performance remediation strategies.
- Operational error contributing factors – Provided initial assessments of airspace characteristics and supervisory practices associated with the incidence of operational errors.
- Runway safety training – Developed a multimedia training prototype for controllers providing targeted information on effective techniques to mitigate runway incursions.
- Fatigue and shift work– Completed studies relating use of rest period and activity countermeasures with performance in a laboratory environment, and adapted educational information to accommodate unique AF scheduling.
- Organizational assessment – Conducted the FAA-wide Employee Attitude Survey to assess and compare Model Work Environment practices.
- Controller task load measurement – Developed and assessed measures of controller task performance using routinely recorded ATC data.

Selection and Training

- Controller selection – Developed a parallel form to the AT-SAT test battery and continued longitudinal validation of screening and testing tools for selection of job applicants.
- AF job/task analysis – Completed a selection-oriented baseline job/task analysis for AF field maintenance positions to support development of a new AF selection system.
- Workforce planning – Extended the SCRAM functionality to a workforce stock-and-flow model to estimate future hiring requirements.

KEY FY 2004 PRODUCTS AND MILESTONES:

ATS-related research within the National Plan research thrusts include:

Information Management and Display

- HSI integration issues – Identify detailed human-system integration inconsistencies and other human

factors risks with enhanced capabilities in oceanic and offshore ATC legacy systems.

- Electronic flight data – Develop recommendations for display techniques for flight progress data to meet tower controller information needs.
- Enhanced surveillance data – Develop controller information and display requirements for effective use of Automated Dependent Surveillance-Broadcast.

Human-Centered Automation

- Inter-operability between advanced decision aids – Assess the cumulative impact on controller performance, situation awareness, and workload resulting from the incremental integration of decision aids developed in support of the OEP relative to achieving intended benefits.
- Human-in-the-loop simulation of centralized maintenance – Develop maintenance specialist information and decision making requirements through simulations of advanced monitor and control capabilities.

Human Performance Assessment

- Incident causal factors – Develop a web-based prototype knowledge management system to integrate and analyze causal factors data from assessments of operational errors and runway incursions.
- Reduction of operational errors – Develop targeted management and training interventions effective for mitigating human errors leading to operational errors.
- Memory enhancement for tower controllers – Develop recommendations to mitigate runway incursions.
- Maintenance communication workload – Recommend inter- and intra-facility communication and coordination flows to mitigate impacts from workload and human error.
- Maintenance specialist cognitive performance – Identify recommendations to mitigate human factors impacts from off-normal maintenance operations.
- Organizational assessment – Report on lessons learned, organizational issues, and successful practices in developing a Model Work Environment from the FAA-wide Employee Attitude Survey.
- Task load and performance assessments - Develop objective task load and performance measures in Performance and Objective Workload Evaluation Research (POWER) to assess controller task load across different ATC systems.

Selection and Training

- Maintenance training issues – Assess specialist and technician training strategies and equipment to identify shortfalls in use of new monitor and control systems and technologies.
- Selection of applicants ATS positions – Develop technical enhancements and continue longitudinal validation of screening and testing tools for selection of applicants into ATS positions.
- ATS management training assessment – Identify recommendations to resolve ATS management training and succession planning shortfalls relative to requisite skills and experience for management positions.

FY 2004 PROGRAM REQUEST

The FY 2004 program supports ATS with research to address human performance issues in the acquisition, design, operation, and maintenance of ATC systems over the next several years. Research projects will provide timely information to answer critical human factors questions.

ONGOING ACTIVITIES

Information Management and Display

- Examine human-system integration issues with data link, conflict probe, and traffic management product improvements.
- Develop baseline requirements for tower controller flight data information needs supporting acquisition mission analysis.
- Assess standardization issues in maintenance user interface design.

Human-centered Automation

- Assess how interoperability between advanced decision support tools effects controller performance, and roles and responsibilities.
- Assess information requirements and coordinated decision making in a centralized maintenance environment.

Human Performance Assessment

- Assess improvements to the JANUS technique for the mitigation and reduction of human and system errors related to air traffic operations.

- Assess human factors improvements to tower team operations for improving runway safety.
- Recommend best practices through an organizational assessment addressing the Model Work Environment.
- Validate task load and performance measures obtained before and after implementation of new controller automation tools.
- Validate shift scheduling principles for effectively managing controller fatigue through a field operational test.

Selection and Training

- Continue longitudinal validation of ATS selection processes.
- Assess ATS management training shortfalls limiting succession planning.

NEW INITIATIVES

Human-centered Automation

- Assess human factors impacts of the AT strategic concept for a multi-sector planning position using controller-in-the-loop simulation.

Human Performance Assessment

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

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2002)	$ 117,267
FY 2003 Request	9,862
FY 2004 Request	8,899
Out-Year Planning Levels (FY 2005-2008)	38,827
Total	$ 174,855

Budget Authority ($000)	FY 2000 Enacted	FY 2001 Enacted	FY 2002 Enacted	FY 2003 Request	FY 2004 Request
Contracts:					
Air Traffic Control/Airway Facilities Human Factors	1,661	2,277	2,756	4,214	2,800
Personnel Costs	5,034	3,984	4,071	4,002	4,445
Other In-house Costs	1,305	1,721	1,673	1,646	1,654
Total	**8,000**	**7,982**	**8,500**	**9,862**	**8,899**

OMB Circular A-11, Conduct of Research and Development ($000)	FY 2000 Enacted	FY 2001 Enacted	FY 2002 Enacted	FY 2003 Request	FY 2004 Request
Basic	0	0	0	0	0
Applied	8,000	7,982	8,500	9,862	8,899
Development (includes prototypes)	0	0	0	0	0
Total	**8,000**	**7,982**	**8,500**	**9,862**	**8,899**

A11i – Air Traffic Control/Airway Facilities Human Factors Products and Activities	FY 2004 Request ($000)	Program Schedule					
		FY 2003	FY 2004	FY 2005	FY 2006	FY 2007	FY2008
082-110 Air Traffic Control/Airway Facilities Human Factors							
Human Performance Assessment	$616						
Human factors Design Standards Development		◆	◇	◇	◇	◇	◇
Human-System Interface Integration		◆	◇	◇			
Tower Controller Information Requirements		◆	◇	◇			
AF Information Display and Management		◆	◇	◇	◇	◇	◇
Human Centered Automation	$1,036						
Incremental Decision Support Tool Inter-Operability Assessments		◆	◇	◇	◇		
AT Strategic Concepts Simulation Assessments		◆	◇	◇	◇	◇	◇
Situational Awareness in Centralized Monitor and Control		◆	◇	◇	◇		
Human Performance Assessment	$840						
Examination of Causal factors Related to Operational Errors		◆	◇	◇	◇	◇	◇
Runway Safety Analysis and Educational Guidance		◆	◇	◇			
Airway Facilities Work Flows and Communications		◆	◇	◇	◇		
Controller Shift Work, Work Schedules, and fatigue		◆	◇				
POWER Task Load and Performance Assessment		◆	◇	◇			
Team Processes in Centralized Monitor and Control Systems		◆	◇	◇			
FAA Wide Employee Attitude and Organizational Assessment		◆	◇	◇	◇	◇	◇
Selection and Training	$308						
AT Management Succession Planning and Training		◆	◇	◇	◇		
Applicant Evaluation System Longitudinal Validation		◆	◇	◇	◇	◇	◇
Prototype Workforce Analysis Tool Development and Analysis		◆	◇	◇			
Personnel and Other In-House Costs	$6,099						
Total Budget Authority	$8,899	$9,862	$8,899	$9,193	$9,543	$9,860	$10,231

Note: **Out year numbers are for planning purposes only. Actual funding needs will be determined through the annual budget process.**

AEROMEDICAL RESEARCH

GOALS:

The FAA safety mission dictates that:

- Injury and death patterns in civilian flight accidents be investigated and meticulously analyzed to determine cause and prevention strategies.
- Recommendations for protective equipment and procedures be developed.
- Options be evaluated on behalf of FAA regulatory and medical certification staff charged with the proposal of safety and health regulations addressing all aircraft cabin occupants and their environment.
- Recommendations for aircraft cabin evacuation be developed for infants and adults of all ages, sizes and abilities

The identification of pilot, flight attendant, and passenger medical conditions that are incompatible with in-flight physiological and performance demands, both in the absence and presence of emergency flight conditions is a concurrent mission. The resulting bioaeronautical data is to be effectively shared using advanced, user-friendly modeling and visualization technologies.

Intended Outcomes: The outcomes addressed by this research program are improved health, safety, security, protection, and survivability of aerospace craft passengers and aircrews. This research program identifies human tolerances, capabilities, and failure modes (physiological, psychological, and performance) both in uneventful flight, and during aerospace craft incidents and accidents. Formal recommendations for protective and supportive counter measures and techniques are derived from in-house research.

The FAA is able to exploit new and evaluate existing bioaeronautical guidelines, standards, and models for aerospace craft cabin equipment, procedures, and environments. This serves as a base for new regulatory action and the evaluation of existing regulations to enhance appropriate human performance at a minimum cost to the aviation industry. By reviewing pilot medical histories, flight histories, and information from accidents and incidents, existing and advanced biomedical criteria, standards and assessment/ certification procedures can be proposed to ensure optimal performance capability. By assessing pilot, flight attendant, passenger work, environmental, behavioral, and disease issues, guidelines for actions to improve the health and safety of the aerospace craft occupant can be proposed based on rigorous scientific criteria.

Agency Outputs: The program has developed the following guiding research outcomes to support regulatory and certification processes:

- Quantitative bioengineering criteria to:
  - Support optimum aerospace craft seat and restraint system certification.
  - Support flotation and onboard life support/rescue equipment certification.
- Quantitative biomedical and performance criteria to support development of optimum protective breathing equipment, emergency medical equipment, and operational procedures certification.
- Biomedical/toxicological factors in uneventful flight and in aerospace craft incidents and accidents.
- Fact-based recommendations for aircrew medical standards, assessment/certification procedures, and special issuance.
- Quantitative data about the health risks of flight deck, cabin crew and other occupants to support regulatory oversight.
- Quantitative data about aerospace radiation and other aerospace craft environmental factors and their threats to all occupants.
- Quantitative bioaeronautical, bioengineering and performance criteria to support cabin evacuation certification.

Customer/Stakeholder Involvement: This program contributes to meeting the FAA Strategic Plan Mission Goal for Safety and ARA FY 2003 Performance Plan Goals for Safety and Human Factors. The program is developed around a research agenda set forth in the *National Plan for Civil Aviation Human Factors: An Initiative for Research and Application:*

- Bioaeronautics – Improve the health, safety, protection, survivability and security of aircraft passengers and aircrews through identification of human tolerances, capabilities, and failure modes (physiological, psychological, and performance) both in uneventful flight, and during aircraft incidents and accidents.

The program contributes significantly to the application of emerging technologies, as highlighted in the FAA Aviation Safety Plan. It is an integral participant and research provider under the FAA, Joint Aviation Authorities (JAA), and Transport Canada Aviation (TCA) Aircraft Cabin Safety Research Plan established in 1995 as a coordinated, living plan to maximize the cost-benefit of aerospace craft cabin safety research nationally and internationally.

International Civil Aviation Organization (ICAO) initiatives addressing the health of the aircraft occupant (crew and passenger) are developed under this program before final FAA recommendations are provided to ICAO. This program is the only research component of the FAA that can legally access confidential medical data about pilots for use in epidemiological research studies. Multi-year collaborative studies performed by the FAA and other agencies, both governmental and industrial, evaluating flight crew and passenger symptomatology and diseases have been funded by this budget item to satisfy the mandate placed by Congress upon the agencies in the FY 1994 Appropriation Act and the Wendell H. Ford Aviation Investment and Reform Act of the 21st Century of 2000.

Accomplishments: The program output includes the following :

- In FY2000, an effort was initiated to develop a computational fluid dynamics model of airflow and particle distribution in order to determine the potential for contaminants or chemical-biological agents in aircraft cabins. Disease transmission risk, cabin air quality concerns, and the potential for a bio-terrorist attack, all brought on by the events of 9/11, heightened requirements for this study. The model supports determination of the number/location of aircraft occupants who may be affected in an attack, areas of cabin contamination, and potential sensor/warning system requirements. The modeling effort is supported by a cabin airflow study conducted in the CAMI 747 Aircraft Environment Research Facility (AERF). In the summer of 2002, CAMI hosted a colloquium on cabin airflow modeling that enhanced research collaboration and supported industry wide dissemination of the modeling information.
- Data are continuously provided to research sponsors on the role of toxicological and clinical factors associated with each aircraft accident and significant incident. The FAA has worked in close collaboration with the American Society of Heating, Refrigeration and Air-conditioning Engineers (ASHRAE) concerning Congressionally mandated cabin air quality research recommended by the National Research Council.
- Current findings indicate that about one in five pilots fatally injured in a civilian aircraft accident show evidence of using a prescription drug; one in seven has taken an over- the-counter drug; one in fifteen has ingested significantly positive alcohol; and one of thirteen is using a significant controlled dangerous substance.
- Long-term aerospace forensic and epidemiological research has helped the FAA to identify bioaeronautical roles in accident/incident causation. Medical and other factors indicative of pilot incapacitation and inability to perform optimally are under continuous evaluation.
- To promote radiation safety in civil aviation, web-based materials on cosmic and solar radiation exposures in-flight are continuously provided to the aviation industry.

R&D Partnerships: In addition to the previously described partnerships (e.g., FAA/JAA/TCA; FAA/ASHRAE, academic, industrial, and other governmental organizations) coordination and cooperation are leveraged in all research activities. In each of the program areas the FAA maintains direct cooperative research processes with all the manufacturers responsible for the safety products enumerated (seats, restraint systems, oxygen masks, evacuation slides, etc.). FAA investigators also maintain memberships on every Society of Automotive Engineers committee addressing safety research conducted under this program. Besides the active involvement in the FAA/JAA/TCA process of oversight for safety research, participants in this program are represented on appropriate subgroups of organizations such as the Aerospace Medical Association, the Civil Aviation Medical Association, and the Professional Aeromedical Transport Association. Appropriate liaison with all military branches and NASA is maintained either through direct project collaboration (e.g., crashworthiness, aerospace medicine, eye injury from lasers, exposure to cosmic radiation), through participation in the North Atlantic Treaty

Organization aerospace medical advisory groups, the European Union, or collaborations in scientific organizations. Collaboration with the National Academy of Science (NAS) allowing NAS Associates to participate in reseach studies at CAMI has been established.

MAJOR ACTIVITIES AND ANTICIPATED FY 2003 ACCOMPLISHMENTS

The following program results have been achieved or are expected to be achieved in FY 2003:

- Performed epidemiological assessment of biochemical and toxicological factors from fatal civilian aviation accidents.
- Developed recommendations on the use of automatic external defibrillators and emergency medical kits on commercial aircraft.
- Evaluated autopsy data from fatal aviation accidents to provide recommendations for improvement of protective equipment and design practices.
- Conducted human factors evaluations to improve certification procedures regarding the accessibility of passenger life preservers.
- Conducted evaluations of passenger lap belt tension to establish accurate guidelines for biodynamic testing of transport passenger seats.
- Competed cabin evacuation research project evaluating effects of passageway, exit hatch, passenger density, and passenger motivation on evacuation efficiency.
- Completed upgrade and renovation of the CAMI narrow body Aircraft Cabin Evacuation Facility (ACEF) to support near-mid term (five years) cabin evacuation research and safety demonstrations.
- Developed biodynamic test data on side-facing seats and restraint devices to support rule-making organizations.
- Used the 747 Aircraft Environment Research Facility(AERF) to define time requirements for a NASA developed clear air turbulence detection system relative to the need for the cabin crew preparation.

KEY FY 2004 PRODUCTS AND MILESTONES

The following program results are being scheduled in FY 2004:

- Assess bioaeronautical research data that will support aeromedical certification aimed at reduction of in-flight sudden/subtle incapacitation.
- Provide enhanced guidelines for aircraft cabin occupant health maintenance, including verifying the CARI-6 radiobiological computer program that covers large solar particle events.
- Evaluate pilot reported medication usage with actual toxicology findings to determine the accuracy of self-reporting.
- Establish cabin airflow characteristics in the 747 AERF to support evaluation of cabin environmental quality and health.
- Assess molecular biological laboratory techniques that will enhance forensic toxicological aspects of aircraft accident investigation.
- Establish correlation of neck injury and impact dynamics measured using anthropomorphic test mannequins to assess the potential for improved aircraft seat test criteria.
- Evaluate an upgrade project to modernize the narrow body cabin egress test facility to allow flexible simulation of aircraft types and configurations.
- Explore research to determine crew and passenger safety requirements in advanced technology very high altitude transport air or spacecraft.

FY 2004 PROGRAM REQUEST:

The Office of Aerospace Medicine encounters complex medical decisions during the initial and follow-up medical assessments of airmen who request special medical issuances (e.g., cardiac conditions, neurological deficits, corrective vision surgery, etc.) to permit their continued flying. The prospective epidemiological assessment of special issuance methodology and medical outcomes in the airman population is required to ensure that medical issuances do not result in unexpected or increased aircraft accident or incident rates or risks. The following activities are planned.

ONGOING ACTIVITIES

- Support safer aircraft cabin evacuation approval guidelines and safer field applications under routine and emergency operational conditions.
- Reduce head, neck, torso, and extremity injuries in aircraft crash environments.
- Evaluate trends in toxicological, biochemical, physiological, and clinical findings from all major civil aviation aircraft crashes.
- Support Aviation Rule Making Advisory Committee reviews of cabin air quality and altitude safety rules.

- Assess effectiveness of new programs dedicated to the enhancement of passenger performance in emergencies.
- Evaluate in-flight use of medical kits and determine the adequacy of those kits.
- Track special medical issuance pilots to evaluate relative risk and the continuance of specific aeromedical certification standards.
- Provide recommendations for limits to radiation exposure (laser and ionizing).
- Develop an advanced aeromedical research accident database that is user friendly, has rapid response, and produces advanced statistical and graphics analysis.
- Conduct performance and protection assessment of pilot eye-respiratory protective equipment, including protection from chemical/biological agents.

NEW INITIATIVES

- Initiate molecular biological techniques to enhance forensic toxicological aspects of aircraft accident investigations.
- Explore a coordinated review/research effort to define cabin air quality research requirements.

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2002)	$ 83,724
FY 2003 Request	6,306
FY 2004 Request	6,382
Out-Year Planning Levels (FY 2005-2008)	28,476
Total	$ 124,888

Budget Authority ($000)	FY 2000 Enacted	FY 2001 Enacted	FY 2002 Enacted	FY 2003 Request	FY 2004 Request
Contracts:					
Aeromedical Research	394	938	491	498	353
Personnel Costs	3,858	3,893	4,268	4,451	4,611
Other In-house Costs	577	1,156	1,362	1,357	1,418
Total	**4,829**	**5,987**	**6,121**	**6,306**	**6,382**

OMB Circular A-11, Conduct of Research and Development ($000)	FY 2000 Enacted	FY 2001 Enacted	FY 2002 Enacted	FY 2003 Request	FY 2004 Request
Basic	0	0	0	0	0
Applied	4,829	5,987	6,121	6,306	6,382
Development (includes prototypes)	0	0	0	0	0
Total	**4,829**	**5,987**	**6,121**	**6,306**	**6,382**

A11j – Aeromedical Research Product and Activities	FY 2004 Request ($000)	Program Schedule					
		FY 2003	FY 2004	FY 2005	FY 2006	FY 2007	FY2008
086-110 Aeromedical Research							
Cabin Health and Environmental Guidelines	$25						
Assessment of Flight Crew Health Risks During a Flying Career		◆	◇	◇	◇	◇	◇
Models of Air Flow and Disease/Chemical-Biological Agent Transmission/Dissemination in Aircraft Cabins		◆	◇	◇			
Human Survival and Protection in Civil Aviation	$178						
Analyze the Suitability for Component Tests as an Alternative for Showing Regulatory Compliance with Crashworthiness Standard for Aircraft		◆	◇	◇	◇	◇	◇
Assess Impact Protection Performance of Aircraft Seating Systems		◆	◇	◇			
Develop Performance-Based Narrow and Wide Bodied Aircraft Cabin Evacuation Approval Guidelines		◆	◇	◇	◇	◇	◇
Development of 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	$150						
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 Forensics 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		◆	◇	◇	◇		
Advanced Aeromedical Accident and Pilot Certification Data Analysis		◆	◇	◇	◇	◇	◇
Personnel and Other In-House Costs	$6,029						
Total Budget Authority	$6,382	$6,306	$6,382	$6,659	$6,959	$7,266	$7,592

Note: **Out year numbers are for planning purposes only. Actual funding needs will be determined through the annual budget process.**

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2.4 Aviation Research Mission Support Program Area Description

Mission

The unifying mission of the Aviation Research Mission Support Program Area activities is to provide leadership and services in support of FAA strategic goals and objectives in industry vitality, global leadership, business practices, and communications. While this program area does not itself produce research, it guides and facilitates the research efforts of others.

Figure 2.4-1 indicates the percentage of the total requested FY 2004 R&D funding that will be devoted to Mission Support activities.

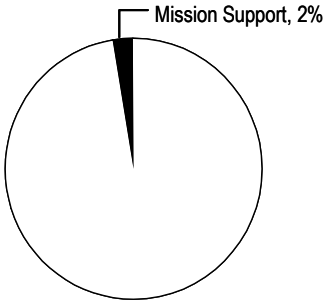

Figure 2.4-1: Percentage of Total FY 04 R&D Funding Supporting FAA Aviation Mission Support

Effective Mission Support management helps to ensure that:

- FAA R&D programs are conducted safely, efficiently, and in the fullest possible collaboration with internal and external customers.
- Sponsoring and performing organizations interface efficiently and responsibly with required authorities in the planning and execution of FAA R&D annual budget cycles.
- Vital ongoing activities of permanent research facilities are sustained through adequate and appropriate funding. These facilities are:
  - The Air Traffic Management Laboratory at the William J. Hughes Technical Center (WJHTC)
  - The Center for Advanced Aviation System Development (CAASD)
- FAA R&D Strategic Partnerships with government and private research institutions, universities, and industry continue and improve in effectiveness.

Program Area Structure

The Aviation Research Mission Support effort is divided into the following areas:

Publication of the annual *NARP*. The primary considerations in the production of this report are as follows:

- R &D Portfolio Strategic Management
- R,E&D Financial Management
- R,E&D Advisory Committee
- International cooperative research and development programs
- Collaboration with NASA on aviation research and development
- R,E&D Partnerships
- Center for Advanced Aviation System Development (CAASD)
- William J. Hughes Technical Center (WJHTC) Laboratories

With the exception of the F&E activities performed at CAASD, all FAA R&D Mission Support is funded through the R,E&D Budget Request.

Effective stewardship of the FAA R,E&D program requires that all NAS users receive the best systems and services achievable for their investment. In the first three elements just listed, the FAA strives to ensure that its R&D program portfolio effectively targets the needs of those who rely on the NAS, that the agency provides for R&D in its budget and R,E&D Plan, and that it properly accounts for its R,E&D financial resources.

The next three elements help to ensure that the agency's research and development program is fully coordinated with other aviation research programs and that others conducting research and development are cognizant of FAA needs and direction. With limited resources available, virtually all entities conducting aviation-related R&D must collaborate in the conduct of programs and share in the results.

The final elements provide the in-house component of our air traffic management research program. CAASD,

the FAA's federally funded research and development center, conducts fundamental, cutting-edge research and development of future ATM systems and procedures. The WJHTC laboratories provide the test beds for proposals for new systems, processes, or procedures.

Program Area Outputs

Detailed outputs of FAA Aviation Research Mission Support activities can be found in the individual program descriptions that follow this program area description. Among the most important general outputs of Mission Support are:

- The annual *National Aviation Research Plan* (*NARP*).
- Periodic and special R,E&D Advisory Committee reports and recommendations.
- The annual proposed FAA R,E&D Budget.
- International planning and implementation documents providing for world-wide aviation research harmonization and interoperability.
- Agreements with other international civil aviation authorities for the cooperative development of aviation systems research programs.
- Cooperative research agreements with academia, other government agencies, and industry.
- Modern, available Air Traffic Management (ATM) laboratories needed to meet the needs of the individual ATM research programs.

R&D Partnerships

Details of partnering between the FAA and other research entities can be found in the individual program descriptions that follow this program area description. Significant partnerships reflecting the work of the Mission Support area as a whole include:

- Received and incorporated periodic R,E&D Program guidance from the R,E&D Advisory Committee.
- Established 125 research and development agreements with 19 countries and with a single air traffic organization representing 17 member states.
- Established an agreement with EUROCONTROL to do cooperative research and development in air traffic management programs.

Intended Outcomes

Detailed anticipated benefits and recent accomplishments of components of FAA Aviation Research Mission Support can be found in the individual program descriptions that follow this program area description.

All work in this area serves the interests of the nation and flying public through some combination of the following:

- Increasing knowledge of the R,E&D program among the agency's customers and stakeholders.
- Increasing the participation of R,E&D customers and stakeholders in the program's formulation.
- Better managing limited R&D resources through more efficient and effective processes for the development and management of the FAA R,E&D investment portfolio.
- Fostering U.S. aviation industry leadership through international cooperation and harmonization in developing and implementing technologies that improve air traffic safety and efficiency.
- Achieving higher quality research and greater value though increased collaboration (partnerships) with the best academic and industrial R&D talent, both within the United States and internationally.
- Vitalizing the U.S. aviation industry by supporting R&D efforts toward the future technological and operational needs of NAS users.

Long-Range View

Mission Support activities will continue as long as the FAA performs research and development. Expected resource requirements in the "out-years" will remain at about 3-5% of the total R,E&D budget.

SYSTEM PLANNING AND RESOURCE MANAGEMENT

GOALS:

Intended Outcomes: The FAA intends that its R,E&D programs more effectively meet customer needs, increase program efficiency, and reduce management and operating costs. The FAA further intends to increase customer and stakeholder involvement in its programs by fostering greater proliferation of U.S. standards and technology to meet worldwide aviation needs. Additionally, the FAA intends to maintain close connections with the National Aeronautics and Space Administration in coordinating our research and development programs.

Agency Outputs: The FAA will:

- Prepare the annual R,E&D budget submission to Congress and publishes the annual *National Aviation Research Plan (NARP).*
- Host three R,E&D Advisory Committee (REDAC) meetings per year as well as a number of subcommittee meetings. REDAC produces periodic and special reports providing advice and recommendations on the R,E&D program to the FAA.
- Update and publish the FAA Research and Development Strategy.
- Produce coordinated research plans with NASA supporting both the efficiency and safety strategic goals of the FAA.

Customer/Stakeholder Involvement: REDAC reviews FAA research commitments annually and provides guidance for future R,E&D investments. The members of this committee and its associated subcommittees represent customer and stakeholder groups including subject matter experts from various associations, user groups, corporations, government agencies, as well as universities and research centers.

Accomplishments: Each year, the FAA provides R,E&D program status information through the *NARP* and submits the R,E&D budget requests to the Office of Management and Budget (OMB) and Congress. REDAC has provided the FAA with an independent strategic view on the agency's research commitments. In a recent report, the committee has reviewed the FAA's planned FY 2004 R,E&D Investments (April 2002). The Committee has also participated in a joint meeting with Aerospace Technology Advisory Committee (October 2002).

The National Aviation Research Plan, which is submitted to the Congress concurrent with the President's Budget submission, is available to the public on the FAA's web site. The FAA R&D Strategy, published in September 2002 is also available on the FAA web site.

The scope of research activities and the results of the research produced by the FAA and NASA's Joint University Program are available on web sites maintained by Princeton University, one of the participants in the JUP, and the FAA's William J. Hughes Technical Center.

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

MAJOR ACTIVITIES AND ANTICIPATED FY 2003 ACCOMPLISHMENTS:

R,E&D plans and programs

- Published the National Aviation Research Plan (February 2003).
- Published the FAA Research and Development Strategy Performance Goals and Measures addendum (September 2003).

R,E&D advisory committee

- Submitted Committee review of and recommendations for FY 2005 R,E&D Program (April 2003).
- Submitted Committee guidance for FY 2005 R,E&D Program (October 2002).
- Participated in joint meetings with NASA's Aero-Space Technology Advisory Committee (October 2002).

KEY FY 2004 PRODUCTS AND MILESTONES:

R,E&D plans and programs

- Publish the National Aviation Research Plan.
- Update and publish the FAA R&D Strategy.

R,E&D advisory committee

- Prepare recommendations on planned R,E&D investments for FY 2005.
- Prepare other reports as requested by the Administrator.

- Participate in joint meetings with NASA's Aero-Space Technology Advisory Committee.

NASA Field Offices

- Continue the development and implementation of Free Flight Phase 1 and 2 Tools.
- Participate in the development of the 21st Century Aviation Initiative.
- Continue the development and implementation of aircraft structural safety programs.
- Support the FAA/NASA Virtual Airspace Modeling System (VAMS) project goal of developing and airspace system modeling, simulation and evaluation environment.
- Continue to study the feasibility of the Small Aircraft Transportation System (SATS).

Joint University Program

- Publish and disseminate research results reported on at the quarterly reviews.

FY 2004 PROGRAM REQUEST:

This request will be used to further FAA's R,E&D program strategic management of its R&D activities.

Specifically, the FAA will evaluate the Research and Development Strategy against the its R&D Program and agency goals. This will be done to ensure that the strategy remains viable in a changing world and that the program itself continues to support the most pressing needs of the agency. Results of this evaluation will be used in the update of the strategy planned and the program.

The FAA will continue to support the work of the REDAC in its task to advise the Administrator on the agency R&D Program. In particular, the agency will seek the counsel and guidance of the committee for the FY 2005 program, review the proposed FY 2005 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 (NARP)* and submit it annually to Congress as part of the President's Budget Request.

The agency will continue to provide cross-functional management team support for the *FAA R&D Strategic Plan*, ensure that programs planned in response to that plan are balanced across FAA strategic objectives, and ensure the most important and beneficial work is accomplished within the available resources.

The agency will continue to maintain its field offices at the NASA Ames and Langley Research Centers as a vital part of our efforts to coordinate and integrate the research and development programs of the two organizations. Additionally, we will continue to support, along with NASA, the Joint University Program. This program continues to be an important provider of new ideas which in the past have made significant contributions in advancing aviation safety and efficiency of operations in the National Airspace System.

ONGOING ACTIVITIES

- Update of the R&D Strategic Plan
- Publication of the National Aviation Research Plan
- Sustainment of R,E&D Advisory Committee Activities
- Publication of the *NARP*

NEW INITIATIVES

No new initiatives are planned in FY 2004.

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2002)	$ 34,781
FY 2003 Request	1,455
FY 2004 Request	1,261
Out-Year Planning Levels (FY 2005-2008)	5,194
Total	$ 42,691

Budget Authority ($000)	FY 2000 Enacted	FY 2001 Enacted	FY 2002 Enacted	FY 2003 Request	FY 2004 Request
Contracts:					
System Planning & Resource Mgmt	1,164	886	1,130	1,408	1,200
Personnel Costs	0	246	49	43	56
Other In-house Costs	0	30	21	4	5
Total	**1,164**	**1,162**	**1,200**	**1,455**	**1,261**

OMB Circular A-11, Conduct of Research and Development ($000)	FY 2000 Enacted	FY 2001 Enacted	FY 2002 Enacted	FY 2003 Request	FY 2004 Request
Basic	0	0	0	0	0
Applied	1,164	1,162	1,200	1,455	1,261
Development (includes prototypes)	0	0	0	0	0
Total	**1,164**	**1,162**	**1,200**	**1,455**	**1,261**

A14a – System Planning and Resource Management Products and Activities	FY 2004 Request ($000)	Program Schedule					
		FY 2003	FY 2004	FY 2005	FY 2006	FY 2007	FY2008
011-130 R,E&D Plans and Programs							
R,E&D Plans and Programs	$480						
Publish Annual Plan for R&D		◆	◇	◇	◇	◇	◇
R,E&D Financial Management		◆	◇	◇	◇	◇	◇
Prepare Annual Budget Submissions		◆	◇	◇	◇	◇	◇
R<E&D Advisory Committee	$120						
Recommendations on FAA, R,E&D Investments		◆	◇	◇	◇	◇	◇
Joint Meetings with NASA's Aero-Space Technology Advisory Committee		◆	◇	◇	◇	◇	◇
NASA Field Offices	$400	◆	◇				
Joint University Program (Quarterly Research Reviews)	$200	◆	◇				
Personnel and Other In-House Costs	$61						
Total Budget Authority	$1,261	$1,455	$1,261	$1,270	$1,296	$1,302	$1,326

Note: **Out year numbers are for planning purposes only. Actual funding needs will be determined through the annual budget process.**

WILLIAM J. HUGHES TECHNICAL CENTER LABORATORY FACILITY

GOALS:

Intended Outcomes: The FAA maintains and operates research facilities located at the William J. Hughes Technical Center (WJHTC) in support of R,E&D program goals to:

- Reduce the number of accidents and accident risk.
- Perform airspace studies and improve airspace design.
- Increase airport capacity.
- Reduce delays due to weather and system outages.
- Reduce user costs.

These centralized facilities consist of NAS systems, aircraft, simulation facilities, communication systems laboratory, and a Human Factors Laboratories.

Agency Outputs: R,E&D programs require various facilities to emulate and evaluate field conditions. Human factors projects require laboratories to perform human-in-the-loop simulations, measure human performance, and evaluate human factors issues. Airborne and navigation projects require "flying laboratories" that are specially instrumented and reconfigurable to support different projects.

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

- Capacity and air traffic management technology
- Communications, Navigation, And Surveillance (CNS)
- Operational Evolution Plan (OEP) concept validation
- Free Flight Phase 1 and 2
- Weather
- Airport technology
- Aircraft safety technology
- Human Factors
- Information Security
- Environment and Energy
- Automated Dependent Surveillance-Broadcast (ADS-B)
- Terminal Instrumentation Procedures (TERPS)
- Wide/Local Area Augmentation System (WAAS/ LAAS)
- Safe Flight 21

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

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

MAJOR ACTIVITIES AND ANTICIPATED FY 2003 ACCOMPLISHMENTS:

The following programs have been supported by the laboratories:

- Runway Incursion
- Information Security
- Separation Standards
- GPS/WAAS/LAAS
- TERPS
- Satellite Communication
- Data Link
- TCAS/ADS-B
- Acquisition Human Factors
- Delay Reduction
- Runway Pavement Testing
- Safe Flight 21

KEY FY 2004 PRODUCTS AND MILESTONES:

The test beds at the WJH Technical Center provide the necessary infrastructure for R,E&D programs to achieve their goals. Specific milestones and products are contained within individual programs.

FY 2004 PROGRAM REQUEST:

- The WJHTC will maintain and operate technical laboratories/facilities that support R,E&D programs.

ONGOING ACTIVITIES

- Free Flight Phase 2
- Capacity Initiatives (Airspace, Procedures)
- Information Security
- ADS-B/Data Link
- Satellite Com. and Navigation Programs
- Separation Standards
- GPS WAAS/LAAS
- TERPS
- Runway Incursion
- Aircraft Safety
- ATC/AF Human Factors
- OEP Concept Validation

NEW INITIATIVES

No new initiatives are planned in FY 2004.

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2002)	$ 83,922
FY 2003 Request	6,203
FY 2004 Request	3,425
Out-Year Planning Levels (FY 2005-2008)	14,971
Total	$ 108,521

Budget Authority ($000)	FY 2000 Enacted	FY 2001 Enacted	FY 2002 Enacted	FY 2003 Request	FY 2004 Request
Contracts:					
WJHTC Laboratory Facility	3,300	2,710	3,540	3,889	999
Personnel Costs	6,988	8,044	8,046	2,281	2,401
Other In-house Costs	787	1,469	664	33	25
Total	**11,075**	**12,223**	**12,250**	**6,203**	**3,425**

OMB Circular A-11, Conduct of Research and Development ($000)	FY 2000 Enacted	FY 2001 Enacted	FY 2002 Enacted	FY 2003 Request	FY 2004 Request
Basic	0	0	0	0	0
Applied	11,075	12,223	12,250	6,203	3,425
Development (includes prototypes)	0	0	0	0	0
Total	**11,075**	**12,223**	**12,250**	**6,203**	**3,425**

A14b – WJHTC Laboratory Facility Products and Activities	FY 2004 Request ($000)	Program Schedule					
		FY 2003	FY 2004	FY 2005	FY 2006	FY 2007	FY2008
011-140 WJHTC Laboratory Facility							
Systems Support laboratory (En Route, Terminal, Automated Flight Station, Communications, and Scan Radars)	$99						
Free Flight Phase 2		◆	◇	◇			
Operational Evolution Plan Concept Validation		◆	◇	◇	◇	◇	◇
Capacity Initiatives (Airspace, Procedures)		◆	◇	◇	◇	◇	◇
Information Security		◆	◇	◇	◇	◇	◇
Research & Development Laboratory (Target Generator Facility, Cockpit Simulator, Auto tracking, Tech Center Data)	$300						
Approach Procedures (SOIA)		◆	◇	◇	◇		
Free Flight Phase 2		◆	◇	◇	◇	◇	◇
Airspace Design		◆	◇	◇	◇	◇	◇
Operational Evolution Plan Concept Validation		◆	◇	◇	◇	◇	◇
Data Link		◆	◇	◇	◇	◇	◇
Stars Integration		◆	◇	◇	◇		
Aviation Support Laboratory (Aircraft)	$300						
Satellite Communications and Navigation Programs		◆	◇	◇	◇	◇	◇
Separation Standards		◆	◇	◇	◇		
GPS WAAS/LAAS		◆	◇	◇	◇	◇	◇
TERPS		◆	◇	◇	◇	◇	◇
Data Link		◆	◇	◇	◇	◇	◇
Runway Incursion		◆	◇	◇	◇	◇	◇
ADS-B		◆	◇	◇	◇	◇	◇
Aircraft Safety		◆	◇	◇	◇		
Human Factors Laboratory	$300						
Air Traffic Control Human Factors		◆	◇	◇	◇	◇	◇
Airway Facilities Human factors		◆	◇	◇	◇	◇	◇
Operational Evolution Plan Concept Validation		◆	◇	◇	◇		
Personnel and Other In-House Costs	$2,426						
Total Budget Authority	$3,425	$6,203	$3,425	$3,541	$3,678	$3,803	$3,949

Note: **Out year numbers are for planning purposes only. Actual funding needs will be determined through the annual budget process.**

2.2 Aviation Efficiency Research and Development Program Area Description

Mission

The unifying mission of the Aviation Efficiency R&D Program Area is to support the FAA Efficiency Goal, as stated in the agency's Strategic Plan: "*Provide an aerospace transportation system that meets the needs of users and is efficient in the application of FAA and aerospace resources.*"

Figure 2.2-1 indicates the percentage of the total requested FY 2004 R&D funding that will be devoted to the support of Aviation Efficiency research.

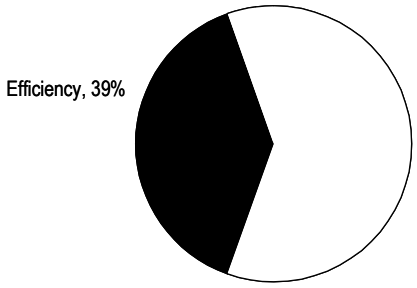

Figure 2.2-1: Percentage of Total FY 04 R&D Funding Supporting FAA Aviation Efficiency Goal

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

Program Area Structure

Broad research emphases within the Aviation Efficiency R&D Program Area include:

- Airports Technology ***
  - Airport Pavement Design
  - Airports Planning and Design
- Advanced Technology Development and Prototyping Program **
  - Aviation System Capacity Improvement (ASCI)
  - Separation Standards
  - Airspace Management Laboratory
  - Operational Concept Validation
  - Software Engineering
  - NAS Requirements Development
  - Domestic Reduced Vertical Separation Minima (DRVSM)
  - Cyber Security for NAS Development
  - Required Navigation Performance (RNP)
- Safe Flight 21 **
  - Ohio River Valley
- Free Flight Research and Development **
- Center for Advanced Aviation System Development (CAASD) R&D Programs **

_____

** F&E Budget Request
*** AIP Budget Request

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

Program Challenges and Strategies

The 2002 *FAA R&D Strategy* provides a conceptual framework that ties the work of the agency's R&D projects to the accomplishment of FAA strategic goals. Section 1.0 of this Plan, "FAA R&D Program Overview," provides a brief discussion of the relationship of high-level program goals (derived from agency goals), through specific challenges and strategies, down to the level of related project results. Table 2.2-1, adapted from the 2002 *FAA R&D Strategy* outlines the current long-term planning structure for the Aviation Efficiency Research and Development program area.

R&D Challenges	R&D Strategies
Derived Goal: Match system capacity to the traffic demands of users of the NAS.	
Increased Airport Arrival/Departure Rates *– Develop and evaluate technologies, practices, and operational procedures that support accelerated design and construction of runways and full exploitation of their capacity.*	(1) Facilitate surface infrastructure design, construction practices, and efficient operational surface movement. (2) Provide terminal airspace standards, procedures, and tools that support improved terminal airspace and route design and permit full use of available runway capacity.
Increased En Route Capacity *– Develop operational concepts, standards, and tools that increase flexibility in responding to changing circumstances and better matching airspace design and capacity and demand.*	(1) Develop tools and analyses to design and evaluate airspace design and reduce separation standards without compromising safety. (2) Develop tools and validate procedures for strategic collaborations between users and providers to resolve tactical congestion problems. (3) Develop and validate improved controller-pilot communication technologies.
Reduced Airport Weather Impacts *– Develop and evaluate technologies, tools, and procedures to achieve near optimum runway acceptance rates without regard for meteorological conditions.*	(1) Develop and validate new services, based on surveillance and navigation technologies and procedural improvements, to enable continued arrival operations as weather deteriorates from visual to instrument meteorological conditions. (2) Validate new cockpit tools and displays to achieve VMC throughput capacity in all weather conditions.
Reduced En Route Weather Impacts *– Develop and evaluate means to deliver weather information to users, and means for providers and users to respond effectively and rapidly to hazardous weather.*	Develop means for greater integration of common weather information into the air traffic management process, including collaborative adjustment of routes.
Expanded Access and Service Availability *– Develop and validate technologies to enable instrument approaches at remote and low-traffic airports.*	Develop alternatives to fixed terrestrial facilities as a means of rapidly introducing improved NAS services in remote areas.
Future Capacity Enhancements *– Explore and apply concepts, technologies and procedures that will make possible NAS capacity increases sufficient to meet traffic demand beyond 2010.*	(1) Develop a NAS architecture to serve as the framework for a flexible ATM that is based on the paradigm of timely and efficient delivery of information to all actors, can readily be reconfigured in response to changing patterns of operation, facilitates evolutionary improvement, and fosters exploration of alternative procedures and strategies. (2) Undertake structured collaborations with NASA and others to identify improved ATM concepts and foster their incorporation into the NAS.

Table 2.2-1: Goals, Challenges & Strategies – Aviation Efficiency R&D Program Area

R&D Challenges	R&D Strategies
Derived Goal: Minimize the costs to users of the NAS.	
Improved NAS Predictability *– Provide users with improved current and projected status information in an operational environment.*	(1) Identify, develop and validate improved technology and processes for communication to users of current and projected NAS status and performance. (2) Identify and develop tools for knowledge capture of operational experience with respect to actual performance and decisions made to support post-analysis that facilitates lessons learned, improved training and repeatability of "best practices," and longer–term strategic planning.
Greater NAS Flexibility - *Validate performance and safety of technologies critical to implementation of Free Flight.*	(1) Accelerate application of CNS technologies critical to Free Flight. (2) Demonstrate and validate advanced technologies in an operational environment to accelerate availability of capabilities that involves users and removes operational constraints.
Derived Goal: Reduce the cost of providing NAS infrastru	
Reduction of the Cost of Providing NAS Services *– Design and evaluate infrastructure technologies that minimize life-cycle costs, and develop tools to accelerate the development of software systems.*	(1) Perform analyses and design NAS subsystems that reflect costs of deployment, operations, repair and maintenance, and workforce needs. (2) Develop means for ensuring that Commercial Off-The-Shelf (COTS) software is safe and will function as required. (3) Develop tools and techniques for efficient development and deployment of NAS software systems.
Reduction of Airport Surface and Terminal Infrastructure Cost *– Develop guidance and standards for pavement design and construction and airport design and layout.*	Conduct testing at the National Pavement Test Facility and conduct analyses to support development of guidance and standards for pavement design and construction and airport design and layout.

Table 2.2-1 (Continued): Goals, Challenges & Strategies – Aviation Efficiency R&D Program Area

Program Area Outputs

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

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

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

Safe Flight 21 Program outputs convey the results of performing detailed risk assessments upon communications, navigation, and surveillance systems with high potential of increasing the efficiency of the NAS. Documentation from this research will guide the FAA and the participating stakeholder community in making decisions

regarding the implementation suitability and readiness of these technologies.

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

FAA/NASA Collaborative R&D (Efficiency)

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

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

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

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

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

International Cooperative Aviation R&D

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

Intended Outcomes

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

A comprehensive R&D program for the improvement of airport and pavement design is

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

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

The Safe Flight 21 Program conducts research in specific operating environments to validate the potential of advanced communications, navigation, surveillance, technologies and related air traffic procedures to increase NAS capacity and efficiency.

Long-Range View

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

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

The Safe Flight 21 Program is intended to take a short- to medium-range approach to the validation of specific technological concepts with high potential to increase NAS efficiency and safety.

AIRPORTS TECHNOLOGY — EFFICIENCY

GOALS:

Intended Outcomes: The FAA intends to enhance airport system efficiency through advancements in airport planning and design and through improvements in pavement design, construction, and maintenance.

Agency Outputs: The FAA is required by law to develop standards and guidance material for airport design, construction, and maintenance. The FAA uses the airport Advisory Circular (AC) system as its principal means of communicating with a user community consisting of U.S. airport planners, designers, operators, and equipment manufacturers. ACs cover airport geometric design, pavement design, safety areas, visual aids, access roads, rescue and firefighting, ice and snow control, and wildlife control. The FAA and its regional offices enforce standards and guiding material when administering the Airport Improvement Program (AIP).

The Airport Technology program provides the technical information necessary to support and update these FAA outputs in a timely manner.

Customer/Stakeholder Involvement: Approximately $2 billion is spent annually to provide operationally safe and reliable airport pavements. The FAA funds about half of this amount as AIP grants; state and local governments and airport operators provide the remainder. Projects funded under the AIP grants must conform to the FAA ACs or standards.

Airports need new pavement design standards for operation of next-generation heavy aircraft to ensure compatibility of their aircraft with airport surfaces throughout the world. To accomplish this, the FAA and the Boeing Company have entered into a Cooperative Research and Development Agreement to build a unique full-scale pavement test facility at the William J. Hughes Technical Center. The FAA, the Boeing Company, and the International Civil Aviation Organization (ICAO) will use data collected from the project in developing international pavement design standards.

The FAA needs these standards to assure the public that Federal funds for rebuilding or strengthening runways are being judiciously spent and also to protect the $100 billion investment in the U.S. infrastructure.

Accomplishments: During the past five years, the Airport Technology research program has provided products to enhance airport efficiency in the United States and around the world. Research results are published as FAA reports and ACs and made available to users worldwide. Some major accomplishments are:

- Began operations of an aircraft deicing facility using infrared energy at a major hub airport.
- Developed an environmentally acceptable replacement for the chlorofluorocarbon (CFC) ozone depletor Halon 1211.
- Completed an evaluation of ramp access to commuter aircraft for people with mobility impairments.
- Issued new pavement design standards to allow operation of Boeing B-777 without weight penalties.
- Established a Center of Excellence (COE) in Airport Pavement Research at the University of Illinois and Northwestern University.
- Installed a comprehensive instrumentation system in concrete pavements at Denver International Airport.
- Completed construction of the National Airport Pavement Test Facility and dedicated it on April 12, 1999. Testing at the facility started on June 4, 1999.
- Established an airport pavement data base containing field data collected at Denver International Airport, allowing on-line access to researchers worldwide.

R&D Partnerships:

- FAA-U.S. Army Waterways Experiment Station*
- FAA-U.S. Air Force, Tyndall Air Force Base*
- FAA-University of Illinois/Northwestern University (COE for Airport Pavement Research)**
- FAA-Boeing Company, Cooperative Research and Development Agreement ($7 million Boeing/$21 million total for National Airport Pavement Test Machine)***
- FAA-Agencies of Canadian Government (for pavement technology and winter operations safety)***
- FAA-NASA (for joint runway traction research)*

- FAA-industry (to test and develop infrared deicing facilities and soft-ground arrestor materials)***

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* Interagency agreement or Memorandum of Agreement (MOA)
** Partnership through matching funds
*** Cost Sharing

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

MAJOR ACTIVITIES AND ANTICIPATED FY 2003 ACCOMPLISHMENTS:

Airport planning and design technology

- Completed reports on sizing terminal components and compiling information on other aspects of terminal planning.

Airport pavement technology

- Completed improvement of back-calculation methods for Nondestructive Testing (NDT) of airport pavements.
- Continued data collection and analysis at Denver International Airport.

National Dynamic Airport Pavement Tests

- Conducted the second series of full-scale traffic tests (life tests) at the National Airport Pavement Test Facility (NAPTF).
- Continued to analyze full-scale traffic test data from NAPTF to relate performance to designs.
- Released updated pavement design program package (LEDFAA 2.0).
- Continued development of three-dimensional finite element based pavement design procedures.

KEY FY 2004 PRODUCTS AND MILESTONES

- Continue Analyzing Full-Scale Data from the National Airport Pavement Test Facility.
- Design and Fabricate Modules for 8-Wheel Gear Loading.
- Publish Upgraded LEDFAA Version 2.
- Conduct Three Technical Workshops for Pavement Design using LEDFAA Version 2.
- Complete Beta testing of FEDFAA pavement computer design.
- Develop Conceptual Guidelines and Computer Tools for Terminal Building Design.
- Develop Design Standards for General Aviation Airports.
- Publish Updated Failure Models for Airport Pavement Design.

FY 2004 PROGRAM REQUEST:

The Airport Technology FY 2003 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.

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2002)	$9,266
FY 2003 Request	6,586
FY 2004 Request	7,750
Out-Year Planning Levels (FY 2005-2008)	35,529
Total	$59,131

Budget Authority ($000)	FY 2000 Enacted	FY 2001 Enacted	FY 2002 Enacted	FY 2003 Request	FY 2004 Request
Contracts:					
Airport - Efficiency	1,488	3,331	2,675	6,586	7,750
Personnel Costs	0	0	0	0	0
Other In-house Costs	0	0	0	0	0
Total	**1,488**	**3,331**	**2,675**	**6,586**	**7,750**

OMB Circular A-11, Conduct of Research and Development ($000)	FY 2000 Enacted	FY 2001 Enacted	FY 2002 Enacted	FY 2003 Enacted	FY 2004 Request
Basic	0	0	0	0	0
Applied	0	0	0	0	0
Development (includes prototypes)	1,488	3,331	2,675	6,586	7,750
Total	**1,488**	**3,331**	**2,675**	**6,586**	**7,750**

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

Airports Technology - Efficiency Products and Activities	FY 2004 Request ($000)	Program Schedule					
		FY 2003	FY 2004	FY 2005	FY 2006	FY 2007	FY2008
Airport Technology – Efficiency Goal	* $7,750						
Conduct the Second Series of Full-Scale Traffic Tests (Life Tests)		◆	◇				
Continue to Analyze Full-Scale Traffic Test Data from NAPTF to Relate Performance to Designs		◆	◇				
Release Updated Pavement Design Program Package		◆	◇	◇	◇	◇	◇
Continue Development of Three-Dimensional Finite Element Based Pavement Design Procedures		◆	◇	◇	◇	◇	◇
Continue Data Collection and Analysis at Denver International Airport		◆	◇	◇	◇	◇	◇
Complete Improvement of Back-Calculation Methods for Non-Destructive Testing of Airport Pavements		◆	◇	◇	◇	◇	◇
Conduct Research on Airport Planning and Design		◆	◇	◇	◇	◇	◇
Total Budget Authority	* $7,750	$6,586	* $7,750	$8,750	$8,838	$8,926	$9,015

Note: Out year numbers are for planning purposes only. Actual funding needs will be determined through the annual budget process.
* These funds are included in the FY 2004 budget request and reflect only the contract dollars.

AVIATION SYSTEM CAPACITY IMPROVEMENT (ASCI)

GOALS:

Intended Outcomes: The Office of Aviation System Capacity (ASC) has aligned itself to support the FAA's safety and efficiency goals in order to provide safer skies for the aviation community and to improve the structure of the National Airspace System (NAS). ASC continues to invest resources in aviation research and development projects to build new runways, produce aviation publications, and provide aviation reporting systems that track flight data to achieve operational enhancement.

ASC is cognizant of the challenges that deminish NAS proficiency. The program's strategy for meeting these challenges is to develop an effective program plan that proposes and implements optimal solutions to rectify critical aviation problems. ASC's current program plan is a microcosm of advanced technolgical innovations and synergies that include the following:

- Developing performance metrics for the Air Traffic Organization that are designed to modernize, operate, and maintain a safe, efficient air traffic management system.
- Assisting the Operational Evolution Staff (OES) in modernizing the NAS through the construction of new runways at high density airports, as well as producing technological procedures that will allow operations during inclement weather.
- Designing a strategy implementation tool, known as Balance Scorecard, that can generate a parallel between strategy and performance in the regions and facilities.

This program: (1) complies with the Government Performance and Results Act (GPRA) of 1993 and Executive Order on infrastructure investment requirements; (2) fulfills the congressional mandate to produce airport improvement plans; (3) responds to the aviation industry's high-priority initiatives for increased capacity; and (4) responds to the recommendations of the Presidential Commission on Improved Airline Competitiveness.

Agency Outputs: The economics of aviation continue to be influenced by the sluggish recovery of the aviation industry and NAS. The FAA's approach to safety, security, and efficiency/ capacity must be realigned if it is to meet industry demands while continuing to maintain the structure of the NAS. The work performed under the ASC program has historically yielded both tangible and intangible benefits in support of other efforts to better align the airline industry, airports and FAA capacity and efficiency initiatives. Future work must and will address post-9/11 realities and will be driven by refreshed analyses and studies. New performance metrics will be needed to align actual and projected traffic demands. The resources provided under this program will be leveraged with FAA and other-agency resources and programs including the Operational Evolution Plan, Transportation Security Agency, Department of Defense, and NASA.

The Aviation System Capacity office has developed an intricate matrix of procedures to modify en route and terminal flight operations. ASC has also developed metrics and data to measure operations intended to implement a more efficient airspace system. The Performance Data Analysis and Reporting System (PDARS) is constantly refined to extend quantitative operational performance measures relating to system safety, delay, flexibility and predictability to all facilities within the NAS. Additionally, ASC continues to conduct analyses to refine ground traffic procedures, and improve flight standards. At the Dallas-Fort Worth International Airport, for example, procedures analyzed in the Perimeter Taxiway Study may permit inbound and outbound taxiing aircraft continuous movement while never requiring a runway crossing.

The ASC program provides a responsive, ongoing problem-solving research capability. It integrates, for the first time, the performing elements of the FAA necessary to gain near-term safety and capacity benefits. This need for a highly adaptive, rapid response capability is expected to exist until NAS Modernization is complete.

ASC establishes a dedicated set of resources, set aside specifically to respond to identified problems, agreed by the performing, regulatory, and consuming interests to share some or all of the following characteristics:

- Maintains or enhances aviation safety and security.
- Offers the potential for immediate or near-term solutions.
- Offers significant relief at locations of transportation significance.
- Employs creative applications of existing technology.
- Requires "corporate" solutions.
- Either will not interfere with, or may be superceded by, national solutions when they become available.

Customer/Stakeholder Involvement: Although the FAA directs the entire capacity program, customers and stakeholders play active roles in its success. Airport authorities from all concerned airports, air carrier representatives, aviation interest groups, and FAA regional and local air traffic control personnel form an integral part of every airspace and airport capacity task force or project.

The Office of System Capacity ensures effective dialogue on the subject of NAS infrastructure improvement. This outreach system may be in the form of a formal advisory committee, a series of informal seminars, or individual meetings with relevant industry elements. The ASC program:

- Serves as a knowledge center for industry- driven capacity enhancement projects.
- Generates, coordinates, and maintains work plans for capacity enhancement projects at least two years into the future.
- Reports on resource requirements, allocations and shortfalls to FAA management as well as the agency's industry outreach mechanism.
- Reports project status both to FAA's senior management and to industry representatives.

The capacity office annually publishes the Aviation Capacity Enhancement (ACE) Plan to keep the aviation world informed of progress and advancements in the capacity arena. Members of the international aviation community regularly consult this document. Requestors in this country include Congress; scholars and students, who use it for their aviation studies; and aviation groups, who use it to develop congressional budget justifications.

As previously stated in "Goals," the overall capacity program reinforces and works in parallel with congressional mandated plans for improvements in airport and FAA performance and results.

Accomplishments:

- Developed a methodology to measure performance of Air Traffic Services in the en route environment.
- Completed the ATS Performance Plan Supplement.
- Prepared and published the 2001 ACE Plan.
- Completed the automation of the ATS Flash Report.
- Developed and revised the ATS customer performance metrics in support of GPRA.
- Completed installation of PDARS at all ARTCCs and at major TRACONs within AWP, ASW, and the Indianapolis ARTCC.
- Completed initial development of the Area Navigation (RNAV) Pro capability that analyzes departure and arrival flight paths in the terminal area and also assesses the feasibility of proposed enroute flight paths.
- Completed Executive Summary and Technical Reports Compact Disc for the O'Hare Delay Task Force.

R&D Partnerships:

In accordance with the annex of the memorandum of understanding between the FAA and EUROCONTROL, the capacity program has established a joint airspace technologies and initiatives group to modernize international aviation. The intended outcome is to meet compatibility requirements between the United States and the rest of the aviation world in such areas as Free Flight, Global Positioning System (GPS), the Flight Management System, the Precision Runway Monitor, and other emerging technologies.

The FAA will partner with major air carriers and business aviation aircraft in developing financial management systems approaches.

The FAA will partner with NASA on projects, including:

- Use of performance measures developed by the capacity program for ATS in compliance with the Congressional mandate for GPRA.
- Joint computer simulation modeling for TRACON systems including the Center TRACON Automation

System (CTAS) and the Standard Terminal Automation Replacement System (STARS).

- Short Haul Civil Tilt rotor simulation of proposed Simultaneous Non-Interfering (SNI) Approach procedure.

The FAA will partner with aircraft manufacturers Boeing and Airbus, avionics manufacturers, Municipal Airport Authorities, Airports Council International – North America, Air Transport Association, and the Airlines Pilots Association for proposed New Large Aircraft (NLA). Work in these partnerships will include Wide Area Augmentation System/Local Area Augmentation System (WAAS/LAAS) for Minimum Vectoring Altitude (MVA) and Automatic Dependent Surveillance – Broadcast (ADS-B) for closely-spaced parallel runway analysis for Airports Council International – North America (ACI-NA).

PDARS, a fully integrated performance measurement tool designed to help the FAA improve the NAS, is a collaborative effort between the FAA Office of System Capacity and NASA's Aviation Safety Program. This tool permits users to analyze, measure, and report system performance on a routine basis and supports trend analysis, present-day operation analysis. PDARS supports ATS reporting under GPRA, the law that requires all Federal agencies to report their annual progress toward meeting their performance goals.

MAJOR ACTIVITIES AND ANTICIPATED FY 2003 ACCOMPLISHMENTS:

NAS Performance Measurement

- En Route Balance Scorecard – Developed En Route Scorecard metrics, conduct cost performance benchmarking causal analysis, provide data infrastructure and system automation capabilities, and facilitate educational briefings to customers and stakeholders.
- Terminal Balance Scorecard – Developed terminal capacity metrics, conduct cost performance benchmarking analysis, and begin prototyping for Southern region.
- Facility Level Metrics – Enhanced system capabilities by expanding system network to include 20 domestic centers, provide maintenance support, and implement national expansion of system coverage.
- Performance Metrics – Developed analytical capabilities for the Air Traffic Organization (ATO).

Airport Development

- Airport Capacity Benchmark Report – Supported publication of the through data collection and analysis for San Francisco, Philadelphia, and Atlanta International Airports.
- NLA – Formulated a Procedures/Collision Risk Model for JFK, Los Angeles, and Indianapolis International Airports for the New Large Aircraft.; facilitated NLA minimum operation procedure development.
- Regional Jets – Conducted modeling to confirm departure-heading procedure created for Newark International Airport; facilitated departure heading and procedure change discussions with Philadelphia, Baltimore-Washington, Boston-Logan, and individual airports.
- 2002 ACE Plan – Completed and distributed.
- 2003 ACE Plan – Began collecting statistics and dialogue for the initial draft of the ACE Plan.

Capacity Improvement Opportunities

- OEP Initiative (AD-1) – Houston Redesign – Supported efforts to increase airport capacity through the development of an additional runway. New runways will contribute to effective capacity to appropriately accommodate increased airport traffic volume. Other Houston initiatives ASC will support include Maintain Runway Use in Reduced Visibility (AW-1) through the development of navigational procedures.
- Navigation fidelity Data – Provided evidence in support of new airways through the development of new flight standards and procedures to determine navigational accuracy (using the Performance Data And Reporting System) of traffic utilization.
- SFO Bay Area Analysis – Conducted modeling and simulation research to provide analysis tools to quantify airspace changes.

Architecture Deployment Support

- Simultaneous Offset Instrument Approaches (SOIA) – Collision Risk and Wake Turbulence Analyses – Provided new means for the San Francisco, St. Louis-Lambert, and Cleveland Hopkins International Airports to manage increased airport throughput.
- Along Track Separation (ATS) – Conducted ATS and Wake Turbulence research analysis to validate a reduction in parallel dependent separation standards.

KEY FY 2004 PRODUCTS AND MILESTONES:

NAS Performance Measurement

- En Route/Terminal Balance Scorecard – Complete measures development, causal analysis, prototyping in Great Lakes Region, evaluation of en route environment, and work on implementation and information systems.
- Facility Level Metrics – Continue refining these analytic tools to incorporate software maintenance, system enhancements, and system automation for reporting.

Airport Development

- Benchmarking – Complete at LaGuardia, Newark, JFK International Airports.
- NLA – Formulate a Procedures/Collision Risk Model for San Francisco, Anchorage, Chicago O'Hare International Airports for the New Large Aircraft program.
- Regional jets modeling – Complete for airports in the Eastern and Central regions to maximize airport capacity.
- 2003 ACE Plan – Complete and distribute.

Capacity Improvement Opportunities

- Capacity Enhancements – Support development, promotion, demonstration, and implementation.

Architecture Deployment Support

- Required Navigation Performance (RNP) – Support implementation of standard operations at San Francisco, Oakland, San Jose, Detroit Wayne County, and Ronald Reagan Airports.
- Along Track Separation Procedures – Support their development for operational implementation at Cleveland Airport.

FY 2004 PROGRAM REQUEST:

In FY 2004, the ASC program will continue to provide analysis and research studies to improve the operational structure of the NAS. The Aviation Capacity Enhancement Plan will be published to provide the aviation community with updated information relating to capacity benchmarks and operational procedures. Additionally, capacity enhancement studies will be implemented to increase airport capacity and reduce flight delays, which will prove to be a cost benefit to air carriers.

The program will also maintain its support to ATS Performance Management by providing timely and accurate performance metrics specifically designed to measure current FAA goals and customer needs.

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2002)	$13,655
FY 2003 Request	5,300
FY 2004 Request	6,500
Out-Year Planning Levels (FY 2005-2008)	32,400
Total	$57,855

Budget Authority ($000)	FY 1999 Enacted	FY 2000 Enacted	FY 2001 Enacted	FY 2002 Enacted	FY 2003 Request	FY 2004 Request
Contracts:						
Aviation System Capacity Improvement	228	1,200	5,300	5,300	5,300	6,500
Personnel Costs	1,627	0	0	0	0	0
Other In-house Costs	0	0	0	0	0	0
Total	**1,855**	**1,200**	**5,300**	**5,300**	**5,300**	**6,500**

OMB Circular A-11, Conduct of Research and Development ($000)	FY 2000 Enacted	FY 2000 Enacted	FY 2001 Enacted	FY 2002 Enacted	FY 2003 Request	FY 2004 Request
Basic	0	0	0	0	0	0
Applied	0	0	0	0	0	0
Development (includes prototypes)	1,855	1,200	5,300	5,300	5,300	6,500
Total	**1,855**	**1,200**	**5,300**	**5,300**	**5,300**	**6,500**

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

Aviation System Capacity Improvement Products and Activities	FY 2004 Request ($000)	Program Schedule					
		FY 2003	FY 2004	FY 2005	FY 2006	FY 2007	FY2008
NAS Performance Measurement	**$3,000**						
Develop & Implement En Route Balance Scorecard		◆	◇				
Develop Terminal Balance Scorecard			◇				
ATS/ATO Balance Scorecard			◇	◇			
Develop AT Systems Metrics - PDARS		◆	◇	◇			
Develop En Route Capacity Metric		◆	◇	◇			
SATS Demonstration			◇	◇			
Airport Development	**$800**						
Conduct Benchmarking		◆	◇	◇	◇	◇	◇
Model & Simulate NLA Ground Movements		◆	◇	◇	◇		
Conduct Regional Jets Departure Procedure Modeling at DFW		◆	◇				
Develop Metrics for OEP 8 Pacing Airports		◆	◇				
Complete and Distribute 2002 ACE Plan		◆					
Begin Data Gathering for 2003 ACE Plan		◆	◇				
2003-2008 ACE Plans		◆	◇	◇	◇	◇	◇
Capacity Improvement Initiatives	**$1,400**						
Model Airspace Redesign at Houston		◆	◇				
Develop, Model and Implement GPS Support Initiatives		◆	◇				
Conduct SFO Bay Analysis		◆					
Architecture Deployment Support	**$1,300**						
Conduct Simulation and Analysis of SOIA		◆	◇				
Along Track Separation Simulation and Analysis		◆	◇	◇			
Simulate and Analyze Wake Turbulence Separation Standards		◆		◇			
Review Required Navigation Performance (RNP) Operations		◆	◇	◇			
Analyze NAS System Modernization Capacity Impacts			◇	◇			
Total Budget Authority	**$6,500**	**$5,300**	**$6,500**	**$6,500**	**$6,600**	**$9,300**	**$10,000**

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.

SEPARATION STANDARDS

GOALS:

Intended Outcomes: The Separation Standards Program works to reduce separation standard values within international airspace to make the following benefits available to providers and users of oceanic air traffic control systems:

- Increased system efficiency — evidenced through reduced aircraft fuel-burn and transit times.
- Increased theoretical system capacity — evidenced through an increase in the number of routes and flight levels controllers can safely support within the same volume of airspace.
- Increased international standardization of separation criteria and resultant enhanced system safety.

Agency Outputs: The FAA's "Strategic Plan for Oceanic Enhancements and Separation Reductions" describes a systematic process for revising international separation values and establishes priorities for such changes. To document and evaluate each separation change, the FAA produces a series of supporting products:

- An operational assessment of the value that the change brings to Air Traffic Control (ATC) system providers and users.
- A benefit-cost analysis.
- A safety assessment of the system before and after application of the change.
- Publication of FAA regulatory material.
- Completion of any new rulemaking required.
- Development of ATC required procedures.
- Development of any new or changed International Civil Aviation Organization (ICAO) guidance material, annexes, or regional supplementary procedures required to standardize and make the reduced separation value safe for international operations.
- Establishment and maintenance of any long-term safety oversight functions required for the implementation and continued safe use of the reduced separation value.

Customer/Stakeholder Involvement: The Separation Standards Program establishes appropriate ICAO-government-industry forums to draw all parties concerned with a change in separation standards into a common process. The cooperating entities may include: state Civil Aviation Authorities (CAA), ICAO Regional and Headquarters elements, ATS providers, ATC system users, industry trade organizations, and unions representing controllers and pilots.

Participants in specific change processes include:

- Asia Pacific separation standards — changes proceed with the coordination and endorsement of the (North Pacific) Oceanic Work Group, Informal (North) Pacific ATC Coordinating Group, and Informal South Pacific ATS Coordinating Group, as well as the ICAO Pacific Reduced Vertical Separation Minimum (RVSM) Task Force established by the ICAO regional planning group, the Asia Pacific Air Navigation Planning and Implementation Regional Group.
- North Atlantic separation standards — changes are carried out through the ICAO Regional Planning Group, the North Atlantic Systems Planning Group.
- West Atlantic Route System Separation Standards (WATRS) — proposed improvements involve participation of the New York Oceanic Capacity Enhancement Task Force.
- Gulf of Mexico and Caribbean Separation Standards — proposed changes involve participation of the Gulf of Mexico Work Group and the ICAO CAR/SAM Regional Planning and Implementation Group (GREPECAS).

The program also provides FAA representation on ICAO's Separation and Airspace Safety Panel (SASP) — the focal point for development of the technical justification for new separation minima as well as the forum for assessing application of recommended ICAO separation practices on a global and regional basis.

Accomplishments: The Separation Standards Program has been the vehicle for the FAA to bring about major reductions in separation standard values affecting international airspace. During fiscal years 1999 through 2002, the program has been responsible for several significant changes:

- Northern Pacific 50-nm lateral separation standard based on operator compliance with Required Navigation Performance (RNP)-10 requirements (April 1998; December 1998; and February 2000). This linkage between a separation standard and an RNP value marked the first use of the ICAO-endorsed concept in any portion of worldwide airspace. The

change has led to measurable improvements in both ATC operations and aircraft fuel-burn and transit time.

- North Atlantic Implementation Management Group Cost Effectiveness (NICE) Program (October 1999). This comprehensive fast-time-simulation-based assessment of the benefits associated with North Atlantic separation changes proposed through the year 2010 resulted in significant changes. Plans were modified for ATS system infrastructure expenditures and users were held to different schedules and equipage requirements in order to participate in the project within the airspace. The FAA's NICE Program contributions were the result of a combined effort by federal staff members and grant-sponsored university researchers.
- Pacific RVSM (February 2000). Based on FAA encouragement, contributions, and previous experience in the North Atlantic, the ICAO Asia Pacific Region planning group established the Pacific RVSM Task Force which oversaw successful implementation of the RVSM between flight levels (FL) 290 and 390 in February 2000. The FAA chaired or co-chaired all Task Force working groups and provided the technical consultation concerning RVSM implementation to States in the region. The ICAO Asia Pacific Region planning group agreed that the FAA Technical Center would provide the safety oversight function associated with RVSM implementation and endorsed establishment of the Asia/Pacific Approvals Registry and Monitoring Organization (APARMO) to carry out this function.
- Expansion of Pacific RVSM to from FL 390 to FL 410 throughout the Pacific (October 2000).
- Introduction of the RVSM into the West Atlantic Route System portion of international airspace over the North Atlantic (November 2001).
- Development of requirements for 30-nm lateral separation standard based on automatic dependent surveillance in oceanic and remote airspace (May 2001).
- Introduction of the RVSM into most of the Western Pacific/South China Sea portion of the Asia Pacific Region (February 2002).
- Initiation of work to introduce NICE simulation methodology into northern Pacific air traffic system planning and analysis (April 2002).
- Initiation of work to introduce global standardization of RVSM regional monitoring agency practices, procedures and data sharing (May 2002).
- Initiation of work to introduce RVSM into ICAO Caribbean and South American (CAR/SAM) Regions in late 2004 through exertion of leadership in ICAO CAR/Sam RVSM Task Force (July 2002).
- Completion of first phase of introduction of a comprehensive airspace safety monitoring oversight function in the Asia Pacific Region through Asia Pacific Airspace Safety Monitoring Task Force (September 2002).

R&D Partnerships: The Separation Standards Program provides FAA representation to ICAO's SASP, the principal global forum for moving ahead with the development of new separation minima. The FAA and other Civil Aviation Authorities (CAA's) typically cooperate in such work, with each State's participant(s) freely sharing research results within the Panel. In addition, the Separation Standards Program maintains close research ties with academia through a contractual relationship with Rutgers University in the development of large fast-time simulation models of oceanic airspace. The program also has a direct link with international separation research activities in which the FAA's GPS Monitoring System supports EUROCONTROL's RVSM safety oversight activities. In turn, that international body provides access to the products of its RVSM research.

MAJOR ACTIVITIES AND ANTICIPATED FY 2003 ACCOMPLISHMENTS:

Emphasis will be upon six major areas:

- Implemented the second phase of RVSM introduction into Western Pacific/South China Sea airspace, thus completing the FAA commitment to the ICAO Asia Pacific Region for assistance in bringing about the RVSM in the airspace over the South China Sea (October 2002).
- Transferred responsibility for provision of Asia Pacific Approvals Registry and Monitoring Organization services within Asia portion of Asia Pacific Region to other States within the Region (May 2003).
- Completed handbook standardizing procedures and data treatment by RVSM regional monitoring agencies (May 2003).
- Developed detailed plans for application of 30-nm lateral and longitudinal separation standards in FAA-administered oceanic airspace of the South Pacific

based on automatic dependent surveillance, controller-pilot data link communications, required navigation performacne-4 and deployed enhanced FAA oceanic automation system (June 2003).

- Completed contributions to Asia Pacific Airspace Safety Monitoring Task Force (August 2004).
- Provided training and guidance to CAR/SAM regional monitoring agency and RVSM Task Force in connection with planned December 2004 RVSM implementation in CAR/SAM Regions (throughout fiscal year 2003).

KEY FY 2004 PRODUCTS AND MILESTONES:

- Initiate one-year pre-implementation safety assessment associated with planned March 2005 introduction of 30-nm lateral and 30-nm longitudinal separation standards in South Pacific airspace administered by FAA.
- Publish necessary ATC procedures and operator approval criteria to support application of 30-nm lateral / 30-nm longitudinal separation standards in South Pacific.
- Participate in conduct of preliminary and final safety assessments for planned December 2004 introduction of RVSM in CAR/SAM Regions.
- Continue provision of RVSM safety oversight function in portions of ICAO Asia Pacific and North Atlantic Regions.
- Publish final results of study of cost-effectiveness of candidate improvement options for northern Pacific airspace.

FY 2004 PROGRAM REQUEST:

The FY 2004 program request provides for:

- Completion of work necessary to initiate final steps associated with reducing horizontal-plane separation minima to 30-nm based on enhanced ATC oceanic automation, Controller Pilot Data Link Communications (CPDLC) and Automatic Dependent Surveillance (FAA Operational Evolution Plan En Route Project 4).
- Completion of safety assessments and other support leading to planned December 2004 implementation of the RVSM in the ICAO Caribbean and South American Regions.
- Completion of recommendations for northern Pacific airspace improvement options.
- Continued provision of RVSM safety oversight function in portions of ICAO Asia Pacific and North Atlantic and Pacific regions.
- Continued support to planned December 2004 Domestic RVSM implementation (FAA Operational Evolution Plan En Route Project 6).

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2002)	$6,945
FY 2003 Request	2,200
FY 2004 Request	2,500
Out-Year Planning Levels (FY 2005-2008)	14,300
Total	$25,945

Budget Authority ($000)	FY 2000 Enacted	FY 2001 Enacted	FY 2002 Enacted	FY 2003 Request	FY 2004 Request
Contracts:					
Separation Standards	1,400	2,200	2,200	2,200	2,500
Personnel Costs	0	0	0	0	0
Other In-house Costs	0	0	0	0	0
Total	**1,400**	**2,200**	**2,200**	**2,200**	**2,500**

OMB Circular A-11, Conduct of Research and Development ($000)	FY 2000 Enacted	FY 2001 Enacted	FY 2002 Enacted	FY 2003 Request	FY 2004 Request
Basic	0	0	0	0	0
Applied	0	0	0	0	0
Development (includes prototypes)	1,400	2,200	2,200	2,200	2,500
Total	**1,400**	**2,200**	**2,200**	**2,200**	**2,500**

*** In FY 1999 in-house costs for Separations Standards Project was included in System Capacity, Planning and Improvements budget item.**

Separation Standards Products and Activities	FY 2004 Request ($000)	Program Schedule					
		FY 2003	FY 2004	FY 2005	FY 2006	FY 2007	FY2008
Separation Standards							
30–nm lateral/30-nm Longitudinal Separation Standard in FAA-Administered Oceanic Airspace	$700						
Developed ICAO Documentation and Specifications		◆					
Develop Implementation Requirements, Operational Concept, and Procedures		◆	◇				
Conduct Trials			◇	◇			
Implement				◇			
Conduct Safety Oversight				◇	◇	◇	◇
Asia Pacific and North Atlantic RVSM	$200						
Conducted Readiness and Safety Assessments		◆					
Implemented		◆					
Conduct Safety Oversight – Pacific		◆	◇	◇	◇	◇	◇
Asia Pacific and Global Standardization of RVSM and Other Airspace Safety Functions	$700						
Develop Common Principles and Practices		◆					
Develop Long-Term Monitoring Requirements		◆	◇				
Reduced Vertical Separation Minimum in ICAO Caribbean and South America	$700						
Develop Planning Through Task Force		◆	◇				
Conduct Data Collection and Analysis		◆	◇	◇	◇		
Implement		◆		◇	◇		
Investigation of Northern Pacific Airspace Improvement Options Using North Atlantic Cost Effectiveness Methodology	$200						
Provide Initial Report		◆					
Identify Promising Options; Conduct Simulation and Analysis; Identify Best Options; Make Final Reports		◆	◇				
Total Budget Authority	**$2,500**	**$2,200**	**$2,500**	**$2,500**	**$3,100**	**$3,700**	**$5,000**

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.

AIRSPACE MANAGEMENT LABORATORY

GOALS:

Intended Outcomes: The mission of the Air Traffic Airspace Management Program Office (ATA) is to meet the demand for air transportation while still ensuring that sectors and routes are designed for the safest, most efficient use by operators and that local and national environmental regulations are diligently satisfied.

The ATA Airspace Laboratory supports this mission by providing national and regional management specialists with: detailed, quality information based on: specially created databases; simulation modeling for analysis and reporting; and custom-produced presentation aids. As resources permit, Lab personnel also develop information systems and fill data requests for other FAA lines of business.

Major categories of activities carried out by the Laboratory include:

- Identify issues and perform analyses, with appropriate attention to potential environmental impact in support of the ATA 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 Federally Funded Research and Development Center (FFRDC) analysts.
- Develop information system applications to support other FAA lines of business dependent on extensive operational data such as overflight "fee for service" assessments and obstacle awareness and evaluation.
- Serve as the FAA's repository and redistribution center for the regular reporting and research applications of air traffic operational activity data. For example, the Laboratory currently provides Enhanced Traffic Management System (ETMS) data to various FAA offices, including the Free Flight Office and the Daily Measurement of Air Traffic Services.

Information products provided on a regular basis during the past year include:

- Acquisition, storage, distribution, and information extraction of air traffic operational data.
- Quantitative analysis of current air traffic activity, including some performance measures such as reported cancellations, diversions, and delays.
- Environmental (noise) analyses.
- Development of the following information systems:
  - Obstruction evaluation database.
  - Overflight "fee for service" assessments.
  - Foreign Overflight Notification System (for DOD).
  - The Consolidated Operations and Delay Analysis System (CODAS).
  - Airspace Metrics

Customer/Stakeholder Involvement: Successful demonstration of the capabilites of the ATA Laboratory has been shown to have value, and even greater protential value, across several FAA lines of business. In addition to the Airspace Management Program Office, the Office of System Architecture and Investment Analysis (ASD), the Office of System Capacity (ASC), Air Traffic Planning and Procedures (ATP), and Air Traffic System Management, the Lab has supported the missions of the Cost Accounting Team, the Office of Financial Services, the Office of Aviation Policy, and the Operational Evolution Plan.

The Laboratory also has provided ongoing support for numerous projects of the FAA Regions involving field analyst staffing, analytical work, daily access to operational data, and continuing technical support for database query programming.

The ATA Laboratory has been identified as the element responsible for supporting airspace design dependencies for FAA Facilities and Equipment (F&E) programs with broad government and industrial involvement, including:

- Local Area Augmentation Systems (LAAS).
- Low Altitude Direct Routing using Wide Area Augmentation Systems (WAAS).
- Runway Incursion Program.
- WAAS Precision Approaches.
- Automatic Dependent Surveillance (ADS) studies.
- Single and Multi-center metering.
- Final Approach Spacing Tool (FAST) implementation studies.
- New Host Consolidation/Dynamic Resectorization studies.

Accomplishments:

Obstruction Evaluation Deployment

- Deployed national infrastructure to support web-based workflow processing of Obstruction Evaluation cases.
- Provided mechanism of Airports to submit airport and runway data directly to national Flight Data Center

Airspace issue identification

- Tracked critical parameters for proactive identification of issues.
- Visualized/analyzed past and current traffic patterns.
- Analyzed system performance.

Airspace design and environmental evaluation

- Developed alternative airspace designs for examination.
- Analyzed changes to airspace design on flow, capacity, delay, workload, and other metrics as required.
- Developed data necessary to evaluate noise and consider pollution impacts to complement airspace design analysis.

R&D Partnerships: Organizations that will use or support the laboratory include the Office of System Architecture and Investment Analysis (ASD), the Office of System Capacity (ASC), and Air Traffic Management (Plans & Procedures, Resource Allocation, and Airspace divisions).

MAJOR ACTIVITIES AND ANTICIPATED FY 2003 ACCOMPLISHMENTS:

- Enhanced web-based metrics for drill-down analysis of city-pair distances and elapsed times.
- Deployed web-based metrics for arrival and departures at top 100 US airports including flight track drill-down.
- Enhanced web-base Obstruction Evaluation (OE) legacy replacement system to reduce processing time and standardize multi-divisional workflow.
- Performed analytical work/studies on behalf of FAA Regions and national management.
- Provided Sector Design Analysis Tool (SDAT) support with sector analysis studies.
- Began traffic data repository collection of high-precision aircraft position reports to support National Airspace Redesign and Environmental analysis.
- Developed concept papers on a range of topics, including:
  - Airspace data services and data management.
  - Multidivisional services to support development of advanced navigation (using GPS).

KEY FY 2004 PRODUCTS AND MILESTONES:

- Continue collection and management of data and metrics from air traffic operations in support of the following:
  - Free Flight Office
  - Office of System Capacity
  - Operational Evolution Plan
  - National Airspace Redesign
- Integrate the ability for external submission of Obstruction Evaluation cases by the public.
- Begin Integration of local and regional airspace design concepts into a system-wide national level scope.
- Support environmental studies, especially those that are noise-related.
- Support the examination of technologies being acquired or alternative procedures with respect to potential for Air Traffic Control (ATC) efficiency and other performance-related improvements.
- Continued development of information systems as demanded by several FAA lines of business.

FY 2004 PROGRAM REQUEST:

Significant changes in avionics and air traffic control technology, coupled with continuing changes in the type, amount, and distribution of traffic, have created a need to study and redesign the nation's airspace for current and future use. Airspace redesign will be required to complement FAA's implementation of global positioning navigation systems, Free Flight, and related dynamic sectorization. While airspace changes have been analyzed and implemented for decades at the local level, a systematic, comprehensive national analysis has not been performed. An overall approach in the management and tracking of a national design is being developed.

The above described activities serve to demonstrate the proven technical capability in prototype form. The need to develop this capability into a full-scale mission capability has been validated by FAA Mission Need Statement # 331.

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2002)	$11,500
FY 2003 Request	4,500
FY 2004 Request	7,000
Out-Year Planning Levels (FY 2005-2008)	40,700
Total	$63,700

Budget Authority ($000)	FY 2000 Enacted	FY 2001 Enacted	FY 2002 Enacted	FY 2003 Request	FY 2004 Request
Contracts:					
Airspace Management Lab	3,000	4,000	4,500	4,500	7,000
Personnel Costs	0	0	0	0	0
Other In-house Costs	0	0	0	0	0
Total	**3,000**	**4,000**	**4,500**	**4,500**	**7,000**

OMB Circular A-11, Conduct of Research and Development ($000)	FY 2000 Enacted	FY 2001 Enacted	FY 2002 Enacted	FY 2003 Request	FY 2004 Request
Basic	0	0	0	0	0
Applied	0	0	0	0	0
Development (includes prototypes)	3,000	4,000	4,500	4,500	7,000
Total	**3,000**	**4,000**	**4,500**	**4,500**	**7,000**

Airspace Management Lab Products and Activities	FY 2004 Request ($000)	Program Schedule					
		FY 2003	FY 2004	FY 2005	FY 2006	FY 2007	FY2008
Analyze, Deploy, and Enhance Traffic Data and Metrics Products and Projects.	$4,500	◆	◇	◇	◇	◇	◇
Analyze, Enhance and Support Environmental Tools.	$500	◆	◇	◇	◇	◇	◇
Provide Full-Scale Deployment and Integration Services for Obstruction Evaluation Workflow System	$2,000	◆	◇	◇	◇	◇	◇
Total Budget Authority	$7,000	$4,500	$7,000	$9,000	$9,500	$10,200	$12,000

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.

OPERATIONS CONCEPT VALIDATION

GOALS:

Agency Outputs: The FAA will provide:

- A well-defined, well-understood, "validated" operational concept based on system modeling and simulation.
- Validated, integrated, configuration-managed requirements for the subsystems of the new target system to provide a coherent, comprehensive framework to guide associated research and development activities (e.g., specific requirements for Automatic Dependent Surveillance Broadcast (ADS-B) capabilities, Surface Management capabilities, Advanced Concept Probe).
- Top-level designs for the major new Air Traffic Management (ATM) capabilities and subsystems associated with the operational concept (e.g., the ground-based and airborne information infrastructures required for modernization and the design of a capability to dynamically tailor an air traffic controller's airspace responsibility to accommodate traffic demand more efficiently).
- A system-level safety assessment of the operational concept and associated new capabilities.
- A risk-mitigation plan to guide development activities for new capabilities.
- A human factors validation plan that provides a comprehensive roadmap of activities to ensure that new functionality will be operationally acceptable to flight crews and controllers.

Customer/Stakeholder Involvement: The RTCA Select Committee for Free Flight Implementation cooperates in operational concept development and validation. The FAA has conducted a detailed survey of the major stakeholders to obtain their ranking of future concept sub-elements to support modernization. This level of stakeholder participation ensures that the concept fully satisfies user community requirements – an essential prerequisite to validating the concept of a modern NAS based on a shared, integrated infrastructure.

Accomplishments: The vision for the modern NAS has been developed and published in the *Government/ Industry Operational Concept for Free Flight* (RTCA, August 1997) and *A Concept of Operations for the NAS Airspace System in 2005* (Air Traffic Services, September 1997). These documents have provided guidance to the development of the NAS Architecture Version 4.0. Additional details appear in the appendices to this document.

Starting in FY 1999, initiated the following activities in validation of concepts and associated top-level designs, risk-mitigation planning, and coordination with the human factors activity of a validation plan:

Operational concept development

- Developed detailed concepts for the Information Management of airspace resources needed to facilitate improved flight planning and impact assessment. – NAS Common Reference.
- Developed a detailed framework for individual service enhancement and domains to support the development of system-level requirements for modernization.
- Developed a NAS performance model for evaluating the impact of proposed concepts on operational performance. Developed quantitative measures and goals for mid-term concept capabilities.
- Developed detailed 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

- Conducted a comparison of U.S. Eastern Triangle operations to European core airspace.
- Established a validation data repository for the reuse of experimental data and results.
- Developed a capability for the fast-time analysis of new concepts such as multi-sector planning and dynamic resectorization.
- Developed detailed scenarios of operational changes in support of architecture and research requirements.
- Conducted joint FAA/NASA/user concept validation activities, including human-in-the-loop simulations.

Concept system design

- Delivered an analysis of the core factors related to common trajectory.
- Conducted an analysis of the effects of dynamic boundaries on operational and controller performance. This is a step in the development of dynamic

sectorization to support increased route flexibility in the face of increasing demand.

- Conducted and analysis of en route sectorization strategies to support the mid-term design for the Eastern Triangle.
- Developed detailed workload assessments of traffic situations for use in validating density concepts and alerts for Collaborative Decision-Making (CDM) and Traffic Flow Management (TFM) products.
- Developed concept for and analysis of separation normalization (three miles everywhere).

R&D Partnerships: This work directly relates to the FAA/NASA memorandum of understanding (MOU) on ATM research and development. Work under this program is coordinated through the joint Integrated Product Team Plan to ensure NASA's efforts complement and are integrated into the NAS Operational Concept. NASA contributes to the development and validation of flight deck concepts and in the far-term ATM system development.

The concept development and concept validation effort is also coordinated with the European community via agreements with EUROCONTROL. This effort ensures that unique solutions/transitions are not developed in different quadrants of the globe, a situation which would impose an undue burden on U.S. carriers, manufacturers, and other participants in the global airspace system.

MAJOR ACTIVITIES AND ANTICIPATED FY 2003 ACCOMPLISHMENTS:

Operational concept development

- Developed an expanded concept of TFM through a comparison of existing practices in Europe and the United States.
- Delivered a Concept of Use for Management by Trajectory.
- Expanded the en route evolution concept to incorporate Flight Data Management (FDM) into TFM.

Concept validation

- Developed a testbed for modernization.
- Developed a model for, and assessed the role of, the strategic controller in a CDM separation environment.
- Developed an information flow model to translate concepts into interface requirements.

Concept system design

- Delivered an information model to translate concept into NAS interface requirements.
- Completed a study of the technical and human factor parameters underlying flight strip replacements.

KEY FY 2004 PRODUCTS AND MILESTONES:

Operational concept development

- Expand the high altitude concept through the analysis of cognitive and situational awareness issues, such as the development of point-to-point strategies that eliminate the need for latitude/longitude data from flight plans and verbal exchanges.
- Conduct an analysis and develop the concept to support change in cross facility coordination (terminal and en route).
- Develop detailed Concepts of Operations for the interaction of service providers in en route and terminal airspace to support the validation of the FAA's Airspace Management Concept.
- Develop a performance framework for concepts including Required ATM System Performance and Real-Time Streaming Protocol (RTSP).

Concept validation

- Populate the Validation Data Repository to capture all FAA activities and results associated with concept and concept-of-use validation. Establish metrics to allow comparability of results across program validation efforts in the U.S. and Europe.
- Validate the flight intent Concept of Use to ensure completeness and harmonization of the definition for integration into ground and airborne decision support systems in the US and Europe.
- Provide capability to model Air Traffic Management (ATM) influences (strategic simulator).

Concept system design

- Extend closed-loop system dynamic modeling of decisions and demand dynamics related to scheduling and management of aircraft in congested en route airspace.
- Leverage human factors research work, and human factors and operational validations experimentation, to define the information type, update rate, and display requirements needed to support agreed-to operational improvements of the NAS Concept of Operations through 2010.

- Provide capability to model ATM influences (strategic simulator).

FY 2004 PROGRAM REQUEST:

The FY 2004 request continues to transition work on the NAS operations concept from its intial broad perspective, and its early validation emphasis, toward development of the various complex scheduling and controling structures needed for the FAA to fulfill its increasingly vital mission requirements for airspace and traffic flow management.

Concept validation efforts provide the performance requirements for information management to support the tactical and strategic common situational awareness assumption and needs of the next generation of ground and airborne support systems, including weather and traffic information distribution. The operational concept validation efforts extend the identification of information type, update rate, and display requirements to decision support tools in general.

Among the envisioned programs that have to be fleshed out with detailed procedures and full statements of participant roles, and responsibilities is the NAS Common Reference concept. Only further demonstration and validation can show if this concept can support the integration of the entire NAS infrastructure with all airspace definitions within the proposed En Route Automation Modernization (ERAM) methodology.

Other potentially valuable technologies that require further detailed proof of their conceps include Flight and Surveillance Data Processing and programs that will rely upon new common trajectory standards to improve aviation efficiency and capacity through implementation of "Management by Trajectory."

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

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2002)	$12,918
FY 2003 Request	2,500
FY 2004 Request	2,700
Out-Year Planning Levels (FY 2005-2008)	24,200
Total	$42,318

Budget Authority ($000)	FY 2000 Enacted	FY 2001 Enacted	FY 2002 Enacted	FY 2003 Request	FY 2004 Request
Contracts:					
Operations Concept Validation	2,200	1,400	2,500	2,500	2,700
Personnel Costs	0	0	0	0	0
Other In-house Costs	0	0	0	0	0
Total	**2,200**	**1,400**	**2,500**	**2,500**	**2,700**

OMB Circular A-11, Conduct of Research and Development ($000)	FY 2000 Enacted	FY 2001 Enacted	FY 2002 Enacted	FY 2003 Request	FY 2004 Request
Basic	0	0	0	0	0
Applied	0	0	0	0	0
Development (includes prototypes)	2,200	1,400	2,500	2,500	2,700
Total	**2,200**	**1,400**	**2,500**	**2,500**	**2,700**

Operations Concept Validation Products and Activities	FY 2004 Request ($000)	Program Schedule					
		FY 2003	FY 2004	FY 2005	FY 2006	FY 2007	FY2008
Operations Concept Validation							
Operational Concept Development	$500						
Develop detailed concepts of operations for interaction of service providers in en route and terminal airspace.		◆	◇	◇	◇	◇	◇
Develop detailed concept of ops for evolution of TFM.		◆	◇	◇	◇	◇	
Develop performance framework for RTSP.		◆	◇	◇	◇	◇	
Develop en route evolution concept including flight data management across NAS.		◆	◇	◇			
Develop terminal airspace evolution concept.		◆	◇	◇	◇	◇	
Concept Validation	$1,200						
Establish the VDR to capture activities and results associated with concept.		◆	◇	◇			
Establish metrics to allow comparability of results across program validation efforts in the U.S. and Europe.		◆	◇	◇	◇	◇	◇
Conduct validation of information management concept.		◆	◇	◇	◇	◇	◇
Concept System Design	$600						
Extend closed-loop system dynamic modeling of decisions and demand dynamics related to scheduling and management of AC in congested en route airspace.		◆	◇	◇	◇	◇	◇
Leverage work in human factors research and operational validation to define information type, update rate, and display requirements to support NAS concept through 2010.		◆	◇	◇	◇	◇	◇
RTCA	$400						
Developed Aviation community of MASPS, MOPS and integrated plans to support future concepts and modernization		◆					
Total Budget Authority	$2,700	$2,500	$2,700	$5,000	$5,000	$6,200	$8,000

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.

SOFTWARE ENGINEERING R&D

GOALS:

Intended Outcomes: The FAA intends to improve the National Airspace System (NAS) and reduce NAS and avionics acquisition, development, and maintenance costs by developing and impleenting improved software processes and procedures. These actions will directly benefit passengers, as well as all elements of air transportation, and greatly contribute to a safe, secure, and efficient NAS.

The FAA's Software Engineering Resource Center (SERC) was established in June 1998 as a focal point for applied research on FAA software-intensive systems. The SERC is an FAA-wide resource that addresses strategic software technology problems impacting the mission, performance and enhancement of FAA in-house software and systems engineering competencies.

Agency Outputs: A primary outcome goal of the SERC is to reduce the cost of delivering Information Technology (IT) services without reducing service quality, and acquire and maintain critical IT knowledge, skills, and abilities. The targeted goals and objectives of this work are to: (1) partner FAA personnel with industry and academia experts to solve mission-critical software and systems engineering problems; (2) provide training and exposure to new technologies that increase workforce competencies in the systems and software engineering fields; (3) evaluate and validate improved software processes, methods, and engineering tools that enhance architecture, systems and software engineering, testing, and certification functions over the life cycle of NAS systems; and (4) evaluate existing and future work processes, information flows and information technology models and standards to establish guidelines and standards for FAA IT architecture.

The following are specific outcomes of the SERC's currently funded applied research activities:

Research On Applying COTS/NDI Within NAS Ground Systems And Avionics

- Evaluation and prototyping of systems and software engineering processes and methods for use in commercial off-the-shelf (COTS)-intensive systems: This research identifies and evaluates more effective practices for software requirements definition, software analysis and design, and testing that are appropriate for safety-related systems using COTS/non-developmental item (NDI) software. The activity includes investigating methodologies to quantify, characterize, and guard against the risk of accidentally activating unintended COTS functionality for a given system and environment.
- Software estimation model for COTS-intensive systems: SERC research is seeking to identify and develop better ways of estimating and predicting the life cycle costs of COTS-intensive systems. This work will include consideration of the complex interactions of major cost and schedule drivers that relate to the evaluation, interfacing, integration, product refreshment, and maintenance of COTS.

This research will produce a set of evaluation criteria and guidelines for COTS software proposed for use in safety-related aviation systems. It will also establish the processes and technical methods required to evaluate COTS/NDI-based systems prior to contract awards and ensure that the use of COTS/NDI software will not compromise aviation system safety.

NAS Architecture Research

- NAS adaptation improvement: The SERC is evaluating new technology and developing prototype tools to create a common NAS-wide adaptation work environment. This environment will facilitate the standardization of data, tools and services as well as information exchange; thereby improving the way adaptation is performed across the NAS. It will facilitate the accomplishment of agency goals and initiatives, including increased air safety and NAS modernization, by providing NAS aeronautical and as-adapted data to support management decisions and engineering analyses.
- Evaluation and prototyping of high-integrity, safety-critical architectures: The emphasis is to find better and less expensive ways to ensure that NAS hardware, software, and adaptation are safe, secure, and efficient in the face of challenges from bad code, security breaches, and the like.
- Architecture definition and description: This research is investigating unified approaches to formal architecture definition and description for cost-effective evaluation and comparison of competing candidate architectures for acquisition.

Specific research outputs will be guidelines and standards for defining, representing, and designing high-integrity architectures for the NAS and, executable and reusable architecture models and simulations that can be extended or tailored to support NAS domain-specific engineering and product acquisitions.

Customer/Stakeholder Involvement:

The FAA has been routinely criticized by Congress and the General Accounting Office (GAO) for its shortcomings in managing evolving systems and software requirements, and the acquisition of software-intensive systems. These shortcomings have resulted in increased cost, decreased quality, and delayed deployment of software-based products and services. Because all the systems required to modernize the NAS are dependent on software, the FAA must improve its software engineering capabilities to ensure that these software systems, products and services do what they were intended to do.

The SERC is providing leadership by bringing stakeholders, users, subject matter experts, and managers together to solve IT, operational, cost estimation, scheduling and other major software engineering problems. The SERC has identified technologies with potential to make software engineering processes more cost effective and more compatible with industry standards, while building towards the NAS Architecture vision of the future. With the assistance from stakeholder organizations, the SERC proposes potential approaches to address known problem areas that could benefit in the near term from working prototype solutions.

Working through a formal network of universities and research organizations, the SERC establishes inter-disciplinary teams of FAA, academic, and industry practitioners to identify, evaluate, and foster proven technology and effective processes in FAA programs. The SERC is a collaborative venture with the William J. Hughes Technical Center, the Operational Support Service, and the Chief Information Officer.

Accomplishments:

Research on applying COTS/NDI within NAS ground systems and avionics

- In conjunction with the University of Southern California, Texas A&M, and Software Metrics, Inc., the SERC has completed development of a Constructive COTS Cost Estimation Model (COCOTS), collected maintenance data on 20 projects (13 FAA), and conducted research on life-cycle cost criteria. Life-cycle costing data is currently being collected to calibrate the model from several FAA projects (URET, VSCS, DSR, etc.), as well as data from NASA (Hubbell), the U.S. Army and Reuters. The model is being piloted on FAA projects (such as ERAM), training is being provided to acquisition and investment analysis personnel, data on lessons learned are being collected, and guidelines are being generated for the Acquisition Management System.

NAS architecture research

- The SERC is developing a NAS Adaptation Services Environment (NASE) computing platform that will increase the business value targets of e-Gov to ensure the aeronautical and adaptation data used to conduct critical agency business, or for public dissemination, are timely, accurate, accessible, understandable, and secure. The NASE currently houses an Adaptation Data Mart for the Standard Terminal Automation Replacement System (STARS) and will do so for the Center-TRACON Automation System (CTAS), En Route Host, and User Request Evaluation Tool (URET) communities over the next fiscal year.
- The NASE has demonstrated that a major "e-Government" application can be developed and placed into use in less than a year by employing best commercial software engineering and process improvement practices, including full alignment with the technical and components based architecture recommended by the Federal Enterprise Architecture Program Management Office. It has also proved the efficiency of the Rational Unified Process, as shown by its rapid development and controlled error-free installation. This on-budget and on-time aggressive development was based on a foundation architecture and UML documentation.

R&D PARTNERSHIPS:

- Constructive COTS Cost Model – University of Southern California, Texas A&M University, Boston University, NASA, Department of Defense
- COTS Guidelines – Software Engineering Institute, University of Southern California, Software Metrics, Inc.
- Adaptation Improvement Program – Boston University, Northrop-Grumman, Air Force Research Laboratory, ICAO

MAJOR ACTIVITIES AND ANTICIPATED FY 2003 ACCOMPLISHMENTS:

Research on applying COTS/NDI within the NAS ground systems and avionics

- Exposed COCOTS products and estimation services via the NASE portal and calibrate system results with user feedback and continued data and algorithm refinement.
- Completed Constructive COTS Cost Estimation Model, conducted workshops on use of the model, and piloted the tool on two projects.
- Supported development of COTS life-cycle management plans and life-cycle issues

NAS architecture research

- Funded research studies to develop business cases for consolidation of projects requiring computing resources to reduce acquisition, operations and maintenance costs
- Harmonized and aligned the NASE Foundation Architecture, the AIO Enterprise Architecture, the ISS Architecture, and the NAS Architecture 4.0 and following NAS Architectures. Researched the use of architectures to affect system interoperability, development of the web environment infrastructure, and convergence and standardization of Web and IT products, processes, and procedures.
- Continued developing the NASE by supporting community development of required tools and services within the NASE infrastructure. Continued supporting customer tailoring and application of NASE out-of-the-box functionality. Evolved the NASE by the addition of applications, communities, domains, and data sources. Started the process of establishing FAA standard services and tools from the implemented NASE.

KEY FY 2003 PRODUCTS AND MILESTONES:

The SERC will coordinate the completion of several software engineering projects:

- Make the beta version of the COCOTS life-cycle model available for use within the FAA's Acquisition Management System and expose the model to customer use and evaluation via the NASE portal.
- Provide training, workshops, and briefings on the use of COTS/NDI products in acquisitions.
- Establish a prototype NASE to provide electronic access to aeronautical information, adaptation tools and services. Make these prototype products available for field use.
- Establish technology transfer liaisons with remote researchers and research sites.
- Increase workforce competencies in the systems and software engineering fields through training and exposure to new technologies.

FY 2004 PROGRAM REQUEST:

The software engineering research programs will build upon prior related activities conducted by the SERC and will continue to leverage resources throughout the United States, particularly those of aviation-related programs already underway at several universities. Specific work will be focused on advanced software architecture and technology applications for specific NAS Programs, and on continued end-to-end assurance of safety critical software systems.

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2002)	$3,200
FY 2003 Request	1,000
FY 2004 Request	1,500
Out-Year Planning Levels (FY 2005-2008)	9,200
Total	$14,900

Budget Authority ($000)	FY 1999 Enacted	FY 2000 Enacted	FY 2001 Enacted	FY 2002 Enacted	FY 2003 Request	FY 2004 Request
Contracts:						
Software Engineering R&D	462	300	900	1,000	1,000	1,500
Personnel Costs	538	0	0	0	0	0
Other In-house Costs	0	0	0	0	0	0
Total	**1,000**	**300**	**900**	**1,000**	**1,000**	**1,500**

OMB Circular A-11, Conduct of Research and Development ($000)	FY 1999 Enacted	FY 2000 Enacted	FY 2001 Enacted	FY 2002 Enacted	FY 2003 Request	FY 2004 Request
Basic	0	0	0	0	0	0
Applied	0	0	0	0	0	0
Development (includes prototypes)	1,000	300	900	1,000	1,000	1,500
Total	**1,000**	**300**	**900**	**1,000**	**1,000**	**1,500**

Software Engineering R&D Products and Activities	FY 2004 Request ($000)	Program Schedule					
		FY 2003	FY 2004	FY 2005	FY 2006	FY 2007	FY2008
F&E 1F01 Software Engineering R&D							
Research on applying COTS/NDI in NAS Ground Systems and Avionics	$300	◆	◇	◇	◇	◇	◇
NAS Architecture Research	$1,200	◆	◇	◇	◇	◇	◇
Total Budget Authority	$1,500	$1,000	$1,500	$1,100	$1,500	$3,100	$3,500

Notes:

- Out year numbers are for planning purposes only. Actual funding needs will be determined through the annual budget process.
- In the Facilities and Equipment appropriations, personnel and other costs are budgeted in Activity 6, not the program budget line item.

NAS REQUIREMENTS DEVELOPMENT

GOALS:

Intended Outcomes: This program will support Mission Analysis (MA) and National Airspace System (NAS) requirements development efforts. It will fund studies, efforts to prepare and validate strategies and proposals designed to increase overall NAS efficiency. The program supports the FAA System Efficiency mission goal to "*provide an aerospace transportation system that meets the needs of users and is efficient in the application of FAA and aerospace resources*."

As part of the agency's Acquisition Management System (AMS) process, the FAA routinely examines current and projected needs within the NAS with the goal of defining requirements to meet identified needs. This budget line item provides, on a recurring basis, the means to independently investigate the particulars of selected programs (service or system) or technologies. Such investigations assist in determining and selecting only those programs or technologies best suited to advance overall NAS system efficiency.

Agency Outputs: Activities funded by this budget line item include:

- Simulation
- Human factors
- Procedure development
- Performance definition
- Impact analysis
- Workload analysis
- Hazard analysis
- NAS architecture development

This project is contained within the F&E budget in Advanced Technology Development and Prototyping (1C01).

MAJOR ACTIVITIES AND ANTICIPATED FY 2003 ACCOMPLISHMENTS:

- Researched weather radar technology beyond Next Generation Radar (NEXRAD) for the National Academy of Sciences.
- Researched Weather Forecasting Accuracy for FAA Air Traffic Control for the National Academy of Sciences.
- Conducted special studies, research, and analysis of existing operational facilities supporting the Airport Equipment Decision Tool (AEDT).
- Researched Weather Forecasting Accuracy for the FAA Air Traffic Control for the National Academy of Sciences.
- Provided aviation weather issue management, coordination, and support.
- Provided AMS acquisition management and requirements development support.
- Provided Operations and Maintenance rough order magnitude estimates for budget formulation.
- Provided technical and analytical support for weather services and volcanic ash studies for NOAA.
- Provided support for North American Air Surveillance Modernization (NAASM).
- Provided technical and analytical support for the Turbulence Joint Safety Implementation Team under Safer Skies.
- Provided technical and analytical support for the Aviation Weather Technology Transfer process.

KEY FY 2004 PRODUCTS AND MILESTONES:

- Continue to support the AMS process through research and investigation of selected programs and/or technologies. This includes the following:
  - Provide O&M rough order magnitude estimates for budget formulation.
  - Provide acquisition management support for the NAS Implementation Support Contract (NISC).

FY 2004 PROGRAM REQUEST:

A major key to maintaining objective, integrated NAS requirements development is a reliable, sustainable funding source that allows critical analyses of selected developmental systems – those systems that provide both the greatest potential payoffs for NAS system efficiency and the greatest risk of failure. The requested funding will allow investigations that will increase the probability of system success and identify factors and situations that require solutions before development begins.

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2002)	$5,900
FY 2003 Request	3,000
FY 2004 Request	3,000
Out-Year Planning Levels (FY 2005-2008)	12,900
Total	$24,800

Budget Authority ($000)	FY 2000 Enacted	FY 2001 Enacted	FY 2002 Enacted	FY 2003 Request	FY 2004 Request
Contracts:					
NAS Requirements	0	2,900	3,000	3,000	3,000
Personnel Costs	0	0	0	0	0
Other In-house Costs	0	0	0	0	0
Total	**0**	**2,900**	**3,000**	**3,000**	**3,000**

OMB Circular A-11, Conduct of Research and Development ($000)	FY 2000 Enacted	FY 2001 Enacted	FY 2002 Enacted	FY 2003 Request	FY 2004 Request
Basic	0	0	0	0	0
Applied	0	0	0	0	0
Development (includes prototypes)	0	2,900	3,000	3,000	3,000
Total	**0**	**2,900**	**3,000**	**3,000**	**3,000**

NAS Requirements Development Products and Activities	FY 2004 Request ($000)	Program Schedule					
		FY 2003	FY 2004	FY 2005	FY 2006	FY 2007	FY2008
Fund Studies and Other Efforts, and Validate Strategies and Proposals Designed to Increase Overall NAS Efficiency	$3,000	◆	◇	◇	◇	◇	◇
Total Budget Authority	$3,000	$3,000	$3,000	$3,000	$3,200	$3,100	$3,600

Notes:

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DOMESTIC REDUCED VERTICAL SEPARATION MINIMA (DRVSM)

GOALS:

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

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

Agency Outputs: The DRVSM Plan decribes a systematic process for revising domestic separation standards between FL290 and FL410 and establishes priorities for such changes. To document and evaluate each separation change, the FAA produces the following supporting products:

- Operational assessments of the value the change brings to providers and users of the Air Traffic Control (ATC) System.
- A benefit-cost analysis regarding the change.
- A safety assessment of the system before and after application of the change.
- Publication of FAA regulatory material required by the change.
- Completion of any new rulemaking required by the change.
- Development of ATC procedures required by the change.
- Development of any new or changed guidance material and procedures required to standardize and make the reduced separation standard safe for domestic operations.
- Establishment and maintenance of any long-term safety oversight function required for the implementation and continued safe use of the reduced separation standard.

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

Accomplishments: The DRVSM Program is the vehicle for the FAA to effect major reduction in separation standards affecting domestic airspace within the United States. This recently funded program has established a comprehensive plan for the implementation of its objectives. Fast-time simulations were conducted for a preliminary assessment of benefits. An industry day seminar was conducted for users, who included representatives identified as customers/stakeholders.

A relationship was established with EUROCONTROL and the United Kingdom to collect and anaylyze data related to RVSM in Europe. The United States and Canada have also formalized a joint RVSM implementation agreement for those portions of Canadian airspace that abuts the United States.

MAJOR ACTIVITIES AND ANTICIPATED FY 2003 ACCOMPLISHMENTS:

- Conducted a cost-benefit analysis.
- Examined the operational factors and controller workload associated with implementation of DRVSM via human-in-the-loop simulations.
- Conducted a second set of human-in-the-loop simulations to examine ATC procedures and Computer-Human Interface issues associated with DRVSM implementation.
- Developed and deployed a monitoring system and established North American Approvals Registry and Monitoring Organization.
- Performed rulemaking for the implementation of DRVSM .
- Conducted DRVSM seminar for customers and stakeholders.
- Developed pilot procedures for application within DRVSM airspace.
- Developed ATC procedures for use within DRVSM airspace.
- Developed procedures for handling mountain wave activity within DRVSM airspace.
- Assessed the impact of DRVSM implementation on NAS automation systems and plan for upgrades/modifications.
- Began an initial safety analysis.

KEY FY 2004 PRODUCTS AND MILESTONES:

- Implement NAS automation systems modifications required for DRVSM implementation.
- Complete air traffic controller and operator/ pilot training.
- Continue simulations to test newly developed ATC procedures and report on simulation results.
- Continue work on the safety assessment.
- Develop and test acceptable ATC procedures for non-approved military aircraft to transit DRVSM airspace.
- Continue the rulemaking process.

FY 2004 PROGRAM REQUEST:

The FY 2004 program request provides for:

- The conduct of real-time simulation and safety assessments necessary to progress the DRVSM Program towards implementation.
- Analyses of the outcomes and implications of completed real-time simulations and safety assessments.
- The development of procedures based on an operational understanding of real-time simulation and safety assessment analyses.
- The continuation of tasks necessary in the rulemaking process for the implementation of DRVSM beginning in December 2004.

Expansion of the collaborative effort with academia, users and providers of ATC services and the aviation industry to ensure understanding, and acceptance of DRVSM benefits.

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2002)	$2,100
FY 2003 Request	2,100
FY 2004 Request	1,900
Out-Year Planning Levels (FY 2005-2008)	*
Total	$6,100

Budget Authority ($000)	FY 2000 Enacted	FY 2001 Enacted	FY 2002 Enacted	FY 2003 Request	FY 2004 Request
Contracts:					
Domestic Reduced Vertical Separation Minima Program	0	0	2,100	2,100	1,900
Personnel Costs	0	0	0	0	0
Other In-house Costs	0	0	0	0	0
Total	**0**	**0**	**2,100**	**2,100**	**1,900**

OMB Circular A-11, Conduct of Research and Development ($000)	FY 2000 Enacted	FY 2001 Enacted	FY 2002 Enacted	FY 2003 Request	FY 2004 Request
Basic	0	0	0	0	0
Applied	0	0	0	0	0
Development (includes prototypes)	0	0	2,100	2,100	1,900
Total	**0**	**0**	**2,100**	**2,100**	**1,900**

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

*** Out year funding under review**

Domestic Reduced Vertical Separation Minima Program Products and Activities	FY 2004 Request ($000)	Program Schedule					
		FY 2003	FY 2004	FY 2005	FY 2006	FY 2007	FY2008
Domestic Reduced Vertical Separation Minima							
DRVSM	$1,900						
Conduct Rule Making		◆	◇				
Conduct Safety Assessment		◆	◇	◇	◇		
Develop Database		◆	◇	◇	◇	◇	
Develop Monitoring Procedure		◆	◇				
Conduct Modeling and Simulations		◆	◇	◇			
Conduct Analysis of Data		◆	◇	◇	◇	◇	
Develop Procedures		◆	◇	◇			
Conduct Monitoring			◇	◇	◇	◇	◇
Post Implementation Safety Assessment					◇	◇	◇
Total Budget Authority	$1,900	$2,100	$1,900	*	*	*	*

Notes:

– Out year numbers are for planning purposes only. Actual funding needs will be determined through the annual budget process.

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* Funding requests for all years are under review.

CYBER SECURITY FOR NAS DEVELOPMENT

GOALS:

This focused development effort will provide FAA with tools, techniques and procedures for improving the definition and allocation of information systems security (ISS) services across the National Airspace System (NAS), a very complex, heterogeneous network in a system-of-systems environment.

The system security engineering process must be redesigned to improve the definition and allocation of specific NAS security requirements in support of the FAA security and enterprise architecture efforts. Results from this effort will improve that requirements process, and will be fed back to the security architecture. These results will lead to a more cost-effective enterprise security architecture, and more cost-effective security measures for the NAS. The goal of this research is to optimize ISS services across FAA enterprise networks and operating environments through an integrated assessment of the *system of systems* that characterizes the NAS.

Intended Outcomes: Cyber Security for NAS Development will provide continuing foundational support for security engineering and system architecture effort for the ARA line-of-business, in support of FAA policy and goals. The project establishes standardized technical methods and solutions to address information security risks to the NAS. The project will ensure that FAA-developed and operated systems will meet NIST, NSA, DOT & FAA guidance in an enterprise security environment, consistent with executive and legislative mandates.

The Cyber Security for NAS Development project builds upon work already underway within ARA, and provides ongoing planning, guidance, and support for data integrity and assurance within ARA-developed/owned systems. It provides a balanced, optimized and layered implementation of security services that can be delivered in a centrally directed, cost effective manner. Accomplishment of project goals can lead to measurable improvement in enterprise security services for the FAA.

The Cyber Security for NAS Development project provides security engineering and system analyses for research and planning to ensure successful enterprise security architecture. The project will also support detailed requirements analysis and engineering for individual programs, projects, and subsystems to ensure optimization of information systems security services across air traffic services and NAS capabilities. The project will balance the following major security functions:

- Incident Prevention
- Incident Detection
- Incident Response

A NAS enterprise approach must balance these major security functions to achieve cost-effective, interoperable security management that is responsive to rapidly changing threat levels. Managing and administering security of the NAS as an enterprise function is critical to Homeland Security.

Customer/Stakeholder Involvement:

Achieving balance functionality and security management capability across the NAS will provide direct benefits to the Integrated Product Teams and to their suppliers. The products of Cyber Security for NAS Development will lead to more secure networks and operating environments for FAA information technology systems, including a more complete, tailored set of specifications and standards for NAS security requirements.

Analyses and security engineering development activities involve the W. J. Hughes Technical Center, Atlantic City, NJ; Volpe Transportation Systems Center, Boston, MA; Air Traffic Services ISS Managers, Staff Offices, and Regional ISS Officers; and the Center for Advanced Aviation System Development (CAASD). The Office of the Associate Administrator for Research and Acquisition will lead the Cyber Security for NAS Development project.

Benefits accrue to the aviation transportation system. The flying public and Homeland Security benefit through more secure, more reliable information systems that are resistant to cyber-threats and attacks by adapting available government and commercial technologies to the unique environment of the FAA and NAS.

Accomplishments: The Cyber Security for NAS Development project has not previously been funded; however, the FAA has accomplished ISS goals that establish the need and a foundation for beginning a focused development effort to optimize enterprise security services.

NAS Vulnerability Assessment

Conducted vulnerability survey and assessment of current and planned systems within the NAS architecture and modernization plan. Responsive to Critical Infrastructure Protection guidance.

NAS Risk Assessment

Applied available threat stipulations to vulnerabilities, conducted security requirements analysis, and produced assessment of NAS risks, which supported development of the NAS ISS Architecture.

FAA ISS Architecture

Continuing development and evolution of the ISS framework for integrating enterprise security services into the FAA networks and operating environments.

System-level Security Certification/Authorization

Responsive to Critical Infrastructure Protection guidance, OMB A-130, and DOT directives. Validated the need foreseen within the ISS Architecture for increased integration of security services to provide layered protection across major FAA and NAS functional capabilities.

NAS Protection Profile Development

Continuing effort to comply with ISO standards and the Common Criteria.

Enterprise Security Model Development

Initial definition of layered security model for FAA-wide implementation of layered defense and enterprise security services.

R&D Partnerships:

- The FAA Technical Center helps optimize of enterprise security services, including the introduction of public key infrastructure (PKI) and encryption technologies into the NAS environment.
- FAA Safeguard assists the FAA Technical Center with enterprise vulnerability assessment and technology applications for PKI.
- Other partnerships will be developed to balance major security functions among NAS domains.

MAJOR ACTIVITIES AND ANTICIPATED FY 2003 ACCOMPLISHMENTS:

- Developed processes and models for evaluating NAS enterprise/domain security requirements against available system-level ISS capabilities.
- Conducted tradeoff analysis to determine optimum ISS architecture for enterprise security services.
- Conducted system engineering analysis of security layers, applying the FAA enterprise security model and application of commercially available security products and services.
- Developed costing methodology and target cost model for analyzing cost-benefit tradeoffs among enterprise and system-level security mechanisms.

KEY FY 2004 Products and Milestones:

- Develop model for evaluating NAS enterprise and/or domain security requirements.
- Conduct gap analysis of domain security performance and cost compared to comparable, system-level security model.
- Provide recommended process for ISS requirements determination for new system development.
- Validate NAS performance impacts due to enterprise ISS implementation.

FY 2004 PROGRAM REQUEST:

The $1.7 million FY 2004 request initiates advanced technology development and prototyping for NAS enterprise security development. The resulting models, analyses, and studies will support improved, more cost effective security services throughout the FAA, but most importantly within the NAS. The ARA Development System Assurance project will influence the determination of security layers and their implementation across the NAS, providing the ability for more centrally directed prevention, detection, and response to ISS incidents.

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2002)	$0
FY 2003 Request	2,700
FY 2004 Request	1,700
Out-Year Planning Levels (FY 2005-2008)	10,100
Total	$14,500

Budget Authority ($000)	FY 2000 Enacted	FY 2001 Enacted	FY 2002 Enacted	FY 2003 Request	FY 2004 Request
Contracts:					
Cyber Security for NAS Development	0	0	0	2,700	1,700
Personnel Costs	0	0	0	0	0
Other In-house Costs	0	0	0	0	0
Total	**0**	**0**	**0**	**2,700**	**1,700**

OMB Circular A-11, Conduct of Research and Development ($000)	FY 2000 Enacted	FY 2001 Enacted	FY 2002 Enacted	FY 2003 Request	FY 2004 Request
Basic	0	0	0	0	0
Applied	0	0	0	0	0
Development (includes prototypes)	0	0	0	2,700	1,700
Total	**0**	**0**	**0**	**2,700**	**1,700**

Note: Out year funding is under review.

Cyber Security for NAS Development Products and Activities	FY 2003 Request ($000)	Program Schedule					
		FY 2003	FY 2004	FY 2005	FY 2006	FY 2007	FY2008
Development System Assurance							
FAA Technical Center Evaluation/Model	$300						
Develop and Implement FAA Technical Center Evaluation Model			◇	◇	◇	◇	◇
FAA Safeguard Gap Analysis and ISS Domain Requirement Process	$1,000						
Perform Gap Analysis and Establish Requirements			◇	◇	◇	◇	◇
Other Research and Development to Validate Enterprise ISS Performance Within the NAS	$400						
Perform R&D as Required			◇	◇	◇	◇	◇
Total Budget Authority	$1,700	$2,700	$1,700	$2,000	$2,000	$3,000	$3,100

Notes:

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REQUIRED NAVIGATION PERFORMANCE (RNP)

GOALS:

Intended Outcomes: The FAA's goal in implementing RNP is to transition from a ground-based to a performance-based National Airspace System (NAS). RNP will:

- Facilitate reduced obstruction protection areas for instrument flight procedures and aircraft separation standards.
- Take advantage of improved navigation accuracy, resulting in increased flight path predictability and repeatability.
- Increase the number of flights that can safely operate and access a given airspace.
- Allow the shift from standard operations tied to the performance of ground-based systems to operations tailored for aircraft system performance.

By refining navigation system performance and maximizing airspace usage, maximum benefits can be derived from RNP:

- Procedures will be flown in the same manner by all aircraft.
- Reduced route separation.
- Improved obstacle clearance.
- Improved landing weather minimums.
- Reduced pilot and controller workload.

Through the implementation of more accurate, predictable and repeatable flight paths and airspace containment, RNP contributes to meeting the long-term concept of "Free Flight" and in shaping air navigation as an integral part of the Global Communications, Navigation, Surveillance/Air Traffic Managemetn (CNS/ATM) Plan.

Agency Outputs:

The specific outputs of the RNP Program will contribute to the production of a plan for the phased implementation of RNP into the NAS and development of RNP procedures and criteria.

- Assess the certification basis for Area Navigation (RNAV) avionics in today's industry.
- Produce an incremental phased implementation strategy with standards, criteria, and schedules for:
  - Reduced obstruction protection areas.
  - Increased flight path predictability and repeatability.
  - Improved airspace and procedure design.
- Develop policy, criteria, procedures, and regulations necessary for timely use of RNP in the aviation industry to support the RNP phased implementation strategy using a total systems approach.

Customer/Stakeholder Involvement: The RNP Program has established relationships with various industry and government groups to reach a consensus for the goals of the RNP program. Industry participants include:

- ALPA (Air Line Pilots Association)
- AOPA (Aircraft Owners and Pilots Association)
- ATA (Air Transport Association)
- FMS (Flight Management System) Task Force
- GAMA (General Aviation Manufacturers Association)
- HAI (Helicopter Association International)
- IATA (International Air Transport Association) NBAA (National Business Aircraft Association)
- RAA (Regional Airline Association)
- RTCA Free Flight Select Committee
- TARA (Terminal Area RNAV Applications Taskforce)
- TAOARC (Terminal Area Operations Aviation Rulemaking Committee)
- Government groups include DoD and FAA stakeholders.

MAJOR ACTIVITIES AND ANTICIPATED FY 2003 ACCOMPLISHMENTS:

- Met with key government and industry participants to gather input for FAA/Industry Roadmap.
- Published FAA Order 8260.51, U.S. Standard for RNP Instrument Approach Procedure construction.
- Develop inventory of equipage.
- Perform mixed equipage analysis.
- Develop benefits and metrics for RNP Program.

KEY FY 2004 PRODUCTS AND MILESTONES:

The products and program milestones include:

- Development of an RNP universal Containment Probability Model to simulate various aircraft performance and flight characteristics under a varied set

of flight conditions, navigation systems and approach performance requirements.

- Conduct an en-route separation risk analysis leading to RNP en route criteria, standards and implementation.
- Examine terminal airspace issues including RNP based radius to fix (RF) legs, departure divergence issues and completion of RNP Standard Terminal Arrival (STAR) criteria.
- Enhancement of RNP instrument approach capability through use of Special Aircraft and Aircrew Required (SAAAR) to allow public design criteria.
- Completion of standards development and trial implementation of RNP Parallel Approach Transition (RPAT).

FY 2004 PROGRAM REQUEST:

Using the guidance from the FY03 publication of FAA Order 8260.51, the emphasis in FY 2004 will be to produce the design criteria, standards and policy to further prepare the airspace infrastructure for enhanced equipage of RNP capable aircraft.

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2002)	$0
FY 2003 Request	0
FY 2004 Request	7,000
Out-Year Planning Levels (FY 2005-2008)	*
Total	$7,000

Budget Authority ($000)	FY 2000 Enacted	FY 2001 Enacted	FY 2002 Enacted	FY 2003 Request	FY 2004 Request
Contracts:					
Required Navigation Performance	0	0	0	0	7,000
Personnel Costs	0	0	0	0	0
Other In-house Costs	0	0	0	0	0
Total	**0**	**0**	**0**	**0**	**7,000**

OMB Circular A-11, Conduct of Research and Development ($000)	FY 2000 Enacted	FY 2001 Enacted	FY 2002 Enacted	FY 2003 Request	FY 2004 Request
Basic	0	0	0	0	0
Applied	0	0	0	0	0
Development (includes prototypes)	0	0	0	0	7,000
Total	**0**	**0**	**0**	**0**	**7,000**

*** Out year funding under review**

Required Navigation Performance (RNP) Products and Activities	FY 2004 Request ($000)	Program Schedule					
		FY 2003	FY 2004	FY 2005	FY 2006	FY 2007	FY2008
Required Navigation Performance (RNP)	$7,000						
RNP Instrument Approach Procedures							
Data Collection			◇				
Data Analysis			◇				
Criteria Development			◇				
Total Budget Authority	$7,000	*	$7,000	*	*	*	*

Notes:
– Out year numbers are for planning purposes only. Actual funding needs will be determined through the annual budget process.
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* Funding requests for all years are under review.

SAFE FLIGHT 21 — OHIO RIVER VALLEY

GOALS:

Intended Outcomes: Intended Outcomes: Safe Flight 21 – Ohio River Valley is a government/industry initiative to demonstrate and validate, in an operational environment, the capabilities of advanced communications, navigation, surveillance, and air traffic procedures designed to increase capacity and efficiency in the NAS. The program will be a step in implementing capabilities that prove to be beneficial.

The Safe Flight 21 Ohio River Valley project:

- Addresses pilot and controller human factors issues.
- Develops and assesses new operational procedures and associated training.
- Streamlines certification processes and procedures.
- Develops a cost-effective avionics and NAS infrastructure.
- Defines a realistic NAS transition path supported by the user community.

Agency Outputs: Safe Flight 21 is essential to risk mitigation related to the evolutionary process of bringing emerging technologies into the NAS. The program will address the risks and challenges of fielding advanced communications, navigation, and surveillance systems, such as Automatic Dependent Surveillance – Broadcast (ADS-B), Controlled Flight Into Terrain (CFIT) avoidance, Flight Information Services – Broadcast (FIS-B), and the Traffic Information Service – Broadcast (TIS-B).

These objectives will be achieved through:

- Evaluating the three ADS-B links [i.e., 1090 MHz, Universal Access Transceiver (UAT), and VHF Datalink (VDL) Mode 4].
- Conducting operational tests of nine operational enhancements identified by RTCA:
  - FIS-B for Special Use Airspace (SUA) status, weather, wind-shear, Notices To Airmen (NOTAM), and Pilot Reports (PIREP).
  - Cost-effective CFIT avoidance through graphical position display.
  - Improved terminal operations in low-visibility conditions.
  - Enhanced see-and-avoid.
  - Enhanced en route air-to-air operations.
  - Improved surface surveillance and navigation for pilots.
  - Enhanced airport surface surveillance for controllers.
  - ADS-B surveillance in non-radar airspace.
  - ADS-B-based separation standards.

Customer/Stakeholder Involvement: The jointly-developed Safe Flight 21 Program resulted from inputs that the FAA Administrator requested from the RTCA Select Committee on Free Flight Implementation. The program is strongly endorsed by the RTCA Free Flight Steering Committee. Safe Flight 21's own Steering Committee is the focus for ongoing coordination between stakeholders and the Safe Flight 21 program, including the RTCA Select Committee representatives from the FAA, the Aircraft Owners and Pilots Association (AOPA), the Airline Pilots Association (ALPA), the Air Traffic Control Association (ATCA), the Cargo Airline Association (CAA), the MITRE Corporation, and U.S. airlines.

Accomplishments:

- Published the operational evaluation (OpEval) final report from the first OpEval in Wilmington, Ohio, conducted in FY 1999.
- Established or modified operational concepts and procedures required to support the Safe Flight 21 applications evaluated in OpEval-2, specifically:
  - Approach spacing
  - Departure spacing
  - Runway and final approach occupancy awareness
  - Airport surface situational awareness
- Acquired and installed a "single stack" Common ARTS automation system and displays, at the Louisville Terminal Radar (TRACON) facility, for evaluation by air traffic controllers in their work with for airborne ADS-B applications.
- Coordinated avionics requirements with industry avionics manufacturers and awarded four contracts to develop prototype avionics systems.
- Completed a preliminary analysis, begun in FY 2000, for NAS-wide implementation of ADS-B.
- Conducted OpEval-2 at Louisville, Kentucky, in 1st quarter FY 2001, to demonstrate applications and gather data on approach spacing, departure spacing, runway and final approach occupancy awareness, and airport surface situational awareness.

- Conducted a detailed data analysis and published the OpEval-2 final report.
- Installed a multilateration/ADS-B surface surveillance system at Memphis, Tennessee in preparation for an FY 2001 OpEval focusing on surface management.
- Conducted Air Traffic Modernization Day at Memphis in 3rd quarter FY 2001, focusing on surface safety applications and system integration of the multilateration system.
- Updated the ADS-B Operational Safety Assessments (OSA) for the nine SF-21 operational enhancements (each of which is being evaluated in the context of the Safe Flight 21 ADS-B applications).
- Conducted a Preliminary Hazard Assessment (PHA) of ADS-B technology, included updating and modifying the existing ADS-B Initial Hazard Analysis (IHA) to meet the requirements for a PHA in accordance with the NAS Modernization System Safety Program Plan (SSMP).
- Conducted a Comparative Safety Assessment (CSA) to compare the NAS with and without the use of ADS-B at a future state.
- Conducted a CSA for Airborne Conflict Management (ACM) .
- Completed the ADS-B technical work assessment to recommend an ADS-B link decision.
- Continued air traffic procedure development for terminal environment
- Continued development of TIS-B and FIS-B requirements and specifications
- Developed and approved concepts of operation for Terminal and Surface Applications
- Installed a multi-lateration system at Louisville test bed.
- Completed development of Call sign procedure and received approval for the phraseology to be tested in FY2003.
- Continued to conduct tests of Safe Flight 21 applications including a test of the TESIS avionics in Memphis.

R&D Partnerships: The Safe Flight 21 – Ohio River Valley program is based on the principle that government and industry will share in the development and implementation of new communications, navigation, and surveillance technologies as the nation enters the Free Flight era.

The FAA will partner with the aviation industry in supporting Safe Flight 21 – Ohio River Valley. This will allow the FAA and industry to share the funding of avionics and ground systems and to build on ongoing industry initiatives. Safe Flight 21 will build on Ohio River Valley activities by:

- Identifying and resolving ADS-B technology issues.
- Developing ADS-B operational concepts.
- Focusing data collection activities during OpEvals and test events to answer as many operational and avionics certification issues as practical.
- Focusing on cockpit human factors issues.
- Exploring the use of TIS-B and FIS-B data link messages to receive traffic, weather, and other information in the cockpit.
- Developing, in conjunction with industry partners, an integrated cockpit display of terrain, traffic, and weather information.
- Ensuring that organizations representing controllers and commercial and general aviation pilots are included in Safe Flight 21 planning and in the evaluation of operational enhancements and data link alternatives.

MAJOR ACTIVITIES AND ANTICIPATED FY 2003 ACCOMPLISHMENTS:

In FY 2003, the FAA anticipates accomplishing the following activities in support of Safe Flight 21 in the Ohio River Valley:

- Continued air traffic procedure development for terminal environment with ATM-lab evaluations.
- Developed TIS-B and FIS-B requirements and specifications and plan testing in the small airport test bed at Prescott.
- Developed Small Airport Architecture in support of Safe Flight 21 General Aviation requirements and applications.
- Updated and approved concepts of operation for Terminal and Surface applications.
- Installed multilateration system capability at Memphis.
- Conducted data collection activities and metrics development using the call sign procedure at the Louisville test bed.
- Continued to conduct tests and demonstrations of SF-21 applications, including avionics, at the Louisville and Memphis test beds.

KEY FY 2004 PRODUCTS AND MILESTONES:

Key FY 2004 products and milestones involve activities related to the limited implementation of ADS-B applications in the Ohio River Valley that prove beneficial in meeting the intended outcomes of increasing the capacity and efficiency of the NAS.

Avionics and ground systems

- Coordinate within FAA to initiate the integration of ADS-B into the ARTS and STARS baselines.
- Continue to conduct tests and demonstrations of prototype avionics with airport surface moving maps and TIS-B and FIS-B products.
- Complete installation of a prototype TIS-B and FIS-B broadcast capability at Memphis.
- Conduct end-to-end evaluations.

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2002)	$51,700
FY 2003 Request	11,400
FY 2004 Request	6,900
Out-Year Planning Levels (FY 2005-2008)	21,400
Total	$91,400

Budget Authority ($000)	FY 2000 Enacted	FY 2001 Enacted	FY 2002 Enacted	FY 2003 Request	FY 2004 Request
Contracts:					
Safe Flight 21-Ohio River Valley	10,000	22,700	14,000	11,400	6,900
Personnel Costs	0	0	0	0	0
Other In-house Costs	0	0	0	0	0
Total	**10,000**	**22,700**	**14,000**	**11,400**	**6,900**

OMB Circular A-11, Conduct of Research and Development ($000)	FY 2000 Enacted	FY 2001 Enacted	FY 2002 Enacted	FY 2003 Request	FY 2004 Request
Basic	0	0	0	0	0
Applied	0	0	0	0	0
Development (includes prototypes)	10,000	22,700	14,000	11,400	6,900
Total	**10,000**	**22,700**	**14,000**	**11,400**	**6,900**

Safe Flight 21 - Ohio River Valley Products and Activities	FY 2004 Request ($000)	Program Schedule					
		FY 2003	FY 2004	FY 2005	FY 2006	FY 2007	FY2008
Safe Flight 21 - Ohio River Valley							
Operational Enhancements	$6,900						
Improve Capability for Approaches in Low Visibility Conditions		◆	◇	◇			
Enhance Capability to See and Avoid Adjacent Traffic		◆	◇	◇			
Improve Capability of Pilots to Navigate Airport Taxiways		◆	◇	◇	◇		
Enhance Capability for Controllers to Manage Aircraft and Vehicular Traffic on Airport Surface		◆	◇	◇	◇	◇	◇
Program Management and Support		◆	◇	◇	◇	◇	◇
Safety Assessment		◆	◇	◇			
Total Budget Authority	$6,900	$11,400	$6,900	$10,000	$6,000	$5,400	$0

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.

FREE FLIGHT PHASE 2

GOALS:

Intended Outcomes: Free Flight research focuses on those recommendations identified in the NAS Concept of Operations, Addendum 4 "Free Flight Phase 2," that can be rapidly transitioned to implementation. The goal of Free Flight research is to accelerate recommended research concepts and achieve an investment decision in accordance with the FAA's Acquisition Management System (AMS). Possible concepts for implementation in the 2003-2005 time frame include Direct-to (D-2), Multicenter Traffic Management Advisor (TMA-MC), Surface Management System (SMS), Problem Analysis, Resolution and Ranking (PARR) and Equitable Allocation of Limited Resources (EALR). Implementation of these concepts will provide the following benefits to NAS users:

- Improved en route routing
- Improved arrival management
- Improved airport surface asset management
- Advanced conflict resolution capabilities
- Equitable distribution of delays

Agency Outputs:

The Free Flight research program plan (RPP) describes the management approach for evaluation of research under the Free Flight Phase 2 (FFP2) program. The research transition plans (RTP) will establish the approach by which the FAA and researchers effectively develop, manage, and facilitate the transition of the individual research programs to the FAA for deployment into the National Airspace System (NAS). To facilitate this transition the following products will be produced:

- Free Flight Research Program Plan
- Research Transition Plans
- Benefits Assessments
- Technical Transfer documentation
- Investment Analysis documentation

Customer/Stakeholder Involvement:

The FAA/AOZ and researchers use a model of technology readiness levels (TRL) as the basis for coordinating activities, roles and responsibilities. Early TRLs (levels 1-3) allow the research organizations to develop and test prior to involvement by the FAA and users. Higher TRLs (levels 4-6) provide key milestones where the organizations, FAA, and users collaborate on a product that will satisfy FAA requirements. Key research organizations involved include NASA and MITRE CAASD.

MAJOR ACTIVITIES AND ANTICIPATED FY 2003 ACCOMPLISHMENTS:

- Completed Operational Concepts for D2, TMA-MC, PARR and SMS.
- Initiated D2 initial benefits assessments.
- Drafted D2 Functional Requirements Documents.
- Conducted controller simulations with the Air Traffic Conflict Probe/Air Traffic DSR Evolution Team (ATCP/ ATDET) to validate the D2 Ops Concept Description, prototype software, and detailed requirements.
- Initiated D2 Implementation & Acquisition discussions.
- Developed TMA-MC Functional requirements.
- Completed TMA-MC Increment 1 evaluation
- Began TMA-MC Increment 2 simulations.
- Completed formal simulation of TMA-MC Increment 2.
- Completed TMA-MC initial benefits assessment.
- Completed SMS traffic management coordinator (TMC) shadowing at Memphis.
- Completed PARR final Air Route Traffic (ART) Ops Concept Description.

KEY FY 2004 PRODUCTS AND MILESTONES:

- Finalize D2 Functional Requirements Documents.
- Finalize D2 Operational Concept.
- Complete D2 Architectural Analysis/Implementation evaluation.
- Begin D2 field site testing phase 2.
- Finalize D2 cost benefit analysis.
- Prepare D2 JRC package.
- Complete TMA-MC benefits assessment.
- Complete TMA cost analysis.
- Update TMA-MC final SSS Requirements for Increment 2.
- Prepare TMA-MC technical transfer package to transition the program to FAA.
- Prepare for a TMA-MC investment analysis decision.

- Begin SMS field demonstration(s) at Memphis.
- Finalize SMS benefits assessment.
- Finalize SMS l Ops Concept.
- Develop SMS technical transfer documentation.
- Prepare for an SMS investment decision.
- Begin PARR field test and complete technical transfer
- Prepare for PARR investment analysis decision

FY 2004 PROGRAM REQUEST:

The FY2004 request provides for:

- Ops concept development/Updates.
- Investment Analysis activities for TMA-MC, D2, PARR and SMS.
- Conduct of cost/benefits analysis in preparation for an investment decision.
- Development of Requirements Documentation for D2, TMA-MC and SMS.
- Support of TMA-MC field evaluations.
- Support of PARR field evaluations and technical transfer.

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2002)	$4,000
FY 2003 Request	7,000
FY 2004 Request	0
Out-Year Planning Levels (FY 2005-2008)	2,200
Total	$13,200

Budget Authority ($000)	FY 1999 Enacted	FY 2000 Enacted	FY 2001 Enacted	FY 2002 Enacted	FY 2003 Request	FY 2004 Request
Contracts:						
Free Flight Phase 2	0	0	0	4,000	7,000	0
Personnel Costs	0	0	0	0	0	0
Other In-house Costs	0	0	0	0	0	0
Total	**0**	**0**	**0**	**4,000**	**7,000**	**0**

Conduct of Research and Development ($000)	FY 1999 Enacted	FY 2000 Enacted	FY 2001 Enacted	FY 2002 Enacted	FY 2003 Request	FY 2004 Request
Basic	0	0	0	0	0	0
Applied	0	0	0	0	0	0
Development (includes prototypes)	0	0	0	4,000	7,000	0
Total	**0**	**0**	**0**	**4,000**	**7,000**	**0**

Free Flight Phase 2 Products and Activities	FY 2004 Request ($000)	Program Schedule					
		FY 2003	FY 2004	FY 2005	FY 2006	FY 2007	FY2008
Free Flight Research and Development	$0						
Develop, Update and Complete Operational Concept for D2		◆	◇				
Develop, Update and Complete Operational Concept for TMA-MC		◆	◇				
Develop, Update and Complete Operational Concept for SMS		◆	◇				
Conduct Activities in Support of an Investment Analysis for TMA-MC, D2, PARR and SMS		◆	◇	◇			
Conduct and Complete Cost/Benefit Analysis for D2			◇	◇			
Conduct and Complete Cost/Benefit Analysis for TMA-MC			◇				
Conduct and Complete Cost/Benefit Analysis for SMS			◇	◇			
Develop Requirements Documentations for D2, TMA-MC and SMS		◆	◇	◇			
Support TMA-MC field Evaluations		◆	◇				
Support PARR Field Evaluations and Technical Transfer			◇	◇			
Total Budget Authority	$0	$7,000	$0	$2,200	$0	$0	$0

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.

CENTER FOR ADVANCED AVIATION SYSTEM DEVELOPMENT (CAASD)

GOALS:

Intended Outcomes: The FAA intends to apply expertise from the Center for Advanced Aviation System Development (CAASD) resources to air traffic service research to produce a safer, more efficient global air transportation system. Because it augments the agency's in-house resources in conducting research for the Air Traffic Services (ATS) line of business, CAASD is an essential component of the FAA's research program.

Agency Outputs: The CAASD research program provides detailed reports, briefings, and concept demonstration systems for use in the evaluation of new Air Traffic Management (ATM) and control operating concepts and/or infrastructure replacements. These products are critical elements in the initial development of a more efficient, more available, and safer next generation ATM and control system.

CAASD provides new technology research for applications for global air traffic management, including new developments in traffic flow management, navigation, communication, separation assurance, security, surveillance technology, and system safety.

Customer/Stakeholder Involvement: The FAA is challenged to increase safety in the nation's civil aviation system while increasing capacity and efficiency. Outcomes within CAASD's work program span system stakeholder as well as FAA issues and needs. Collaborative traffic flow management is included among these important issues and needs.

The CAASD effort supports the RTCA Free Flight Steering Committee. This committee provides the principal collaborative forum among industry, aircraft operators, and FAA representatives in developing plans and requirements for the NAS to evolve to free flight. It defines operational needs leading to free flight and identifies the required affordable NAS Architecture that satisfies those needs.

Additionally, the CAASD effort supports the International Civil Aviation Organization (ICAO) in its efforts to develop 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 and validation.

Accomplishments: CAASD has supported the following accomplishments:

- Conducted field evaluations of prototypes of key Free Flight capabilities to define requirements and estimate potential system benefits.
- Reviewed and analyzed the state of wake vortex detection technology to help the FAA and NASA define programs that will achieve meaningful enhancements to the NAS.
- Developed procedural changes to improve runway safety and efficiency in the en route, terminal and oceanic domains.
- Conducted Safe Flight 21 demonstrations in the Ohio Valley and Alaska that have shown how Communication, Navigation and Surveillance (CNS) technologies can be integrated with procedural changes to enhance service to airspace users.
- Performed analysis, prototyping and laboratory evaluations of key capabilities in the en route and Traffic Flow Management domains to allow ATC specialists to provide a higher level of service to airspace users and to enhance the domain architectures.
- Performed analysis to determine the expected level of performance improvement (in terms of NAS delay, capacity, safety, predictability, flexibility, and/or access) of the future Operational Evolution Plan (OEP) enhancements. These have provided a basis for decision makers to prioritize activities to achieve OEP goals.

R&D Partnerships: In accomplishing the outcomes in the CAASD work program, extensive partnerships have been forged with industry suppliers, aircraft operators, and other non-profit research institutions. These relationships include:

- George Mason University and NASA, on Wake Vortex, ADS-B and surface issues related to capacity.
- EUROCONTROL, on future ATM developments
- NASA Ames, on Multi-Center Traffic Management Advisor (TMA).

- Cargo Airlines Association, Florida Institute of Technology, and the University of Virginia, on ADS-B and its use for situational awareness (traffic and weather information in the cockpit) and self-spacing.
- UPS Aviation Technologies, on the Universal Access Transceiver.
- MIT Lincoln Laboratory, on wake vortex technologies and surveillance requirements and solutions resulting from evolving FAA security requirements.

In the modeling arena, CAASD is engaged in activities with Georgia Tech on Detailed Policy Assessment Tool (DPAT) and The Preston Group with Total Airport and Airspace Simulator and the Santa Fe Institute on agent-based modeling. CAASD also is working with Catholic University on human factors stress monitoring techniques.

CAASD is working with the Volpe National Transportation Systems Center on evolving TFM operational capabilities and infrastructure modernization. Together, the centers are working with the NATCA Aviation Research Institute to obtain operational expertise on CAASD evaluations of new procedures and equipment. On its own, CAASD is working with Airbus, Boeing and Honeywell on path object concepts for future aviaonic systems and with Lockheed-Martin on enroute ATM modernization concepts.

MAJOR ACTIVITIES AND ANTICIPATED FY 2003 ACCOMPLISHMENTS:

- Conducted evaluations of Free Flight capabilities using prototype systems to refine requirements and quantify potential benefits.
- Developed an integrated detailed next-generation air/ground communication system program plan that has wide-spread buy-in from the airspace user community.
- Conducted evaluations of Free Flight capabilities to gather information on their utilization and on the system benefits derived from their use.
- Performed prototype development and assessment of key en route system architecture enhancements.
- Provided strategic planning and analysis supporting regional and national airspace design and policy decisions.

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2002)	$29,568
FY 2003 Request	45,584
FY 2004 Request	50,848
Out-Year Planning Levels (FY 2005-2008)	229,992
Total	$355,992

Budget Authority ($000)	FY 2000 Enacted	FY 2001 Enacted	FY 2002 Enacted	FY 2003 Request	FY 2004 Request
Contracts:					
Center for Advanced Aviation System Development (CAASD)	4,900	3,991	5,143	45,584	50,848
Personnel Costs	0	0	0	0	0
Other In-house Costs	0	0	0	0	0
Total	**4,900**	**3,991**	**5,143**	**45,584**	**50,848**

OMB Circular A-11, Conduct of Research and Development ($000)	FY 2000 Enacted	FY 2001 Enacted	FY 2002 Enacted	FY 2003 Request	FY 2004 Request
Basic	0	0	0	0	0
Applied	4,900	3,991	5,143	45,584	50,848
Development (includes prototypes)	0	0	0	0	0
Total	**4,900**	**3,991**	**5,143**	**45,584**	**50,848**

Notes:

- In FY 2002 Congress transferred CAASD funding from the FAA's RE&D Appropriation to its F&E Appropriation.

- CAASD funding FY 2003 and beyond reflects the portion of Center's funding that accomplishes R&D functions.

Center for Advanced Aviation System Development (CAASD) Products and Activities	FY 2004 Request ($000)	Program Schedule					
		FY 2003	FY 2004	FY 2005	FY 2006	FY 2007	FY2008
Center for Advanced Aviation System Development (CAASD)							
Research, Engineering and Development	$20,339						
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 Expanded 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	$17,796						
Conducted Evaluations of Airspace Redesign Enhancements in all Operational Domains to Improve System Performance and Utilization of Resources		◆	◇	◇	◇		
Conducted 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	$12,713						
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	$50,848	$45,548	$50,848	$53,424	$56,000	$58,800	$61,768

Notes:
- Out year numbers are for planning purposes only. Actual funding needs will be determined through the annual budget process.
- Starting FY 2003 CAASD is a part of the F&E line item of the same name.
- In the Facilities and Equipment appropriations, personnel and other costs are budgeted in Activity 6, not the program budget line item.

2.3 Environmental Research and Development Program Area Description

Mission

The unifying mission of the FAA Environmental R&D Program Area is to support the agency's Environment Goal: "Prevent, minimize and mitigate environmental impacts, which may represent the single greatest challenge to the continued growth and prosperity of civil aero-space."

Figure 2.3-1 indicates the percentage of the total requested FY 2004 R&D funding that will be devoted to the support of Aviation Environmental research.

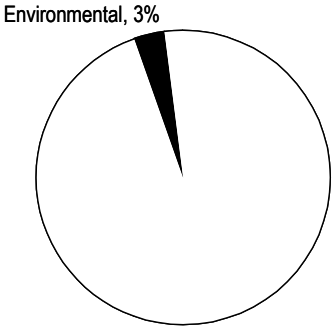

Figure 2.3-1: Percentage of Total FY 04 R&D Funding Supporting FAA Aviation Environmental Goal

Research within this area develops information, tools, methods, and technologies that, when applied to the establishment or improvement of aviation safety standards and acceptable practices, mitigate the adverse impacts of aircraft noise andemissions upon the environment.

Program Area Structure

The environmental research program is a single line item in the annual R,E&D Budget Request. The research area is composed of the following major elements:

- Aircraft noise
- Aviation emissions

Under these subject areas, a cohesive system of research projects that support federal actions to identify, control, and mitigate the environmental consequences of aviation activity.

Program Challenges and Strategies

The 2002 *FAA R&D Strategy* provides a conceptual framework that ties the work of the agency's R&D projects to the accomplishment of FAA strategic goals. Section 1.0 of this Plan, "FAA R&D Program Overview," provides a brief discussion of the relationship of high-level program goals (derived from agency goals), through specific challenges and strategies, down to the level of related project results. Table 2.3-1, adapted from the 2002 *FAA R&D Strategy* outlines the current long-term planning structure for the Aviation Safety program area.

R&D Challenges	R&D Strategies
Derived Goal: Increase understanding of current and potential environmental consequences of aviation-system operations, and alternative countermeasures.	
Enhanced Knowledge Base *- Enhance the knowledge base and array of planning tools available for designing and implementing programs to reduce environmental impacts.*	Develop and validate methodologies and models to assess aircraft noise exposure, aviation emissions and impact on air quality, and greenhouse gas emissions.

Table 2.3-1: Goals, Challenges & Strategies – Environmental R&D Program Area

R&D Challenges	R&D Strategies
Derived Goal: Control and reduce environmental impacts of aircraft and airport operations.	
Minimization of Noise Impacts *- Develop, apply and disseminate knowledge and tools to support international harmonization and optimization of noise-related aircraft certification standards, operational procedures and abatement technology.*	(1) Develop data, requirements, standards, rules, and technical guidance addressing certification of new and modified designs for reduction of aircraft noise. (2) Prepare technical documentation and training materials for use by aircraft manufacturers and others. (3) Provide computer models and impact criteria for use by civil aviation authorities in environmental assessments.
Minimization of Air Quality Impacts *- Develop, apply, and disseminate knowledge and tools for international harmonization and optimization of emissions-related aircraft certification standards, test procedures, and abatement technology.*	(1) Develop emission reduction data, requirements, standards, rules, and technical guidance for certification of new and modified designs. (2) Prepare technical documentation and training materials for use by aircraft manufacturers and others. (3) Provide computer models and impact criteria for use by civil aviation authorities in environmental assessments.

Table 2.3-1 (Continued): Goals, Challenges & Strategies – Environmental R&D Program Area

R&D Partnerships

FAA participates with others in the aviation community in the following joint R&D efforts:

- A series of Memorandums of Understanding enabling the FAA to work with NASA and U.S. industry to identify source noise and emissions abatement technologies.
- Collaboration with the Environmental Protection Agency (EPA), NASA, industry, and academia to assess the local and global impacts of aviation emissions.
- Support of the Volpe National Transportation Systems Center's (VNTSC) continuing efforts to provide substantial technical assistance in aircraft noise and emissions measurement and assessment.
- Collaboration with EUROCONTROL on the SOURDINE project (Study of Optimisation procedURes for Decreasing the Impact of NoisE around airports) to identify new procedures leading to the reduction of noise in the airport vicinity and the requirements for supporting tools.

In addition to the FAA, the U.S. Air Force, Army, Navy, Department of Interior, DOT, EPA, NASA, and the Department of Housing and Urban Development participate on the Federal Interagency Committee on Aviation Noise (FICAN), the recognized forum for partnership among all federal agencies concerned with aviation noise. FICAN has led to expanded coordinated and cooperative research efforts among the individual agencies and, thus, results in more efficient use of federal funds. Agencies have signed a letter of understanding formally documenting their participation on the committee and defining its purpose, scope, membership, process, and products.

Additional details of FAA partnered research in the Environmental R&D Program Area can be found in the description, drawn from the FY 2004 budget submission, which immediately follows this program area description.

Program Area Outputs

Detailed program outputs of FAA Environmental R&D can be found in the description, drawn from the FY 2004 budget submission, which immediately follows this general program area description.

FAA aviation environmental research produces:

- Guidance for noise and emissions standards for the certification of new and modified airframe and engine designs.
- Technical guidance on certification procedures and practices for manufacturers and modifiers in the form of technical reports, handbooks, advisory circulars, training courses, and rules.
- Computer models and impact criteria for civil aviation authorities to use in the environmental assessment of proposed actions.

Intended Outcomes

Detailed anticipated benefits and recent accomplishments of FAA Environmental R&D can be found in the description that is drawn from the FY 2004 budget submission and immediately follows this general program area description.

Through an optimal mix of aircraft noise and aviation exhaust emissions certification standards, operational procedures, compatible land use, and abatement technology, the FAA intends to minimize the global, regional, and local impact of aircraft noise and exhaust emissions.

Long-Range View

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

The solution to controlling the environmental consequences of aircraft traffic growth is achieved through a coordinated regulatory and R&D approach involving the FAA with other federal agencies, such as EPA, NASA and DOD, from the early stages of new aircraft and engine technology research to the commercialization of those technologies.

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

ENVIRONMENT AND ENERGY

GOALS:

Intended Outcomes: The FAA intends to:

- Work with the international aviation community toward further reduction of aviation noise through optimal mix of new aircraft certification standards, operational procedures, compatible land use, and the application of abatement technologies in the proximity of populations exposed to Day/Night operating conditions. Through previous actions, the FAA reduced this impact by 80 percent from the 1992 Level (65dB).
- Define and minimize the impact of aircraft emissions through an optimal mix of new aircraft certification standards, operational procedures, and abatement technology.
- Improve analytic and planning tools in order to provide a better understanding of aviation's enviromental impacts, and gain insight into the consequences of alternative courses of action.

Agency Outputs: The findings of aviation environmental research have resulted in the publication of significant standards, rules and technical guidance including:

- Standards for the certification of new and modified designs for the reduction of aircraft noise and engine exhaust emissions.
- Technical reports, handbooks, Advisory Circulars (AC), training courses, and procedures for use by manufacturers and modifiers.
- Computer models and impact criteria for use by civil aviation authorities in the environmental assessment of proposed actions.

Customer/Stakeholder Involvement: The FAA works closely with other federal agencies, industry, and foreign governments through a unified regulatory R&D approach to guide R&D efforts into the impact of aviation upon the environment. Lessons learned from this research identify and shape technologies, regulations, and certification criteria that offer potential to improve our present and future global environment.

The Aviation Regulatory Advisory Committee (ARAC) is a formal standing committee composed of representatives from aviation associations and industry. Established by the FAA, ARAC provides industry input in the form of recommendations, advice, and information for consideration in the full range of FAA rulemaking activities. ARAC harmonization working groups have been tasked to ensure that the aircraft noise certification regulations that impact both domestic and foreign parties do not impose different standards in each country involved.

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). The purpose of CAEP is to establish and assess the adequacy of international aviation environmental standards, especially in the areas of aircraft noise and engine exhaust emissions standards.

The FAA and other interested federal agencies established the Federal Interagency Committee on Aviation Noise (FICAN) to provide forums for debate over needs for future aviation noise research and to encourage new efforts in this area. FICAN conducts annual public forums in different geographic regions to solicit general input on aviation noise impacts with the intent to better align research with the public's concerns.

Accomplishments:

- Produced reports to Congress on the following:
  - Quiet technology for air tour aircraft operating in Grand Canyon National Park.
  - The annual progress of the FAA/NASA subsonic jet noise research program from FY1994 to 2001.
  - Nonmilitary helicopter noise impact on densely populated communities
- Developed advanced computer models — for airport and heliport noise analysis that have resulted in the sale of over 600 copies around the world. In the United States, these models have been used in over 160 airport studies involving more than $1.3 billion in airport noise compatibility grants. This program has also produced an aircraft overflight noise exposure prediction model for Grand Canyon National Park.
- Held public forums on aviation noise research in:
  - Atlanta, Minneapolis, San Diego, Seattle, Washington, DC, and Columbus.

- Produced special reports and findings:
  - Annual reports of FICAN activities since 1994.
  - One compendium on federal aviation noise research projects.
  - Federal findings on: (1) the relationship between aircraft noise and sleep awakenings, (2) research on natural quiet, (3) effects of aircraft noise on classroom learning, (4) value of supplemental noise metrics in aircraft noise analysis, and (5) effects of low frequency on residences.

Funding has also led to enhancements to the computer model used for airport air quality analysis and its formal acceptance by the Environmental Protection Agency (EPA) as a preferred guideline model with EPA's highest ranking, and to the development of a handbook on the procedures for airport air quality analysis for use by civil and military aviation authorities. Standardizing the civilian and military analytical procedures will improve the quality of the environmental assessments reviewed by the Federal Government.

R&D Partnerships: The FAA works closely with NASA through a series of Memorandums of Agreement to identify source abatement technologies. The FAA also participates with NASA, industry, and academia to assess the possible global impact of aircraft engine exhaust emissions. The Volpe National Transportation Systems Center (VNTSC) continues to provide substantial technical assistance in the areas of aircraft noise and engine emissions measurement and assessment. FICAN is a forum for partnership, as all Federal agencies concerned with aviation noise are represented on the Committee. FICAN has led to expanded coordinated and cooperative research efforts among the individual agencies, resulting in the more efficient use of Federal funds.

MAJOR ACTIVITIES AND ANTICIPATED FY 2003 ACCOMPLISHMENTS:

Aircraft noise reduction and control

- Established a new Center of Excellence for Aircraft Noise Mitigation (Noise COE) to involve academia, industry, and government to achieve solutions to existing airport noise problems.
- Published first report on the assessment of the FAA/NASA aircraft noise reduction technology research program.
- Published update to aircraft noise certification handbook (AC36-4).

Engine emissions reduction and control

- Updated the FAA Engine Exhaust Emissions Database to be consistent with the ICAO databank.
- Continued to examine alternative, simplified engine exhaust emissions measurement procedures to reduce manufacturers certification test costs.
- Analyzed methods and procedures identified during the FY02 training/workshop with industry and government participants.
- Published FAA AC 34-1A, including updated field practices, procedures for approval of supplemental engine emissions certification data, and harmonized technical guidance related to engine emissions certification.
- Developed a draft Aerospace Information Report (AIR) on measurement/sampling of particulate matter emissions from aircraft engines.
- Assessed the potential benefits to be achieved from incorporating emissions reduction technologies emanating from NASA research programs.

Aviation noise analysis

- Achieved Society of Automotive Engineers (SAE) approval of new guidelines for the calculation of airplane noise in the vicinity of airports.
- Finalized new version of a model to assess global exposure to noise from transport airplanes that incorporates land use GIS.

Aviation emissions analysis

- Finalized reports on validation activities for the Emissions And Dispersion Modeling System (EDMS) version 4.1, including aircraft plume characterization study, carbon monoxide measurement study, and comparative analysis of EDMS results versus European models and airport emissions monitoring.
- Finalized a first-order approximation method for calculating particulate matter emissions from aircraft engines.
- Completed the validation of individual modules and inter-module testing for the modeling System for assessing Aviation Global Emissions (SAGE), version 1.

- Assessed baseline national and global emissions inventories, and potential benefits of CNS/ATM enhancements using SAGE version 1.
- Delivered the first version of the Screening Model for Airport Air Quality (SMAAQ) to FAA Flight Standards field personnel.
- Published an update (addendum) to the handbook for airport air quality analyses.
- Published draft technical guidance concerning the reduction of emissions from ground support equipment (GSE), including emissions calculation methodology.

KEY FY 2004 PRODUCTS AND MILESTONES:

Aircraft noise [Combines former Aircraft Noise Control and Aviation Noise Analysis program areas]

- Promulgate new federal noise certification standard for subsonic jet and large transport airplanes.
- Release new INM database of aircraft (including helicopters) noise and performance values/parameters.
- Conduct first annual Noise COE conference.
- Continue to examine and validate methodologies used to assess aircraft noise exposure and impact.

Engine emissions [Combines former Engine exhaust emissions control and Aviation emissions analysis program areas]

- Develop and publish harmonized, simplified engine exhaust emissions certification test procedures and technical guidance materials that will increase efficiency and reduce costs of the tests.
- Conduct testing and analysis of particulate matter emissions from aircraft engines to support development of SAE E31 AIR.
- Continue to assess potential benefits to be achieved from incorporating emissions reduction technologies emanating from NASA research programs; identify technology goals for long term reduction of aircraft engine emissions.
- Continue to examine and validate methodologies used to assess aviation emissions and their impact on air quality; identify and implement enhancements to EDMS.
- Complete development of the SAGE model, version 1.1 for assessing aviation's global emissions; complete design of SAGE versus 2 including an economics module.
- Publish guidance document for estimating and reducing emissions from ground support equipment.
- Continue development and enhancement of the SMAAQ.
- Develop and publish resource and guidance materials for addressing issues related to toxic air pollutants in the aviation environment.

FY 2004 PROGRAM REQUEST:

The FAA will continue to work with NASA in the Quiet Aircraft Technology (QAT) research program intended to identify the noise reduction technologies that will enter the marketplace within 10-15 years - in time- for use by U.S. industry in the next generations of aircraft. The agency will use its research findings to consider new environmental certification standards and procedures for the next generation of transport aircraft. In accordance with the National Environmental Policy Act, the FAA must consider and mitigate the environmental consequences of its actions. A variety of methodologies and research are necessary to support and properly assess the environmental impact of aviation. The objective is to enhance and advance computer modeling techniques to better estimate environmental impacts. The FAA will continue to work with NASA, the manufacturing industry, and foreign authorities to provide technical support for development and implementation of aircraft environmental certification regulations through proactive response to changes in airplane technology, measurement/ analysis technology, regulatory policy, and international regulatory initiatives.

ONGOING ACTIVITIES

- Support the FAA role in the ICAO CAEP working groups assessing the international standards and recommended practices needed to demonstrate compliance with the international aviation environmental standards for aircraft noise and engine exhaust emissions.
- Examine and validate methodologies used to assess aircraft noise exposure and impact.
- Enhance the model to that assesses global exposure to noise from transport airplanes
- Enhance and validate the EDMS and the SMAAQ, and related input databases.

- Develop and test SAGE.
- Maintain currency of the regulation and technical guidance materials concerning aircraft noise and engine exhaust emissions certification requirements.

NEW INITIATIVES

No new initiatives are planned in FY 2004.

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2002)	$ 79,808
FY 2003 Request	7,550
FY 2004 Request	7,975
Out-Year Planning Levels (FY 2005-2008)	33,346
Total	$ 128,679

Budget Authority ($000)	FY 2000 Enacted	FY 2001 Enacted	FY 2002 Enacted	FY 2003 Request	FY 2004 Request
Contracts: Environment and Energy					
Aircraft Noise	1,329	678	19,822	4,024	3,951
Engine Emissions	1,527	2,115	989	2,046	2,357
Personnel Costs	589	653	1,086	1,383	1,580
Other In-house Costs	36	27	184	97	87
Total	**3,481**	**3,473**	**22,081**	**7,550**	**7,975**

OMB Circular A-11, Conduct of Research and Development ($000)	FY 2000 Enacted	FY 2001 Enacted	FY 2002 Enacted	FY 2003 Request	FY 2004 Request
Basic	0	0	0	0	0
Applied	3,481	3,473	22,081	7,550	7,975
Development (includes prototypes)	0	0	0	0	0
Total	**3,481**	**3,473**	**22,081**	**7,550**	**7,975**

A13a – Environment and Energy Products and Activities	FY 2004 Request ($000)	Program Schedule					
		FY 2003	FY 2004	FY 2005	FY 2006	FY 2007	FY2008
091-110 Aircraft Noise Control	**$3,951**						
Assessment of FAA/NASA Aircraft Noise Reduction Technology Research		◆	◇	◇	◇	◇	◇
Noise COE Reports, Conferences, Findings, and other Activities		◆	◇	◇	◇	◇	◇
Publish Advisory Circular 36-4 (and Updates)		◆		◇		◇	
New Noise Standard for Subsonic Jets and Large Airplanes			◇				
New Noise Standard for Helicopters					◇		
Release Integrated Noise Model (INM) Updates			◇	◇	◇	◇	◇
Validation of the Methodologies Used to Assess Aircraft Noise Exposure and Impact		◆		◇		◇	
Development of Model to Assess Global Exposure to Noise from Transport Airplanes		◆		◇			◇
Enhanced Aircraft Noise Modeling for Airspace Management Activities					◇		
091-115 Engine Emissions (Combines Former Engine Exhaust Emission Control and Aviation Emissions Analysis Program Areas)	**$2,357**						
Updated FAA Engine Exhaust Emissions Database		◆		◇		◇	
Assessment of Technological and Scientific Bases to Support Future ICAO Engine Emission Standards		◆		◇		◇	
Alternative Simplified Engine Exhaust Emissions Certification Test Procedures			◇		◇		◇
Updated Advisory Circular 34-1		◆	◇		◇		◇
Measurement/Sampling Protocol for Particulate Matter (PM) Emissions from Aircraft Engines		◆			◇	◇	
Release Emissions and Dispersion Modeling System (EDMS) Updates		◆		◇	◇		
Validation of Methodologies Used to Assess Aviation Emissions and Their Impact on Air Quality			◇			◇	
First-Order Approximation Method for Aircraft Engine PM Emissions		◆		◇			
Handbook for Airport Air Quality Analysis		◆					
Complete Global Emissions Model, SAGE, Version 1 and Updates		◆		◇		◇	
Forecast and Assessment of Aircraft Engine Emissions Burden and Mitigation			◇		◇		◇
Release Screening Model for Airport Air Quality (SMAAQ), Version 1, and Updates		◆		◇			
Guidance Document for Estimating and reducing Emissions from Ground Support Equipment		◆	◇				
Resource and Guidance Materials Concerning Toxic Air Pollutants in the Aviation Environment				◇		◇	
Personnel and Other In-House Costs	**$1,667**						
Total Budget Authority	**$7,975**	**$7,550**	**$7,975**	**$8,085**	**$8,289**	**$8,389**	**$8,583**

Note: **Out year numbers are for planning purposes only. Actual funding needs will be determined through the annual budget process.**

APPENDIX A

RESEARCH, ENGINEERING AND DEVELOPMENT ADVISORY COMMITTEE

The FAA values the ongoing involvement of the Research, Engineering and Development Advisory (R,E&D) Committee in reviewing its current and planned R,E&D programs. A formal process has been established whereby the agency replies to the Committee's reports. This documents summarizes recent Committee recommendations and FAA responses.

FAA's R,E&D Advisory Committee and NASA's Aerospace Technology Advisory Committee will continue joint meetings to establish a framework that allows FAA and NASA to communicate, coordinate, and manage their R&D goals in the areas of safety, efficiency, and environment and energy.

Since preparation of the 2002 *FAA National Aviation Research Plan*, the Committee submitted the following reports:

- *Report of the Security Subcommittee*, dated February 4, 2002
- *Recommendations on Fiscal Year 2004 R,E&D Investments*, dated February 4, 2002
- *Committee/Subcommittee Guidance on Fiscal Year 2004-2008 R&D Investments*, dated July 11, 2002

In 2003, the FAA expects to receive the Committee's recommendations on FAA's planned research and development investments for Fiscal Year 2005, including detailed recommendations from the standing subcommittees.

- *Committee Guidance on Fiscal Year 2004-2008 R&D Investments*, dated July 11, 2002

At the April 23-24, 2002, Committee meeting, the Committee reviewed the FAA's planned FY 2004-2008 R&D Investments and provided recommendations to FAA in a letter dated July 11, 2002 from Committee Chair, Dr. Deborah Boehm-Davis to Administrator Jane Garvey. Below are the Committee's recommendations and FAA's response. A formal response was provided December 18, 2002.

Recommendation 1**:** We recommend that FAA develop a mechanism for evaluating the extent to which your research is directed toward satisfying specific - typically near term - requirements versus supporting anticipatory - typically longer term - needs that will allow you to meet the goals outlined in your strategic plan. Further, we recommend that FAA be proactive in developing a more effective process for integrating individual research projects into an overall program that focuses on aviation as an integrated system.

Response: An FAA Research and Development (R&D) Strategy document has been developed that provides a description of how the FAA's R&D program is addressing FAA's goals. This document was coordinated within the FAA and is being shared with the Department of Transportation and the Office of Management and Budget. We also agree with the second part of your recommendation that FAA be proactive in building a research program that "focuses on aviation as an integrated system." Your assistance with the work of the Air Transportation Advisory Group (a group jointly supported by the REDAC and the National Aeronautics and Space Administration (NASA) Advisory Committee) provided an early push to develop this integrated aviation system. In addition, The President's Aerospace Commission Report provides an outlook on the future of aviation in the U.S. and the role of academia, Government and industry to bring about that future. In anticipation of that report, FAA and NASA have been discussing a potential initiative to design a truly integrated aviation system for the future.

Recommendation 2: We recommend that FAA develop mechanisms to foster an increased level of awareness and support for research from line management of the operational side in addition to that already felt by researchers.

Response: We concur with the need for such a mechanism and will work this year to better communicate the importance and contribution of R&D to operational line management.

Recommendation 3: We would like to encourage that serious thought be given to the placement of the chief research officer as the FAA goes through their reorganization processes. Research is of central importance in achieving the long-term goal of a safer and more effective aviation system. The committee recom-

mends that serious thought be given to creating a senior executive position with the responsibility and authority to ensure integration and coordination of research across the operational elements.

Response: The FAA shares the opinion of the committee that research is critical to achieving the long-term goals of a safer and more efficient aviation system. The idea of a Chief Research Officer with authority to coordinate research across the lines of business is certainly one that will be considered among other ideas and recommendations in any reorganization proposal.

Recommendation 4: The movement of money from R&D to Facilities and Equipment (F&E) creates several impediments to the conduct of research. The committee would like the opportunity to work with you to inform Congress of the difficulties created by funding R&D out of F&E funds.

Response: We partially concur with the committee's assessment. While recognizing that there are opportunities to improve the way research is funded, we believe we are able to manage the current process so that it is not an impediment to the conduct of research.

Recommendation 5: Finally, the committee valued the participation of several associate administrators in the most recent meeting. We look forward to a continued and fruitful dialogue with these members of your senior management team in future meetings.

Response: The Associate Administrators appreciate the dialogue with Committee members at the meetings. It provides valuable feedback on their programs. We look forward to continuing this participation at future meetings.

Subcommittee on Airports

Recommendation:

- Supports continued operation of the National Pavement Test Facility.
- Supports continuing research to prepare for introduction of new large aircraft.
- Supports research in wildlife control and mitigation.
- Supports continued research into visual guidance, lighting and marking, and reductions in runway incursions.
- Supports research into airport planning and design, but believes the research should be refocused on terminal security issues resulting from the events of 9/11.

Response: We are appreciative of the continued support from the Airports Subcommittee for the Airport Technology Research Program. In particular, we have modified our research activities in airport planning and design to refocus on terminal security issues resulting from the events of 9/11. This redirection was discussed at the recent subcommittee meeting held August 13 and 14, 2002 at the FAA William J. Hughes Technical Center.

Subcommittee on Environment and Energy

Recommendation: Subcommittee supported the basic aviation environmental research program for noise and emissions as proposed by the FAA for fiscal year 2004.

Response: Concur.

Recommendation: Subcommittee endorses the FAA proposal for an additional $15M above the basic research program to both supplement the NASA Quiet Aircraft Technology (QAT) project and to sustain the FAA's Center of Excellence for Aircraft Noise Mitigation.

Response: Concur. A Center of Excellence for noise mitigation can help provide some near term noise relief while waiting for the long-term research program to achieve results.

Recommendation: The Subcommittee recommends that the development of the System for assessing Aviation's Global Emissions (SAGE) be expedited without detriment to the other emissions related projects.

Response: The FAA supports this recommendation only if the FAA environmental budget receives the funding levels requested in the President's budget.

Recommendation: The Subcommittee endorses increased funding to ensure that version 2 of the SAGE model, including an economics module, is validated and delivered in sufficient time to influence decision making associated with the work program for the seventh meeting of the International Civil Aviation Organization (ICAO) Committee on Aviation Environmental Protection (CAEP).

Response: Concur, however, the FAA can support this recommendation only if the FAA environmental budget receives the funding levels requested in the President's budget.

Recommendation: The Subcommittee recommends that future FAA budget requests encompass funding necessary to acquire data to characterize particulate matter emissions from aircraft engines, in accordance with procedures agreed by the Society of Automotive Engineers (SAE) E3 1 Committee.

Response: Concur. This item will be included in future FAA environmental budget requests.

Subcommittee on Aircraft Safety

Recommendation: Clarification should be provided by AVR-1 on purpose of FAA-sponsored research.

Response: The Associate Administrator for Regulation and Certification (AVR-1) provided clarification on the purpose of AVR-sponsored research during his address at the last REDAC Committee meeting, April 23, 2002, in Arlington, Virginia. His remarks also noted how research plays a significant role in AVR's strategic objectives, and explained in detail how AVR corporately identifies, prioritizes, and manages its research portfolio. A transcript of his address is enclosed.

Recommendation: A process should be put in place for industry review and comment on TCRG recommendations prior to submission to FAA leadership.

Response: FAA agrees with this recommendation and is working with the Safety Subcommittee to develop an acceptable process and we are continuing our discussion. It is important to note that our research teams work closely with their industry colleagues as well as NASA, academia, Department of Defense (DOD), and other civil aviation authorities. This has been a very successful effort in identifying the direction of research proposals.

Recommendation: Research related to flight crew needs is indeed urgently needed, but that it must be fully integrated with research done by the Air Traffic Control (ATC)/Air Traffic Management (ATM) community.

Response: FAA agrees with this recommendation and for the past several years has submitted an above target initiative requesting funds to systematically address air/ground integration issues. FAA management has indicated that if the above target initiative was not funded, then the major elements of the program should be included in our base research portfolio.

Recommendation: The issue of aircraft related "Toxicity Detection and Elimination" should be submitted to Transportation Security Agency (TSA) for review and, with input of affected industry, developed into an action plan.

Response: FAA believes aircraft toxicity and elimination is an aircraft safety issue and is therefore addressed in the Proposed Implementation of Cabin Air Quality Recommendations approved by the Administrator on June 17, 2002. AVR proposes to sponsor research in this area and will coordinate with TSA as it pertains to the security interests. This research was proposed as an above the base request for FY 2004. That proposal was not approved. Presently, the FY 2004 base budget on Cabin Air Quality will support the National Research Council (NRC) recommendations only. The plan is available at http://www.faa.gov/AVR/AAM/caq/. REDAC support for this endeavor is appreciated.

Recommendation: Numerous opportunities for matching funds from industry are available and should be pursued.

Response: FAA agrees with this recommendation and has several research programs where industry has provided funding. As a matter of fact, we continue to actively pursue leveraging our research expenditures through avenues such as cost sharing and in-kind contributions from industry, academia, and other government agencies. At the most recent meeting with the Aircraft Safety Subcommittee, additional information was provided to the extent of our leveraging efforts. The Subcommittee commended that "the group has gone a long way in leveraging with other research organizations." We also requests REDAC to assist in identifying other research partners.

Subcommittee on Air Traffic Services

Recommendation: Supports an examination of existing separation standards associated with ATC procedures and determine areas where standards can be reduced.

Response: FAA fully supports the intent of your recommendation. We believe the most immediate benefit would be to expand the US airspace where 3-mile separation is applicable. Our Flight Standards Service and Office of System Architecture and Investment Analysis have begun an effort with Massachusetts Institute of Technology Lincoln Laboratory (MIT/LL) to evaluate opportunities for extending areas where 3-mile separation can be accomplished – based on the performance of our existing surveillance and tracking systems.

Recommendation: Supports aviation weather program being funded at base level.

Response: The President's FY 2003 Budget Request for Aviation Weather research was at $26M, a significant increase from the $18M enacted level of FY 2002. FAA's request for Aviation Weather research in FY 2004 is in discussion within the Executive Branch.

Recommendation: Recommends that the wake vortex program be supported at an additional $3M above the $1M in the base, without drawing from other programs.

Response: Consistent with a previous ATS Subcommittee recommendation, much work has been done over the past several months. FAA has devoted extensive resources to identifying research goals and objectives as well as appropriate research project deliverables for the wake turbulence program. As a result, the Agency can now prudently apply the earmarked funds toward substantiated needs.

Subcommittee on Human Factors

Recommendation: Pointed to a lack of a comprehensive human-system integration plan.

Response: We agree that the FAA lacks a comprehensive plan for human-system integration (HSI) at the National Airspace Systems (NAS) level. However, the Free Flight and Safe Flight 21 programs have developed comprehensive HSI plans. In addition, assessments of specific HSI issues have been made with pre-planned product improvements and other enhanced capabilities proposed for integration into baseline TRACON systems. This approach is being extended to other operational domains as well as the Operational Evolution Plan. Although funding constraints do not accommodate robust assessment of HSI considerations across all operational conditions associated with new technologies and capabilities, we are encouraged by the progress.

Recommendation: Pointed to a continuing need for investment in longer-range issues.

Response: While research activities like validation of tests and criteria for screening and selecting applicants for AT/AF positions necessitates a longitudinal approach, the nature of the agency's mission, combined with Congressional mandates and constrained budgets, results in most of the base research program having a near- term focus. By partnering with other organizations such as NASA, MITRE, and Lincoln Laboratories, as well as conducting research that is part of Advanced Systems Concepts, longer- range issues are addressed.

Recommendation: Suggested that the requirements database held by AAR-100 is a useful tool that might be considered for other areas within the FAA.

Response: The AAR-100 program management database is a secure, interactive web-based application that provides management, sponsors, science advisors and researchers a means to baseline and track research requirements from concept development to completion. Its independent modules can be configured to meet an organization's needs. The NASA-Ames Research Center's Information Processing Branch adopted this database, and we stand ready to provide this powerful management tool to other organizations within and outside the FAA.

Recommendation: However, requirements are often identified too late in the process to be most effective; there is a need to anticipate future needs.

Response: Base research program's which focus on near-term requirements utilize most of the resources. By partnering with other organizations, as well as conducting research that is part of Advanced Systems Concepts, longer-range future needs can be identified and addressed. Our flight deck human factors program is reassessing automation research and putting more emphasis on new technologies in general aviation. Additionally, coordination with NASA-Ames and MITRE CAASD through the Interagency Air Traffic Management (ATM) Integrated Product Team (IPT), and with EUROCONTROL through the Action Plans and ATM Symposiums provides windows into future ATS research trends on advanced capabilities.

Recommendation: Supports research to allow for the development of new avionics training and certification requirements.

Response: The flight deck human factors program continues to emphasize research that provides the aviation community with human performance information and guidance critical to the design, operation, regulation, and certification of new avionics and associated training and procedures. We will continue to look for opportunities to leverage non-government resources and utilize those key research results as we expand research in this area.

Recommendation: Needs to be maintained in any restructuring and the PBO.Response: Human factors has achieved a "critical mass" with all the ingredients for continued success – support within the agency, strong leadership, a business strategy inextricably tied to achieving ARA goals, a world-class research team, and expanded visibility and support within the aviation community. Decisions regarding organizational changes should be designed to provide the human factors team with even greater opportunities to impact safety and the FAA acquisition process.

Report of the Security Subcommittee (dated February 4, 2002)

As a result of the tragic events of September 22, 2001, Administrator Jane Garvey reconstituted the

Subcommittee on Aviation Security into an Ad Hoc Security Subcommittee to evaluate security related research ideas and capabilities resulting from the thousands of solicited and unsolicited recommendations on how to mitigate attempted acts of terrorism received by FAA. These recommendations came from private enterprises, universities, other government agencies, private consultants, citizens and elements within FAA. The Ad Hoc Security Subcommittee was comprised of the REDAC Security Subcommittee members, Chairs of the other REDAC subcommittees, four Aviation Security Advisory Committee (ASAC) members, and selected DOD, Aviation Consumer Action Project and Boeing representatives. On November 20, 2001 the Administrator received an interim report from the Security Subcommittee. The Research, Engineering and Development Advisory Committee provided the final report on February 4, 2002.

Recommendation 1: Implement Test Bed Pilots

Implement test beds in two airports to demonstrate new technologies in checkpoint, checked baggage and cargo screening, access control of employees (including biometrics), perimeter intrusion, and surveillance. Integrate security systems through the implementation of centralization of command control, communication, and intelligence.

Airports must be viewed as a system. We recommend the implementation of pilot programs in two airports, one smaller (i.e. Milwaukee, WI with 6 million passengers per year) and one larger, using operations research and test bed demonstrations. This will support the rapid deployment of existing systems for screening baggage and passengers for concealed explosives and lead to the effective use of these systems. Technical and operational solutions to all security challenges should be airport tested in locations where the penalty of a mistake (airport shutdown) is minimum, i.e., start small where failure is not catastrophic. The level of protection against the breadth of threats needs to be bought up uniformly. Security operations within airports need to be integrated. Procedures and technology need to be in place to prevent, deter, or mitigate violent attacks using conventional weapons or explosives. Passenger facilitation must be part of the security solution or we will be accomplishing the terrorist's goals of paralyzing commercial aviation, and ultimately, the U.S. economy.

Technology Recommendations

Near Term (1-2 years):

We recommend applying existing technology, using either commercially available products or products near fruition with newly developed procedures and processes addressing aviation security applications. Including:

- Positively track baggage, cargo, and cabin supplies from logistics entry point to
- aircraft;
- Positively control access to the sterile areas of airport;
- Rapidly inspect all baggage for large explosive devices and dispersal mechanisms using procedures and technology;
- Test frequent flyer positive identification process and procedures;
- Verify the operational suitability of using technologies, such as biometrics and smart cards, in a Passenger Travel Identity Card; and
- Deploy anomaly detection/passenger imaging systems (x-ray or mm wave backscatter).

Recommendation 2: Enhanced Explosives Detection R&D

Perform R&D and support new detection technology development and processes that will result in efficient and effective screening in a reasonable time.

We recommend that R&D be accelerated to address the pressing need to render 100 percent screening of checked and carry on bags, and persons for weapons and explosives. There are existing technologies that can be applied to this problem, understanding that continued improvements of explosive detection and personnel screening technology need to occur.

Technology Recommendations

Near Term:

- Consider the use of combined technology to meet detection and false alarm requirements of the Explosives Detection System (EDS) certification standard.
- Consider advanced technology for screening of people such as imaging-backscatter/x-ray and trace detection portals.

Mid Term:

Consider EDS for carry on, cargo, and mail.

Long Term (5 years):

- Develop technology for rapid inspection of all baggage and cargo for all threats.
- Develop technology for rapid inspection of all concession supplies for weapons and threat sized explosive devices.

Recommendation 3: Smart Credentials

Voluntary prescreening of trusted passengers through smart credentials. Beginning with a control pilot program, verify the operational suitability of using technologies, such as biometrics and smart cards in a Passenger Travel Identity Card. Demonstrate the use of the various models of biometrics technology for employees and passengers.

Current passenger prescreening does not assess the true identity of the passenger nor does it identify passengers who are a potential risk or threat based on historical patterns or known identification inconsistencies. Information and technology are required to assess the true identity and flag those who pose a potential risk or threat to passenger safety and security. Passengers can be identified as trusted, unknown, or name list identified. Security enhancement measures must include the following actions:

- Establish a nationwide program of voluntary prescreening of passengers, together with the issuance of "smart" credentials to trusted passengers. This will facilitate expedited processing of the vast majority of air travelers and enable security professionals to focus their resources more efficiently;
- Share relevant law enforcement and intelligence information on a continuing basis with those responsible for aviation security; and
- Deploy new technology to augment the aviation security program and ensure adequate protection for air travelers, addressing two basic categories of requirements:
  - Establishment of Identity: A Passenger Travel Identity Card could facilitate the basis in establishing identity. The passenger would apply for an Identity Card on a voluntary basis and would be subject to some form of background check as the first layer of scrutiny.
  - Determination of Trust/Risk: The passenger prescreening system is presently not linked to law enforcement or other federal agency databases, and security data is not shared between airlines when a person is transferring to/from another airline. A data interchange between federal agencies and airlines needs to be defined to share data in usable formats in a secured, timely manner.

Technology Recommendations

Near/Mid Term:

Search and Integration of Databases

There are a number of commercially available computer programs that are designed to rapidly search various databases to verify and authenticate a person's identity. Once identity is determined (based on pre-determined data elements), the databases could be used to perform a background check and establish trustworthiness of that individual. Once identity and trust have been established, the individual would be approved for a Passenger Travel Identity Card. The card could be used within the check-in system and would, in effect, serve as evidence of prescreening for the vast majority of airline passengers, allowing security resources to be concentrated on the remaining population of travelers.

Biometrics

Unique characteristics (fingerprint, retinal or iris scan, etc.) can be stored in the encrypted file on the Passenger Travel Identity Card. The card would be used for re-authentication of identity at check-in. The card could be used within the check-in system and would, in effect, serve as evidence.

Long Term: Expand Computer Assisted Passenger Prescreening System

Current passenger prescreening is not designed to identify passengers who are a potential risk or threat based on historical patterns or known identification inconsistencies. The passenger prescreening system is presently not linked to law enforcement or other federal agency databases, and security data is not shared between airlines when a person is transferring to/from another airline. A data interchange between federal agencies and airlines needs to be defined to share data in usable formats in a secured timely manner.

Computer Assisted Passenger Prescreening could be modified to expand the criteria (i.e., add Intel criteria, travel patterns, passport data) and application uses (scenarios for flights into or out of specific cities; i.e., DCA) to identify automatically individuals, groups,

flights, and situations that necessitate extraordinary security scrutiny.

Recommendation 4: Aircraft Hardening

Incorporate aircraft hardening technologies (door and cabin) into commercial aircraft.

The primary emphasis should be on hardening cockpit doors and bulkheads. If the flight crew can be protected from hijackers getting access to the cockpit, the crew is in the best positioned to prevent the aircraft from being used as a weapon of mass destruction. A second priority is cabin monitoring and duress alarm. However, any technology that could potentially compromise safety is unacceptable.

Technology Recommendations

Near/Mid Term:

- Aircraft Hardening:
  - Cockpit Doors and Bulkheads

The bulkhead and door must be hardened to: 1) prevent forced access; 2) be bullet resistant; and 3) withstand hand grenade attack. Reinforcing materials are available that would accomplish this, and allow the pilots to see into the cabin without being seen, and even to shoot through while being bullet resistant on the cabin side. The area around the flight deck door must be protected in flight to allow crew transit. The flight deck and flight instruments need to be protected from electronic attack (both radio frequency and electromagnetic pulse) and laser attack.

- Aircraft Cabin

The aircraft cabin must be hardened to protect against explosive devices and their concealment. This includes designing a specific location for the placement of an explosive device discovered in flight. A hazardous material containment system must be developed for in flight use in the cabin.

- Search and Sealing Technology:

Capable people should perform aircraft searches. After cleared, the aircraft should be sealed using technology ranging from tamper proof tape to some mechanical locking device. A monitored intrusion alarm system would be a valuable addition to protecting a parked, unattended aircraft.

- Cabin Monitoring and Duress:

A duress-signaling device in the cabin to signal the cockpit in the event of a situation would be connected to remote cameras set up to monitor the cabin. Visual alert data could be communicated to the ground via cell phone technology or a form of satellite communication for over-water flights.

  - Flight deviation alert to aid controllers to detect potential hijacking situations may be helpful, but needs to be considered in a broader systems context of how such information would be used to intervene.
  - Taking the control of the aircraft from the pilot using automated systems is not a technically feasible or politically acceptable option at this time.

Recommendation 5: Improve Screener Performance

Accelerate R&D to enhance the tools for selection, training, and performance monitoring of screeners. Focus areas are: improved employee selection tests; advancing the implementation of Threat Image Projection (TIP); and the development of a quality management process.

The job description of airport screeners must grow to allow them to assume a greater role in the security process. Screeners are our smartest security sensor and must be offered the tools, the education, and the empowerment to perform fully their important job. We recommend the following initiatives:

- Enhance training and performance monitoring of screeners;
- Improve employee selection tests;
- Improve evaluation and performance measurers;
- Review operational procedures for human factors issues;
- Continue and advance the implementation of TIP; and
- Develop quality management process.

Additionally, we recommend background checks of all airport or airline employees and any individuals that have unescorted access to the secure areas.

Recommendation 6: Database Integration

Integrate the airport air carrier passenger database with watch list information from other government agencies. Develop the capability to track security information from curbside check-in to final gate processing.

Technology Recommendations (Near, Mid Term)

There are a number of commercially available computer programs that are designed to rapidly search various databases to verify and authenticate a passenger's identity. Once identity is determined (based on pre-determined data elements), the databases could be used to perform a background check and establish trustworthiness of that individual. Additionally, information concerning the status of the security screens of the passenger and his/her luggage throughout the various screening stages at the airport must be coordinated, tracked, and be available to share with other, connecting airports/airlines.

Recommendation 7: Employee Access Control

Using a systems approach, incorporate technologies in access control systems, including the use of biometrics, piggyback detection, and breach control.

An integrated approach using both positive identification technologies in conjunction with access control and perimeter monitoring should be used to enforce authorized entry into the sterile environment of the airport. The challenge of an insider attack will increase as other terrorist access points are closed down.

Technology Recommendations

- Use biometrics to identify authorized airport personnel;
- Tighten control access to and all movement within the airport perimeter;
- Enhanced control, oversight, and inspection of airport ramp and catering activities; and
- Establish procedures and access control barriers/turn-stiles to deny armed personnel from forced entry beyond the hand-carry/magnetometer check points at boarding areas and at airfreight terminal.

Recommendation 8: Airport Public Area Protection

Develop procedures and evaluate and deploy as appropriate current screening technologies for truck/van/car bombs.

We recommend: the establishment of procedures, access control, and inspections to deny large explosive devices from entering the terminal; the establishment of procedures, access control, and inspections to deny car/truck bombs from approaching the terminal; an increase in security and oversight of airport ramp and catering activities, and the establishment of surveillance areas along approach and take-off paths to secure the limited areas where ground-to-air attack is probable.

Technology Recommendations

Near Term:

- Positive personnel control/turn-stiles for entry and departure from sanitized departure/arrival areas of the airport.
- Procedures to evaluate traffic and deny car/truck bomb approach to terminal.

Long Term:

- Reconfigure airport access and terminal layouts for mitigation against truck/van/car bombs.
- Surveillance areas along approach and take-off paths to secure the limited areas where ground-to-air attack is probable.

Recommendation 9: Chem Bio Threat Technologies

Develop and/or deploy screening kits, equipment, and procedures to determine the presence or absence of chemical and/or biological warfare agents, such as anthrax, small pox, sarin, etc.

Technology Recommendations

Near Term:

- Place chemical/bio detection equipment/kits and inspection at the checkpoint.
- Develop procedures to deal with in flight release of chemical or biological agents to minimize the impact on those onboard and spread of the contamination post flights.

Long Term:

Currently no technology exists to do pre-release chemical/biological detection. Post-release detection technology is currently not fast enough to be effective in the aircraft environment. This is an important area for national long-term research.

Recommendation 10: Enhanced Cargo Screening

We recommend that more security measures be applied to inspection of cargo.

Technology Recommendations

Short Term:

- Cargo Prescreening:

We recommend a fully automated prescreening system (similar to passenger prescreening) for cargo. This system can translate complex data from shipper airway bills into plain English. This system goes far beyond the current known shipper classification. An automated cargo prescreening system could consider hazardous material shipper data, indirect air carrier data, origin/ destination of shipment, flight specific instructions, and other industry information in weighted risk factors. Furthermore, there would be the opportunity to evaluate shipper data against government inter-agency watch-lists.

- Positive tracking and control of cargo and cabin supplies from entry point to aircraft.

Mid/Long Term:

Rapid inspection of all cargo for large explosive devices or other threats.

Recommendation 11: **Develop a redesign of the screening checkpoint as an integrated processed engineered function incorporating features to deal with overt attempts to breach security.**

Technology Recommendations:

Near/Mid Term:

- Deploy passenger imaging (x-ray backscatter or millimeter wave system) portals trace portals to look for concealed weapons or explosives on personnel;
- Increase surveillance of areas near and around the screening checkpoint;
- Establish access control barriers to prevent and contain any overt attempt by armed individuals to force a penetration of the secure area;
- Positively track all carry-on baggage, checked baggage and passengers from check-in to aircraft;
- Develop differential approach (different lanes) appropriate to the level of security screening used at checkpoint based upon the risk posed by the passenger. (Various lanes at checkpoints depending of the security risk of the passenger.);
- Use systems approach to fit the pieces (technology and procedures) together;
- Positively control access to all secure areas of the airport;
- Rapidly inspect all carry-on baggage for explosive devices and dispersal mechanism.

Long Term:

- Checkpoint redesign to integrate into airport and prevent bolters.
- Rapid inspection of all concession supplies for weapons and threat sized explosive devices.

Recommendation 12: **Update, expand and refine threat analysis capability and modeling of threat mitigation measures.**

Although a scant number of proposals were offered in this area, we feel that terrorists have displayed a steep learning curve of how to defeat our security. We must continue to identify terrorist threats and potential vulnerabilities in aviation security and dynamically respond to eliminate these vulnerabilities. We recommend:

- Base further security improvements on results of threat analysis and modeling of response capability;
- Develop countermeasures against cyber attack;
- Model response to hypothetical "out-of-the box" threats and tune system to meet possible threats;
- Use computer modeling to predict success of various threats;
- Develop design parameters of future airport layouts designed to offer an optimal combination of mitigation and cost effectiveness; and
- Consider protecting aircraft against electromagnetic pulse and surface to air missiles during take-off and landing.

FAA RESPONSE TO SECURITY RECOMMENDATIONS

I would like to express my gratitude to you and the members of the Federal Aviation Administration's (FAA) Research, Engineering and Development Advisory Committee (REDAC) Security Subcommittee for the evaluation of over a thousand recommendations submitted to the FAA in response to the tragedy of September 11, 2001. Your team's superior volunteer effort is particularly commendable since this extremely important task was accomplished in a 1-month period. The unique expertise of the members of the subcommittee was invaluable in producing a report that the FAA and the new Transportation Security Administration (TSA) is using as a tool to focus counter-terrorism research and development (R&D) efforts.

We have already implemented a number of your recommendations in order to enhance security at airports. Specifically:

- We have hardened cockpit doors.
- We have implemented a test bed at Baltimore Washington International (BWI) airport to demonstrate new technologies and processes for the checkpoint, checked baggage, and cargo screening.
- We have initiated a 20 airport pilot program to demonstrate state of the art access control technologies, such as biometrics and smart cards.
- We have taken steps to implement 100 percent screening of checked luggage by the end of 2002 using a combination of explosive detection systems (EDS), trace detection, as well as other procedures and technology.
- We have initiated an aggressive program to hire screeners using better tools for selection, training, and performance monitoring.

The aviation security R&D function is in the process of being transitioned to the TSA. The TSA is working to address some of your other recommendations, with the emphasis on efficient long term solutions that will produce not only efficient aviation security, but will enhance the security of all modes of transportation.

Thank you again for convening this special subcommittee session to address this urgent national need.

Committee's Recommendations on FY 2004 Budget (dated February 4, 2002)

At the October 30-31, 2001 meeting, the Committee reviewed FAA's Planned Research and Development Investments for Fiscal Year 2004 and provided recommendations in a letter dated February 4, 2002 from Committee Chair, Dr. Deborah Boehm-Davis. The Committee received a formal response on April 23, 2002.

Recommendation 1 - Request that the Associate Administrators meet with the REDAC Committee to describe how they see the research and development process fitting into their operations and to outline their strategic plan for incorporating R&D into their programs.

Response – The Associates have been invited to the April REDAC to address the role of R&D in accomplishing their mission.

Recommendation 2 - Recommend that the FAA develop a fully competent and expertly staffed organization to absorb and use the results of National Aeronautics and Space Administration's (NASA) R&D.

Response – The Free Flight Office was established to implement new technologies needed to improve National Airspace System (NAS) efficiency, including appropriate technologies developed by NASA that are ready for deployment. As you know, FAA is reorganizing to integrate the acquisition, deployment, and operations functions into one air traffic service organization. The issue you raised about technology transition into operational systems is one of several being considered in structuring the new organization.

Recommendation 3 - Recommend the FAA strengthen its participation in international bodies such as the International Civil Aviation Organization (ICAO) and leadership in the world aviation arena.

Response - We agree that it is vital that FAA participate in international organizations, and ICAO in particular, to ensure that there is a solid and agreed set of international standards for what is truly a global industry. FAA would be pleased to present an overview of our many international activities to the REDAC at your convenience. The following are a sample of such efforts:

- The United States, through FAA, has been very aggressive in promoting an effective international approach on the noise issue. By reinvigorating its own efforts to work within ICAO on noise standards and issues, the FAA brought the European States back into the fold. The FAA worked hard to ensure that ICAO was responsive to the needs of all of its members on aircraft noise concerns. We have another challenge emerging within that forum on engine emissions, as the Europeans appear once again to be leaning to act outside of ICAO.
- The FAA is the United States Meteorological Authority to ICAO and we establish United States requirements for aviation weather. We also participate in ICAO study groups such as the World Area Forecast System, METLINK, and Volcanic Ash.
- With the construction of the National Pavement Test Facility, the FAA is clearly leading the way in international research on airport pavement. This will result in improved pavement design procedures that will be

incorporated into ICAO documents and have the potential for significantly reducing the cost of airport pavement.

- The FAA is an active member on panels and working groups in ICAO and RTCA. We are actively engaged in the ICAO Air Traffic Management Concept Panel to ensure that the global concept for the year 2025 reflects the United States' view on modernization.
- We strongly support international R&D efforts and maintain a strong communication link via the FAA/Eurocontrol R&D Committee. The FAA is actively involved in several R&D Action Plans with the European community through the FAA/Eurocontrol Memorandum of Understanding. Our activities relate directly to overarching operational concepts for use in emerging technologies such as automatic dependent surveillance-broadcast (ADS-B) and cockpit display of traffic information (CDTI), and the evolution of enabling technologies such as automation, communications, navigation and surveillance. These activities are used by both the United States and Europe to clarify our concepts, and develop our architectures. The NAS Architecture includes operational improvements through 2015 identified in conjunction with the user community and includes efforts conducted via the R&D Action Plans. Additionally, each year the FAA and Eurocontrol do a mapping between their individual architectural evolution steps to support concept and R&D comparisons.
- Although there are no formal cooperative initiatives with the European Commission, the FAA and the Commission have been working informally together through either Eurocontrol or as observers on projects of mutual interest.

Recommendation 4 - The FAA Administrator should recognize and champion NASA's research directed towards achieving major capacity and safety gains through a more fully automated air traffic management (ATM) system.

Response - The FAA recognizes that NASA, based on its technical capabilities and facilities, plays essential roles in addressing many of the complex challenges of ATM. One important role is to investigate future ATM concepts, including various levels of automation for both capacity and safety improvements. FAA has been working closely with NASA in formulating the AvSTAR program and senior management has supported NASA's budget request to OMB and Congress. Although we support the role of NASA investigating a wide range of concepts, it would be inappropriate for FAA to champion automated ATM concepts unless or until such concepts are sufficiently researched and validated to provide needed capacity and safety improvements.

FAA has not had the resources to fully participate in the technical effort with NASA that we feel are necessary to help guide long-term R&D.

Recommendation 5 - Recommended a study to evaluate the effectiveness of current research in aircraft noise and emissions reduction technologies.

Response – We believe such studies have been done for aircraft noise. The FAA and NASA have an existing process in place for noise reduction technology research. Since 1992, we have jointly submitted annual reports to Congress on the progress being made under the FAA-NASA Subsonic Noise Reduction Technology Program. We fund and jointly conduct an aircraft noise reduction program, the goal of which is to develop technologies for subsonic jet aircraft to operate at reduced noise levels. The program is an element of the larger Advanced Subsonic Technology Program, which concluded as planned in FY 2001. NASA is analyzing other classes of aircraft and the results will be made available in a subsequent NASA Technical Report titled, "Evaluation of the Advanced Subsonic Technology Program Noise Reduction Benefits." NASA's Quiet Aircraft Technology Program, initiated in FY 2001, will address additional research requirements.

There is currently no equivalent evaluating process in place regarding emissions reduction technology. The current research in aircraft emissions reduction technologies is largely dependent upon the engine manufacturer's ability to progress those technologies beyond the readiness levels that are provided from national research programs. Technologies that aim to reduce fuel burn in addition to reducing emissions may prove to be in greater demand by the air carriers. Proprietary data issues and industry competitiveness can make it difficult to perform a comprehensive evaluation of the effectiveness of current research, especially given that most technologies emanating from research programs are at a low technology readiness level. We will discuss with NASA how we might put in place a

process to evaluate the effectiveness of emissions reduction technology research application.

Recommendation 6 - Urge continued support for the wake vortex program without a loss of funding for the weather research program.

Response – With the funds appropriated in FY02 for wake turbulence research, FAA has established an R&D program to address near-term and, with NASA, long-term wake turbulence issues. The Congressionally directed funds for wake turbulence in FY02 did reduce the weather research program by about 10% from FY01. FAA intends to request continued funding for wake turbulence as well as a strong weather research program. Clearly, if wake turbulence is fully funded it would impact the planned growth in the weather program. Weather is a major safety and efficiency factor and FAA recognizes the need for a substantial increase in R&D.

With respect to the Committee's comments about the performance-based organization, FAA will be addressing the areas you identified as opportunities arise. The primary focus of the planning thus far has been on providing air traffic services as directed by Congress. We will take this opportunity to consider other changes to make FAA more effective, including how R&D is managed. We have just started to address those aspects and will report back to the REDAC as soon as we complete the process.

Clearly the Nation must improve aviation security and increase the investment in R&D. FAA shares your concern that any increased security R&D investment should not be at the expense of other necessary aviation research. Now that the Transportation Security Administration is responsible for security R&D, their budget is separate from FAA starting in FY03. The FAA FY03 R,E&D request reflects that position, does not include security R&D, and maintains about the same level of investment in the non-security areas.

APPENDIX B

ALPHABETICAL LISTING OF NATIONAL AVIATION RESEARCH PLAN BUDGET LINE ITEMS

Budget Program	Item Number	Page
Safe Flight 21 – Ohio River Valley	F&E-1B01xx	2.2-50
Safer Skies	F&E-1C01xx	2.1-29
Separation Standards	F&E-1C01A0	2.2-16
Software Engineering R&D	F&E-1C01E0	2.2-30
System Planning and Resource Management	A14a	2.4-3
Weather Program - Safety	A11k	2.1-8
William J. Hughes Technical Center Laboratory Facility	A14b	2.4-7

APPENDIX C

NUMERICAL LISTING OF NATIONAL AVIATION RESEARCH PLAN PROJECTS

Project Number	Budget Program	Budget Item
98820855--	General Aviation and Vertical Flight Technology (GA&VF)	F&E-1C01J0
98750855--	Software Engineering	F&E-1C01E0
98750847--	Free Fight – Phase 2	F&E-2A03
98750129--	Safer Skies	F&E-1C01L0
98610855--	Operations Concept Validation	F&E-1C01D0
98610112--	Center for Advanced Aviation System Development (CAASD)	F&E-1C01xx
97200855--	Airspace Management Laboratory	F&E-1C01H0
67100903--	Safe Flight 21 – Ohio River Valley	F&E-1B01xx
45540855--	Runway Incursion Reduction	F&E-1C01B0
40160289--	NAS Requirements Development	F&E-1C01I0
26620866--	Domestic Reduced Vertical Separation Minima (DRVSM)	F&E-1C01K0
26610855--	Separation Standards	F&E-1C01A0
26600855--	Aviation System Capacity Improvement (ASCI)	F&E-1C01C0
11280101--	Safe Flight 21 – Alaska Capstone	F&E-1B01xx
TBD	Commercial Space Transportation Safety	OPS
TBD	Cyber Security for NAS Development	F&E-1C01xx
TBD	NAS Safety Assessments	F&E-1C01xx
TBD	Required Navigation Performance	F&E-1C01xx
091-110/115	Aviation Noise Analysis	A13a
086-110	Aeromedical Research	A11j
082-110	Air Traffic Control/Airway Facilities Human Factors	A11i
081-110	Flight Deck/Maintenance/System Integration Human Factors	A11g
066-110	Aircraft Catastrophic Failure Prevention Research	A11f
065-110	Aging Aircraft	A11e
064-110/111	Flight Safety/Atmospheric Hazards Research	A11d
063-110	Propulsion and Fuel Systems	A11b
062-110/111	Advanced Materials/Structural Safety	A11c
061-110	Fire Research and Safety	A11a
060-110	Aviation Safety Risk Analysis	A11h

Project Number	Budget Program	Budget Item
041-110	Weather Program - Safety	A11k
011-160	Center for Advanced Aviation System Development	F&E-5A29
011-140	William J. Hughes Technical Center Laboratory Facility	A14b
011-130	System Planning and Resource Management	A14a
98840855--	Airports Technology – Efficiency	AIP
98840855--	Airports Technology – Safety	AIP

Note: The final two digits of project numbers for the F&E –1C01 line item correspond to the Fiscal Year.

APPENDIX D

ACRONYMS AND ABBREVIATIONS

The Following high-frequency or generally well-known acronyms may appear in the text of this plan without statement of their full equivalents.

AC	Advisory Circular
ARA	Office of the Associate Administrator for Research and Acquisitions
ATC	Air Traffic Control
ATM	Air Traffic Management
ATS	Air Traffic Services
CONOPS	Concept of Operations
DOD	Department of Defense
DOE	Department of Energy
DOT	Department of Transportation
EPA	Environmental Protection Agency
F&E	Facilities and Equipment
FAA	Federal Aviation Administration
GAO	General Accounting Office
NAS	National Airspace System
NASA	National Aeronautics and Space Administration
NTSB	National Transportation Safety Board
OMB	Office of Management and Budget
R&D	Research and Development
R,E&D	Research, Engineering and Development
REDAC	Research, Engineering and Development Advisory Committee
TRACON	Terminal Radar Approach Control

The Following will generally appear with their full equivalents stated in its first occurrence in each major section of this plan or each program description.

A	
AACE	FAA Center of Excellence for Airworthiness Assurance
AANC	Airworthiness Assurance Nondestructive Inspection Validation Center
AAR	FAA Office of Aviation Research
AASF	Alaska Aviation Safety Foundation
AAWG	Airworthiness Assurance Working Group
ACE	Aviation Capacity Enhancement
ACI-NA	Airports Council International – North America
ACM	Airborne Conflict Management
ACO	Aircraft Certification Office
ACRT	Aviation Communications Research and Technology
ADDS	Aviation Digital Data Service
ADS	Automatic Dependent Surveillance
ADSA	ARA Development System Assurance
ADS-B	Automatic Dependent Surveillance-Broadcast
AF	Airway Facilities
AFCB	Arc Fault Circuit Breakers
AFFF	Aqueous Film Forming Foam
AFRL	Air Force Research Laboratory
AFS	FAA Flight Standards Services
AFSS	Automated Flight Service Station
AFSS	Air Force System Specialist
AGATE	NASA Advanced GA Transport Experiments
AHS	American Helicopter Society
AIA	Aerospace Industries Association
AIA-TC	Aerospace Industries Association Transport Committee
AIM	Aeronautical Information Manuals
AIP	Airport Improvement Program
AIR	Aerospace Information Report
ALPA	Airline Pilots Association
AMS	Acquisition Management System
AND	FAA Office of Communications, Navigation, and Surveillance Systems
AOP	FAA NAS Operations Program
AOPA	Aircraft Owners and Pilots Association

AOZ	FAA Free Flight Program Office
APARMO	Asia/Pacific Approvals Registry and Monitoring Organization
APB	WAAS Acquisition Program Baseline
APEC	Asia Pacific Economic Cooperation
APL	Airport Pseudolite Signal
APMS	Aviation Performance Measuring System
APU	Auxiliary Power Unit
AQP	Advanced Qualification Program
ARAC	Aviation Rulemaking Advisory Committee
ARFF	Aircraft Rescue Fire Fighting
ARQ	FAA Air Traffic Research and Requirements Directorate
ARS	FAA Aerospace Weather Policy and Standards Staff
ARS	FAA Air Traffic Requirements Service
ART	Air Route Traffic
ARTCC	Air Route Traffic Control Center
ASA	Airborne Separation Assurance
ASC	Aviation System Capacity Improvements
ASC	FAA Office of System Capacity
ASCI	Aviation System Capacity Improvement
ASD	FAA Office of System Architecture and Investment Analysis
ASDE-X	Airport Surface Detection Equipment - Model X
ASHRAE	American Society of Heating, Refrigeration, and Air Conditioning Engineers
ASRA	Aviation Safety Risk Analysis
ASSAP	Airborne Surveillance and Separation Assurance Processing
AST	FAA Commercial Space Transportation
ASTAC	Aero Space Transportation Advisory Committee
ASTM	American Society for Testing and Materials
AT	Air Traffic
ATA	Air Transportation Association
ATA	FAA Air Traffic Airspace Management Program Office
ATC	Air Traffic Control
ATCA	Air Traffic Control Association
ATCP	Air Traffic Conflict Probe
ATCS	Air Traffic Control Specialist
ATDET	Air Traffic DSR Evolution Team
ATIDS	Airport Target Identification System
ATO	Air Traffic Organization
ATP	FAA Air Traffic Planning and Procedures

ATS	FAA Air Traffic Service
ATS	Along Track Separation
AT-SAT	Air Traffic Selection and Training
ATSOIT	Air Traffic Satellite Operational Implementation Team
ATSRAC	Aging Transport Systems Rulemaking Advisory Committee
ATT	FAA Air Traffic Tactical Operations
AUA	FAA Office of Air Traffic Systems Development
AVR	FAA Office of the Associate Administrator for Regulation and Certification
AWOS	Automated Weather Observation Systems
AWP	FAA Western Pacific Region
AWT	Area Work Teams
B	
BAA	Broad Agency Announcement
BITE	Built-in Test Equipment
C	
C&V	National Ceiling and Visibility
CAA	Cargo Airline Association
CAA	(British) Civil Aviation Administration
CAA	Civil Aviation Authority
CAASD	Center for Advanced Aviation System Development
CAEP	Committee on Aviation Environmental Protection
CAMI	Civil Aerospace Medical Institute
CAR/SAM	Caribbean and South American Region
CASR	Center for Aviation Systems Reliability
CASS	Continuing Analysis and Surveillance
CAST	Commercial Aviation Safety Team
CAST	Certification Authorities Software Team
CC	"Common Criteria"
CDM	Collaborative Decision Making
CDTI	Cockpit Display of Traffic Information
CERT-CC	Computer Emergency Response Team – Coordinating Center
CFC	Chlorofluorocarbon
CFIT	Controlled-Flight-into-Terrain
CHI	Computer-Human Interface
CIA	Central Intelligence Agency
CIP	Capital Investment Plan
CIWS	Corridor Integrated Weather System
CNS	Communications, Navigation and Surveillance

CNS/ATM	Communications, Navigation, Surveillance/Air Traffic management
COCOTS	Constructive COTS Cost Estimation Model
CODAS	Consolidated Operations and Delay Analysis System
COE	Centers of Excellence
COMSTAC	Commercial Space Transportation Advisory Committee
CONUS	Continental United States
COO	Chief Operating Officer
COTS	Commercial-off-the-Shelf
COTS/NDI	Commercial Off-The-Shelf/Non-developmental Item
CPDLC	Controller Pilot Data Link Communications
CRC	Coordinating Research Council
CRDA	Cooperative Research Development Agreement
CRM	Crew Resource Management
CSA	Comparative Safety Assessment
CSIRC	Computer Security Incident Response Capability
CST	Commercial Space Transportation
CST IPT	Commercial Space Transportation Integrated Product Team
CSTB	Caribbean and South American Region Test Bed
CTAS	Center TRACON Automation System
D	
D-2	Direct-to
DPAT	Detailed Policy Assessment Tool
DRVSM	Domestic Reduced Vertical Separation Minima
DSR	Display System Replacement
DSS	Decision Support System
E	
EAA	Experimental Aircraft Association
EATMS	European Air Traffic Management System
EDMS	Emissions and Dispersion Modeling System
EEHWG	Electromagnetic Effects Harmonization Working Group
EGNOS	European Geostationary Navigation Overlay Service
EMI/EMC	Electro Magnetic Interference/Electro Magnetic Compatibility
EMS	Emergency Medical Service
ERAM	En Route Automation Modernization
ETC	Engine Titanium Consortium
ETMS	Enhanced Traffic Management System
EUROCAE	European Organization for Civil Aviation Equipment

F	
FAR	Federal Air Regulations
FAST	Final Approach Spacing Tool
FASTER	Full-Scale Aircraft Structural Test Evaluation and Research
FDM	Flight Data Management
FFRDC	Federally Funded Research and Development Center
FICAN	Federal Interagency Committee on Aviation Noise
FIS-B	Flight Information Services-Broadcast
FL	Flight Level
FMECA	Failure Modes, Effects, and Criticality Analysis
FMS	Flight Management System
FOQA	Flight Operations Quality Assurance
FTD	Flight Training Device
FTHWG	ARAC Flight Test Harmonization Working Group
FY	Fiscal Year
G	
GA	General Aviation
GA&VF	General Aviation and Vertical Flight Technology
GAMA	General Aviation Manufacturing Association
GBI	Ground-Based Inerting
GBT	Ground-Based Transceiver
GIP	Government Industry Partnerships
GNSS	Global Navigation Satellite System
GPRA	Government Performance and Results Act
GPS	Global Positioning System
GREPECAS	Gulf of Mexico Workgroup and the ICAO CAR/SAM Regional Planning and Implementation Group
GSE	Ground Support Equipment
H	
HAI	Helicopter Association International
HFACS	Human Factors Analysis and Classification System
HFDG	Human Factors Design Guide
HFDS	Human Factors Design Standard
HIRF	High Intensity Radiated Fields
HQ	NASA Headquarters
HSI	Human-System Interface
HUMS	Health, Usage and Monitoring Systems
HVAC	Heating, Cooling, Ventilation, Air Conditioning, Refrigeration

I	
I2F	Integration Interoperability Facility
IA	Investment Analysis
IA	Information Assurance
IAIMT	Interagency Integrated Management Team
IAIPT	Inter-Agency Air Traffic Management Integrated Product Team
IATA	International Air Transport Association
ICAO	International Civil Aviation Organization
ID	Intrusion Detection
IDM	Integrated Design and Manufacturing
IFR	Instrument Flight Rules
IGEB	Interagency GPS Executive Board
IHA	Initial Hazard Analysis
IIDA	Integrated Icing Diagnosis Algorithm
IIFA	Integrated Icing Forecast Algorithm
IIP	Instantaneous Impact Point
IIV	Interior Intervention Vehicle
IMC	Instrument Meteorological Conditions
ILS	Instrument Landing System
IMT	Integrity Monitoring Test Bed
INM	Integrated Noise Model
IPHWG	ARAC Ice Protection Harmonization Working Group
IPT	Integrated Product Team
ISS	Information Systems Security
ISSA	Information Systems Security Architecture
IT	Information Technology
ITWS	Integrated Terminal Weather System
IWG	Technical Interoperability Working Group
J	
JAA	Joint Aviation Authorities
JRC	Joint Resource Council
JSATS	Joint Safety Analysis Teams
JSIT	Joint Safety Implementation Teams
JSC	NASA Johnson Space Center
K	
KSC	NASA Kennedy Space Center
L	
LAAS	Local Area Augmentation Systems

LED	Light-Emitting Diode
LEDFAA	Layered Elastic Design
LFL	Lower Flammability Limit
LNAV/VNAV	Lateral Navigation/Vertical Navigation
LOSA	Line Operations Safety Audit
LTP	Local Area Augmentation System Test Prototype
M	
MA	Mission Analysis
MASPS	Minimum Aviation System Performance Standards
MCDC	Modified Condition Decision Coverage
MITLL	Massachusetts Institute of Technology Lincoln Laboratory
MMIR	Maintenance Malfunction Information Reporting
MOA	Memorandum of Agreement
MOPS	Minimum Operational Performance Standards
MOU	Memorandum of Understanding
MRM	Maintenance and Resource Management
MSAS	Japan MTST Satellite Based Augmentation System
MSFC	NASA Marshall Space Flight Center
MVA	Minimum Vectoring Altitude
N	
NAPTF	National Airport Pavement Test Facility
NARP	National Aviation Research Plan
NASAO	National Association of Aviation State Officials
NASE	NAS-wide adaptation services environment
NAWCAD	Naval Air Warfare Center Aircraft Division
NBAA	National Business Aircraft Association
NCEP	National Center for Environmental Protection
NDI	Non-Destructive Inspection
NDI	Non-Developmental Item
NDT	Nondestructive Testing
NEXRAD	Next-Generation Weather System
NEXTOR	National Center of Excellence in Aviation Operations Research
NHTSA	National Highway Traffic Safety Administration
NIAP	National Information Assurance Partnership
NICE	North Atlantic Implementation Management Group Cost Effectiveness
NIMS	NAS Infrastructure Management System
NIOSH	National Institute for Occupational Safety and Health
NISC	NAS Implementation Support Contract

NIST	National Institute of Standards and Technology
NLA	New Large Aircraft
NOAA	National Oceanic and Atmospheric Administration
NOTAM	Notice to Airmen
NPRM	Notice of Proposed Rulemaking
NRL	Naval Research Laboratory
NSA	National Security Agency
NSE	Navigation System Error
NSTB	National Satellite Test Bed
NSTC	National Science and Technology Council
NWS	National Weather System
O	
O&M	Operations and Maintenance
OBOAS	Onboard Oxygen Analysis System
OCP	Operational Concepts Plan
OE	Obstruction Evaluation
OEP	Operational Evolution Plan
OOT	Object Oriented Technology
OOTiA	Object Oriented Technology in Aviation
OSA	Operational Safety Assessments
P	
PAD	Program Area Description
PARR	Problem Analysis, Resolution and Ranking
PCFC	Pyrolysis Combustion Flow Calorimeter
PDARS	Performance Data Analysis and Recording System
PHA	Preliminary Hazard Assessment
PIREPS	Pilot Reports
PKI	Public Key Infrastructure
POD	Probability of Detection
POWER	Performance and Objective Workload Evaluation Research
PPIHWG	ARAC Powerplant Installation and Harmonization Working Group
PVFR	Precision VFR
Q	
QAT	Quiet Aircraft Technology
R	
R&T	Research and Technology
RAA	Regional Airline Association
REDAC	Research, Engineering and Development Advisory Committee

RF	Radius to Fix
RFID	Radio Frequency Identification System
RIRP	Runway Incursion Reduction Program
RITA	Rotorcraft Industry Technology Association
RLV	Reusable Launch Vehicle
RNAV	Area Navigation
RNP	Required Navigation Performance
ROC	Radar Operations Center
RPAT	RNP Parallel Approach Transition
RRLOE	Rapidly Reconfigurable Line-Oriented Evaluation
RTSA	Real-Time Scheduling Analysis
RTSP	Real-Time Streamlining Protocol
RTVS	Real Time Verification System
RUC	Rapid Update Cycle
RV	Reentry Vehicles
RVSM	Reduced Vertical Separation Minimum
RWSL	Runway Safety Lights
S	
SAAAR	Special Aircraft and Aircrew Required
SAE	Society of Automotive Engineers
SAGE	System For Assessing Aviation Global Emissions
SAMA	Small Aircraft Manufacturer's Association
SARPS	Standards and Recommended Practices
SAS	Subcommittee on Aircraft Safety
SASO	System Approach to Safety Oversight
SASP	Separation and Airspace Safety Panel
SATMS	Space and Air Traffic Management System
SATNAV	Satellite Navigation
SATORI	Systematic Air Traffic Operations Research Initiative
SATS	Small Aircraft Transportation System
SATWC	Space and Air Traffic Working Council
SBAS	Satellite Based Augmentation Systems
SBIR	Small Business Innovation Research
SCRAM	Statistical Attrition and Requirements Model
SDAT	Sector Design Analysis Tool
SEATB	Southeast Asia Test Bed
SEE	Single Event Effects
SEI	Software Engineering Institute

SERC	Software Engineering Resource Center
SFAR	Special Federal Aviation Regulation
SLD	Supercooled Large Droplets
SMA	Surface Movement Advisor
SMAAQ	Screening Model for Airport Air Quality
SMPC	Specialty Metals Processing Consortium
SMS	Surface Management System
SN&C	Satellite Navigation and Communications
SNI	Simultaneous Non-Interfering
SOIA	Simultaneous Offset Instrument Approach
SOIT	Satellite Operational Implementation Team
SOURDINE	Study of Optimisation procedURes for Decreasing the Impact of NoisE around airports
SPAS	Safety Performance Analysis System
SSAM	Spaceport Simulation and Assessment Model
SSH	Software Service History
SSID	Supplemental Structural Inspection Document
SSMP	NAS Modernization System Safety Program Plan
STAR	Standard Terminal Arrival
STARS	Standard Terminal Automation Replacement System
STATS	Safety Through Accurate Technical Statistics
SVM	Service Model Volume

T

TAOARC	Terminal Area Operations Aviation Rulemaking Committee
TARA	Terminal Area RNAV Application
TBD	To Be Determined
TCA	Transport Canada Aviation
TCAS	Traffic Alert and Collision Avoidance System
TCC	Transport Canada
TCCA	Transport Canada Civil Aviation
TCWF	Terminal Convective Weather Forecast
TDA	U.S. Trade Development Agency
TERPS	Vertical Flight Terminal Instrument Procedures
TMA(-MC)	Traffic Management Advisor (Multi-Center)
TFM	Traffic Flow Management
TIS-B	Traffic Information Service-Broadcast

TOGAA	Technical Oversight Group on Aging Aircraft
TSA	Transportation Security Administration
TSB	(Canadian) Transportation Safety Board
TSO	Technical Standard Orders
U	
UAT	Universal Access Transceiver
UEDDAM	Uncontained Engine Debris Damage Assessment Model
UPS	United Parcel Service
URET	User Request Evaluation Tool
USDA	United States Department of Agriculture
V	
VAMS	Virtual Airspace Modeling System
VCP	Volume Coverage Patterns
VDL	VHF Datalink
VF	Vertical Flight
VFR	Vertical Flight Rules
VLTA	Very Large Transport Aircraft
VMC	Visual Meteorological Conditions
VNTSC	Volpe National Transportation Systems Center
W	
WAAS	Wide Area Augmentation System
WATRS	West Atlantic Route System Separation Standards
WFD	Widespread Fatigue Damage
WG	Work Group
WJHTC	FAA William J. Hughes Technical Center
WRF	Weather Research and Forecast
WSDDM	Weather Support to Deicing Decision Making
WVSS	Water Vapor Sensing System
Y	
Y-K	Yukon-Kuskokwin Delta Region