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2002

Federal Aviation Administration
National Aviation Research Plan

U.S. Department of Transportation
Federal Aviation Administration

February 2002

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

1.0 Overview

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

Delivery of the 2002 *NARP* fulfills the annual reporting requirement placed upon the Federal Aviation Administration by Section 48102(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. In response to OMB guidance, current-year program descriptions and accompanying high-level schedules are grouped in the 2002 *NARP* according to FAA goals structure and R&D mission support needs. As in the past, each such grouping is preceded by a general program area description.

The five year planning cycle described in the 2002 *NARP* spans Fiscal Years 2003 through 2007. Current projections of costs and associated research activities for these years are provided throughout this document 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.

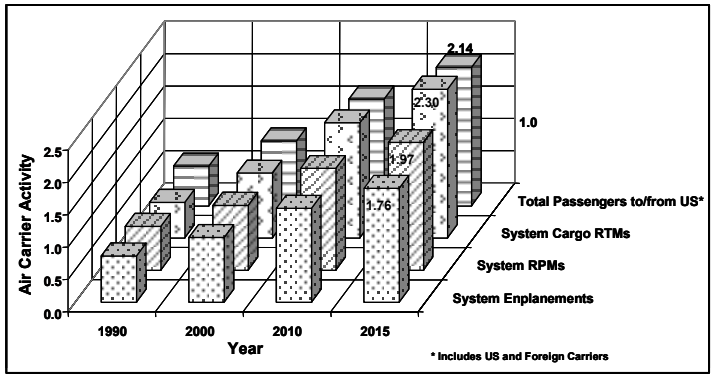

Figure 1-1: U.S. Domestic Air Carrier Activity, 1990-2015, Indexed to 1990

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 congressionally-mandated mission poses an ever-increasing challenge.

Aviation is a vital component of the nation's economy and its way of life. Recent terrorist events have publicly demonstrated how vital the National Airspace System (NAS) is to the strength of our economy and conduct of our daily lives.

The 2002 *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 required tools and systems to transport our citizens and visitors safely, securely, efficiently, and in a manner that respects and preserves our natural environment.

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. An estimated one in every twenty dollars in the U.S. Gross Domestic Product is generated by aviation and related industries, including the airlines, travel industries, food services, construction, and communications.

The current recession in the world economy has increased pressures upon U.S. domestic carriers to perform with increased efficiency and the terrorists attacks of September 11, 2001 have increased public concern for aviation safety. The FY 2003-2007 Capital Investment Plan advances the FAA's cautious estimate that it will take from 12 to 18 months before passenger demand returns to pre-September levels. The projections of near-future air traffic demands depicted in Figure 1-1, however, are based on relatively constant economic assumptions and should remain helpful for planning. Growth in commercial fleet size—as well as growth in general aviation, air cargo, and commercial space transportation activity—are expected to be associated with

increasing demands upon the NAS between now and 2015. More aircraft in the air implies more activity at the nation's airports. Figure 1-2 projects the growing demands that will be felt at the fifteen largest U.S. airports as the year 2015 approaches.

The high levels of terminal congestion, delays, and unpredictability experienced in recent years by the aviation system suggest a system that already is highly stressed and volatile. Time – and the continued ability of the NAS to safely and securely meet public demands for performance, cost, and service – will reveal whether commercial aviation forecasts prove correct.

Contradictions abound. The increasing effects of an international free-market environment mitigate against stricter regulatory practices at the same time as a public fearful of terrorism pressures the FAA to bear down in its regulatory role. Hopes placed in an emerging small regional jet fleet multiply as major aircraft manufacturers plan new or enlarged airliners capable of carrying more than 500 passengers. Uncertainty regarding future fuel costs seems unavoidable. No one solution or combination of solutions will solve all problems. Current and evolving research must identify affordable, dynamic, systemic solutions to reduce the complex causes of system stress.

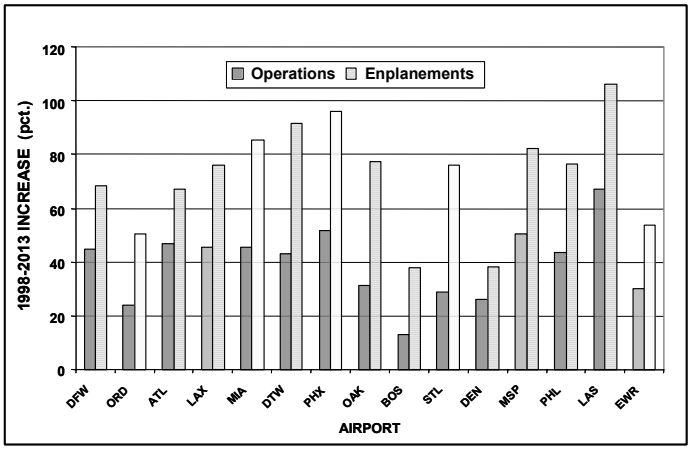

Figure 1-2. Projected Increase in Air Carrier Operations and Enplanements, 1998-2013, for the 15 Top Airports in terms of 1998 Operations.

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

Up to thirty members may hold two-year terms on the committee. 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 REDAC meets two times during the year, typically in April and in September.

NASA's Aero-Space Technology Advisory Committee and the REDAC now conduct joint meetings to establish a framework allowing them 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, both 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 charged with the coordination of all joint R&D efforts.

According to the 1998 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 advanced potential for long and short-term NAS improvement. The FAA's complementary R&D role is to prepare identified technologies for introduction into the NAS. The FAA sponsors research to develop and field regulations and procedures to standardize the operation of new systems, as well as research to refine the systems themselves. The results of FAA R&D have provided operational benefits in direct support of the agency's key goals in safety, security, efficiency, and environmental compatibility.

1.6 FAA Strategic Goals and R&D

The prime elements of the FAA mission are embodied in three overarching, research-dependent goals:

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

Security: "*Prevent security incidents in the aviation system*."

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

The FAA has identified important additional goals that enable the agency to accomplish its mission. One such "enabling goal" carries with it particular 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 associated with each of the above strategic goals. These are:

R&D and the Safety Goal:

- Working to eliminate terminal area and airport surface collisions.
- Developing and certifying new automated technologies using extensively tested, highly reliable software.
- Working to eliminate aging aircraft concerns (e.g., mechanical and electrical systems, and "aging software") particularly in embedded systems.
- Identifying and addressing negative implications of increased flight deck and ground automation.
- Achieving human-centered designs in new cockpit/flight deck systems.
- Adapting the role of flight crews to high-technology automation-rich aircraft.
- Fully realizing the potential for collection and analysis of safety-relevant operational data.
- Increasing the rate of introduction of new technologies with possible new failure modes.
- Avoiding unintended adverse safety consequences associated with security countermeasures.
- Increasing the numbers of commercial space launch and landing sites, launches and landings, and making adequate provision for increased complexity of space launch vehicles.

R&D and the Security Goal:

Most elements of NAS security R&D will be transitioning from the FAA to the newly-created Transportation Security Administration within DOT. The FAA remains responsible, however, for the implementation and maintenance of physical security affecting its own facilities and personnel, as well as for ongoing R&D in the area of information security and technology. The research program for Information Security and Technology is included in the Aviation Safety Research and Development Program Area Description.

R&D and the System Efficiency Goal:

- Reducing system delays.
- Improving system performance in bad weather, especially low ceilings and visibility.
- Increasing the flexibility and adaptability of system architecture.
- Substantially increasing global traffic with associated need for increased oceanic, en route, terminal, and surface throughputs.
- Improving the rate at which technical and procedural evolution of air traffic management system can occur.
- Identifying and removing adverse human performance and behavioral demands upon controllers, pilots, and others in the NAS.
- Improving pavement design and construction standards.
- Providing air traffic services for a wider range of aircraft to include: dirigibles, unmanned air vehicles, new small aircraft, business jets, jumbo airliners, space vehicles and payloads.
- Developing and applying satellite-based navigation and positioning system technology.
- Adapting rapid increases in power and affordability of highly automated information technologies to NAS-based systems.

The Environmental Compatibility Enabling Goal:

- Stimulating environmentally responsible growth in air transportation.
- Meeting the challenges of increased globalization of aviation.
- Harmonizing U.S. and international standards.
- Basing comprehensive environmental assessments – airside as well as landside – on adequate modeling and data collection.

Applicable Goal or Activity	FY 03 Level	Appropriation(s)
Safety	$137.6 M	R,E&D, F&E, AIP
Efficiency	$ 55.8 M	R,E&D, F&E, AIP
Environmental	$ 7.5 M	R,E&D,
Mission Support	$ 8.2 M	R,E&D

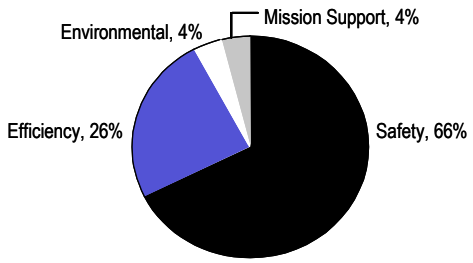

Figure 1-3: FY 03 R&D Funding Percentages by FAA Goals

- Analyzing and simulating alternative mitigation strategies, including economic factors and stakeholder impacts.

Figure 1-3 shows the relative percentages of FY 03 R&D funding to be directed toward meeting each of the three overarching FAA mission goals plus the agency's enabling environment and energy goal.

1.7 The FAA R&D Strategic Plan

The Office of Aviation Research (AAR) works closely with NAS users to achieve beneficial R&D outcomes for the entire aviation community. In the past year, AAR has begun development of an *FAA R&D Strategic Plan* to guide research activities over the next five years and beyond. The overall planning framework proposed in the draft *R&D Strategic Plan* has been developed to ensure alignment of the FAA R&D program with FAA mission and enabling goals.

Planning Framework

Effective planning of R&D activities requires a longer time perspective than is shown in the *FAA Strategic Plan*. The broad framework proposed in the draft *R&D Strategic Plan* introduces terms and concepts to accommodate the unique timing and diversity of R&D needs.

The tentative R&D strategic planning framework is depicted in Figure 1-4. Appropriate R&D sub-goals are "derived" from the agency's mission goals, and defined to clarify linkages between goal levels and the research essential to their achievement. Each derived R&D goal is broken down into one or more potentially measurable "performance objectives," addresses a specific aspect of the goal, and is dependent on research products for its accomplishment. To the extent possible, these derived goals correspond to subgoals identified in other planning documents.

Each performance objective implies a conceptual and production "challenge" for the FAA R&D community.

The inherent relationship of challenge to objective is suggested in the figure by the upper dashed line appearing between them. R&D strategies are then developed to meet each R&D challenge and its related performance objective through the research products of a selected project or set of projects. The totality of all projects in the R&D portfolio works, as shown in the figure, toward the achievement of the overall program and agency goals.

Metrics will be developed to measure the accomplishment of each performance objective and its relative contribution to meeting associated derived goals. Attainment of each objective will depend largely on the new knowledge, tools, or systems provided by associated R&D projects.

The proposed R&D goals framework will facilitate communication across all levels of the FAA and serve 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. Furthermore, each biennial release of the updated plan will inform the external aviation community of the emphasis and direction of the FAA R&D program and encourage their comment, feedback, partnership, and collaboration.

Figure 1-5 elaborates on the hierarchical framework introduced in Figure 1-4. What the new figure cannot show, however, is that attainment of some FAA Performance Objectives may approach full dependence on successful R&D, while in other cases, R&D may be a

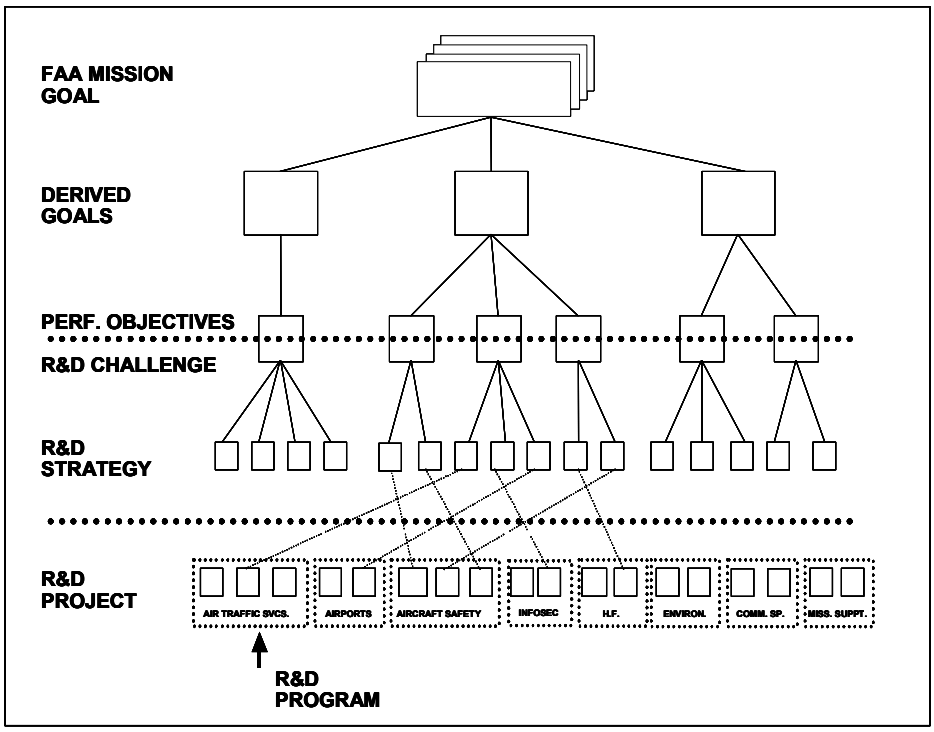

Figure 1-4: Goal-Performance Objective-Strategy Hierarchy, Showing Links to R&D Program

less critical, though still important, element in achieving the objective.

1.8 The FAA Research and Development Program

Operationally, the FAA R&D Program is subdivided into functional areas reflecting the agency's lines of business and the R&D funding structure. Actual research and development work is performed through a combination of appropriations, at agency-funded research centers, and in partnership with other institutions.

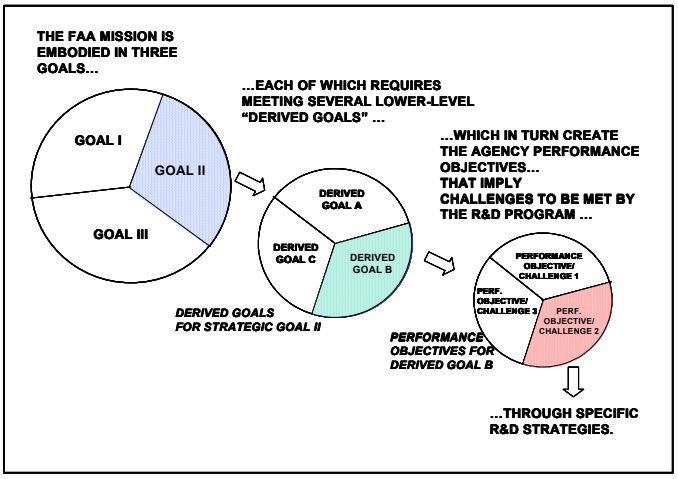

Figure 1-5: Relationship of Strategic Goals, Derived Goals, Performance Objectives, and R&D Strategies.

Functional Areas of R&D

The FAA R&D program, when viewed in terms of research content, can be broken into the following eight categories:

- *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 is also working to reduce occurrences of runway incursions, midair 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 de-

signed to help ensure safe and efficient airport operations. Research focuses on 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, and 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 continued 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 Aviation Medicine*— R&D programs directly support the needs of the FAA's lines of business and NAS users, as identified in the National Plan for Civil Aviation Human Factors. These Civil Aerospace Medical Institute (CAMI) initiatives address major human factors areas affecting the flight deck, Air Traffic Control (ATC), flight deck/ATC system integration, airway facilities, aircraft maintenance, as well as aeromedical issues related to the safe operation and forensic investigation of aircraft 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.

Although the cross-cutting emphases just described no longer include aviation security as a primary FAA R&D responsibility, the agency retains the responsibility to coordinate effectively with the R&D activities of the new DOT Transportation Security Administration. The above distribution of organizationally-based interests helps to ensure outside assessment of FAA R&D investments. R&D mission support management also facilitates research partnerships with industry, universities, and other government agencies that enable the FAA to leverage its research dollars.

William J. Hughes Technical Center Programs

The FAA William J. Hughes Technical Center (WJHTC) is one of the world's leading engineering, research, de-

velopment, and testing facilities for nearly every aspect of aviation including the maintenance and operation of the FAA airborne laboratory fleet. Representative areas of involvement of this diverse and extensive facility include:

- *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 accessible at 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*—The multiple "what if" capabilities of the Research, Development and Human Factors Laboratory apply principles derived from the behavioral sciences to plan and test the deployment of next generation NAS capabilities such as displays and workstations. As NAS modernization will increasingly rely on the automation of suitable tasks, improved and reliable computer-human interfaces are critical to avoid and/or mitigate system-induced operator errors.
- *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. Similarly, they perform tests and evaluations of Automatic Dependent Surveillance—Broadcast capabilities to provide reliable aircraft position data to airborne and ground-based users.
- *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, within DOT, 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.
- *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.

The FAA Technology Transfer Program

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 tailored 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.

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.

Civil Aerospace Medical Institute Programs

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 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 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*—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 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 in support of 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, 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 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.
- *Aviation 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 aviation system are not at a disproportionate risk for health problems from radiation exposures.

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 that are 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.

Center of Excellence in Airworthiness Assurance

The Center in 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.

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 Operations 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.

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.

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.

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.

1.9 Long-Term Research

The Research, Engineering, and Development Management Reform Act of 1996 directed the FAA to identify the allocation of resources among long-term research, near-term research, and development activities.

Long-term research, as defined in the Aviation Safety Research Act of 1988, is 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."

The FAA's R&D is principally associated with applied research: that is, leveraging new technologies identified by research programs in space, aeronautics, communications, computer science, and other related fields of exploration. Developmental activities beyond this stage are found in the Engineering, Development, Test, and Evaluation activity of the FAA's F&E appropriation.

Of the $195,000M appropriated for R,E&D efforts in FY 2002, 29% of these funds are earmarked for long-term research, with the remainder devoted to developmental/near-term efforts. Similarly, the $124,000M FY 2003 congressional budget submission for R,E&D designates 27% of the total request for long-term research. These percentages exceed the congressionally mandated 15% level.

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 FY 2003 R&D that will be devoted to the support of Aviation Safety research.

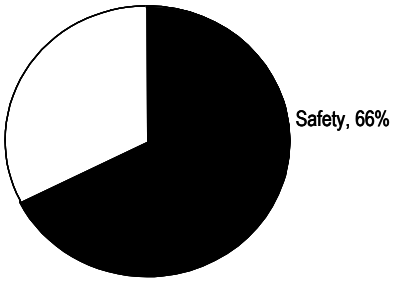

Figure 2.1-1: Percentage of Total FY 03 R&D Funding Supporting FAA Aviation Safety Goal

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 aircraft fleet and space transportation vehicles.

For FY 2003, the primary Aviation Safety R&D performance goal is to*:* "*Reduce aviation accidents and fatalities.*" All research and development within the Aviation Safety R&D Program Area will be directed toward satisfying one of the following Derived Safety Performance Goals:

1. Reduce the occurrence of aviation system accidents due to new or previously unrecognized causal factors.
2. Reduce the recurrence of aviation accidents due to known risk or causal factors.
3. Prevent successful attacks on the integrity and availability of critical NAS information systems.
4. Increase the survivability of aviation system accidents and incidents.

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 2001 *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 propulsion and fuel systems; the reduction of risk from aviation-related fires; the promotion of safer aviation materials and structures; and the improved risk assessment of aircraft, safety performance measurement, and the sharing of safety-related data.

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

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

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 and emerging data technologies and the establishment of procedures for the optimal implementation and use of resulting systems.

The Human Factors and Aviation 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 aircraft passengers and aircrews through identification of human failure modes and development of formal recommendations for counteracting human failure conditions.

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 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 Information Security and Technology Program identifies, develops, and evaluates data technologies, technical information, and procedures that, when implemented, will protect legacy and evolving FAA systems from outside influence.

The FAA is concerned with ensuring the safety and efficiency of operator performance through guidelines, handbooks, advisory circulars, rules, and regulations. The agency provides industry with

human performance information and guidance critical to the design, operation, regulation, and certification of equipment, training, and procedures. With this in mind, the Human Factors and Aviation Medicine Program conducts and manages research that provides the technical information necessary to generate these products and services.

Program Area Structure

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

- Aviation Weather Safety Research (new program designation)
  - 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
  - Local Area Augmentation System (LAAS)
  - Wide Area Augmentation System (WAAS)
  - Automatic Dependent Surveillance Broadcast (ADS-B)
  - General Aviation and Vertical Flight Technology (GA&VF)
  - Surveillance
- 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.
- Information Systems Security and Technology
- Human Factors and Aviation Medicine
  - Flight Deck/Maintenance/System Integration Human Factors
  - Air Traffic Control/Airway Facilities Human Factors
  - Aeromedical Research

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.

Long-Range View

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 information available to all who need it.

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.

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.

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. Support for friction testing of new products to eliminate slipperiness as a cause of accidents will continue beyond 2005. Operation of the FAA's national pavement test facility began in June 1999 with a commitment to continue for ten years.

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 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 provide efficiency and capacity benefits as well.

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.

In collaboration with National Weather Service (NWS) programs, The weather R,E&D program produces weather algorithms, more accurate and rapid forecasting and dissemination of forecasts, and enhanced intuitive capability for aviation decision makers. The program also supports the development of aviation weather instructional materials.

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

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

Customer/Stakeholder Involvement: R,E&D 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). It also merges resources with other NAS drivers, such as "Safer Skies," Free Flight implementation, and it maintains consistency with all 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 analyzed the needs and requirements of aviation weather service users, as presented in the *Aviation Safety Action Plan*. Additionally, it has addressed industry recommendations and requirements found in various documents and publications.

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

- Completed rapid update cycle analyses and forecast 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 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. This accomplishment received the 1999 Government Technology Leadership Award.
- Enhanced the Aviation Digital Data Service (ADDS) via the implementation of a flight path tool depicting vertical cross sections of weather along user-specified flight routes. This tool is providing benefit to users, especially general aviation. This accomplishment received the 2000 Government Technology Leadership Award.

R&D Partnerships: As required by the (amended) Federal Aviation Act of 1958, 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 in the final report of the Weather Joint Services Implementation Team (2000).

In addition to maintaining 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 coordination and leveraging is done directly through interagency agreements, university grants and Memorandums of Agreement (MOAs). Principal partners include the National Center for Atmospheric Research; the National Oceanic and Atmospheric Administration's (NOAA) Forecast Systems Laboratory; the Environmental Technology Laboratory and National Severe Storms Laboratory; Massachusetts Institute of Technology's Lincoln Laboratory; the NWS 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's Cold Regions Research and Engineering Laboratory; UPS; and facilities of 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, AccuWeather, Jeppesen, Sonalyst, and Radian.

MAJOR ACTIVITIES AND ANTICIPATED FY 2002 ACCOMPLISHMENTS:

- Obtained FAA approval for an icing diagnosis algorithm for operational use.
- Began to include turbulence in-situ data in forecast models.
- Implemented ADDS into FAA operational facilities; e.g. the Automated Flight Service Station (AFSS).
- Began development of a 2-4 hour freezing precipitation forecast.
- Delivered a storm tracker algorithm to Radar Operations Center (ROC) for implementation.
- Implemented a 20KM Rapid Update Cycle with cloud analysis at the National Center for Environmental Protections (NCEP).
- Completed development of a detailed plan for the National Ceiling and Visibility (C&V) Program.

KEY FY 2003 PRODUCTS AND MILESTONES:

- Deliver a probabilistic Integrated Icing Diagnostic Algorithm (IIDA) and a probabilistic Integrated Icing Forecast Algorithm (IIFA) to users via ADDS.
- Implement RTVS at the Alaskan Aviation Weather Unit.
- Extend turbulence forecasts to mid-levels (5,000-20,000 feet)
- Begin development of a frost-prediction algorithm.
- Begin real-time testing of a Weather Research and Forecast (WRF) model.
- Deliver new volume coverage patterns (VCP) to ROC for implementation.

- Complete analysis of northeast corridor data for National/Terminal C&V programs.

FY 2003 PROGRAM REQUEST:

Ongoing Activities

- Develop new algorithms for improved forecasts of freezing drizzle aloft.
- Continue to develop automated data analysis and assimilation techniques.
- Transition weather research products to operations in the NWS, the FAA, and industry automation and weather systems.

New Initiatives

None

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2001)	$ 162,167
FY 2002 Enacted	13,763
FY 2003 Request	19,406
Out-Year Planning Levels (FY 2004-2007)	80,591
Total	$ 275,927

Budget Authority ($000)	FY 1999 Enacted	FY 2000 Enacted	FY 2001 Enacted	FY 2002 Enacted	FY 2003 Request
Contracts:					
Weather Program - Safety	10,609	11,896	17,134	12,662	18,435
Personnel Costs	584	450	504	826	891
Other In-house Costs	22	26	62	275	80
Total	**11,215**	**12,372**	**17,700**	**13,763**	**19,406**

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
Basic	0	0	0	0	0
Applied	11,215	12,372	17,700	13,763	19,406
Development (includes prototypes)	0	0	0	0	0
Total	**11,215**	**12,372**	**17,700**	**13,763**	**19,406**

A11k – Weather Program –Safety Products and Activities	FY 2003 Request ($000)	Program Schedule					
		FY 2002	FY 2003	FY 2004	FY 2005	FY 2006	FY2007
041-110 Aviation Weather Analysis and Forecasting	$3,431						
In-flight Icing		◆					
Icing Diagnosis Algorithm Approved by FAA for Operational Use							
Deliverprobabilistic IIDA & IIFA to Users via ADDS			◇				
Implement Extrapolation Features into In-Flight Icing Forecasts			◇				
Test Airborne Detection Systems				◇			
NEXRAD Algorithms	$1,554						
Delivered Storm Tracker Algorithm to ROC for Implementation		◆					
Deliver New Volume Coverage Pattern to ROC for Implementation			◇				
Polarization into all NEXRADs						◇	
Aviation Forecast & Quality Assessment	$2,743						
Implemented ADDS into FAA Operational Facilities, e.g., AFSS		◆					
Implemented at RTV's at the Alaskan Aviation Wx Unit			◇				
Model Development and Enhancement	$2,561						
Implemented 20KM RUC with Cloud Analysis at NCEP;		◆					
Commence Real-Time Testing of WRF Model			◇				
Winter Weather Research	$1,372						
Commenced Development of 2-4 Hour Freezing Precip Forecast		◆					
Commence Development of Frost Prediction Algorithm			◇				
Turbulence	$3,518						
Commenced Inclusion of In-Situ Turbulence Data Into Models		◆					
Extend Turbulence forecasts to mid-levels (5,000-20,000 feet)			◇				
National Ceiling & Visibility	$3,256						
Completed Develop. of Detailed Plan for National C&V Program		◆					
Complete Analysis of NE Corridor Data			◇				
Personnel and Other In-House Costs	$971						
Total Budget Authority	$19,406	$13,763	$19,406	$19,646	$19,967	$20,314	$20,664

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 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 2001:

- Completed the LOOP technology evaluation at Long Beach, CA and identified viable applications for runway safety.
- Completed a technical assessment of microwave motion sensors to determine their feasibility as low-cost airport surface detection equipment.
- Awarded six contracts for technology demonstrations proposed in response to a Broad Agency Announcement (BAA) stemming from an initiative begun as a result of the July 2000 National Runway Safety Summit.

R&D Partnerships:

- Memorandum of Agreement (MOA) with Dallas/ Fort Worth (DFW) Airport Authority to upgrade their 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.
- General working agreement with Volpe National Transportation Systems Center (VNTSC) for research and development of various surface technology projects.

MAJOR ACTIVITIES AND ANTICIPATED FY 2002 ACCOMPLISHMENTS:

- Completed the upgrade of the surface test bed at DFW in accordance with the action plan detailed in DFW/FAA MOA.
- Pursued the development and evaluation of runway status lights on a fast-track basis leading to an operational demonstration during FY 2003.
- Completed all technology demonstrations initiated pursuant to the BAA contracts issued during FY 2001, and generated related technology assessment reports and recommendations.
- Developed a surface technology implementation roadmap for BAA technologies that are found viable and effective.
- Began Runway Safety Blue Print Initiatives.
- Evaluated airport surface marking and painting technologies.
- Improved operational procedures and educational awareness.

KEY FY 2003 PRODUCTS AND MILESTONES

- BAA technology demonstrations.
- Runway status lights technology demonstration.
- Runway Safety Blueprint initiatives – including controller training, simulator/markings, an education and awareness program, technology continuations, human factors studies, and industry conferences.

FY 2003 PROGRAM REQUEST:

- In FY 2003, funding will provide for:
- Continuation of ongoing BAA demonstration and evaluation efforts in preparation for sponsor decisions.
- Presentation of a runway status lights technology demonstration and related analysis of results and findings.
- Sharing of information with air traffic controllers, pilots, and vehicle operators.
- 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 1982-2001)	$16,668
FY 2002 Enacted	5,700
FY 2003 Request	6,700
Out-Year Planning Levels (FY 2004-2007)	28,500
Total	$57,568

Budget Authority ($000)	FY 1999 Enacted	FY 2000 Enacted	FY 2001 Enacted	FY 2002 Enacted	FY 2003 Request
Contracts:					
Runway Incursion Reduction	* 2,269	2,000	11,500	5,700	6,700
Personnel Costs	899	0	0	0	0
Other In-house Costs	0	0	0	0	0
Total	**3,168**	**2,000**	**11,500**	**5,700**	**6,700**

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
Basic	0	0	0	0	0
Applied	0	0	0	0	0
Development (includes prototypes)	3,168	2,000	11,500	5,700	6,700
Total	**3,168**	**2,000**	**11,500**	**5,700**	**6,700**

*** In FY 1999 $900K of contract funds were allocated to Free Flight Phase 1 Atlanta GA**

Runway Incursion Reduction Products and Activities	FY 2003 Request ($000)	Program Schedule					
		FY 2002	FY 2003	FY 2004	FY 2005	FY 2006	FY2007
021-250 Runway Incursion Reduction							
Runway Incursion Plan	$4,700						
Phased Array Radar (Milwaukee)		◆	◇	◇	◇		
Data Fusion/ATIDS/ADS-B/Loops (DFW)		◆	◇	◇	◇	◇	◇
Loop Technology (Long Beach)		◆	◇				
FAA/NASA Evaluation (DFW)		◆					
System Selection for Full Scale Validation Testing		◆	◇				
Continuous Research on Additional Technologies		◆	◇	◇	◇	◇	◇
Multi Lateration Demo			◇	◇			
Runway Incursion Non Technical Solutions	$2,000						
Develop Procedures		◆	◇	◇	◇	◇	◇
Develop Educational Process		◆	◇	◇	◇	◇	◇
Develop Training Guidelines		◆	◇	◇	◇	◇	◇
Completed LOOPS Technology Assessment		◆					
Awarded Six BAA Technical Demo Contracts		◆					
Technical Evaluation of Microwave Motion Sensors		◆					
FAA/DFW MOA for Surface Test Bed Upgrade		◆					
Installation of DFW Surface Test Bed Upgrade			◇				
Develop Runway Safety Lights (RWSL) System Specification			◇				
Complete FY 2001 BAA Technology Demonstrations			◇				
Develop Implementations Roadmap for Selected Technologies			◇				
Runway Status Lights Demonstration System Installation				◇			
Conduct Runway Status Lights OpEval				◇			
Total Budget Authority	$6,700	$6,534	$6,700	$8,200	$9,100	$6,300	$4,900

Notes:

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

– In the Facilities and Equipment appropriations, personnel and other costs are budgeted in Activity 5, not the program budget line item.

NAVIGATION – LOCAL AREA AUGMENTATION SYSTEM (LAAS)

GOALS:

Intended Outcomes: The FAA intends to provide time benefits through satellite-based navigation implementation. Efficiencies and cost savings to be realized by the airlines, the traveling public, and the FAA include:

- Increased numbers of instrument approaches – will extend all-weather service to a greater number of cities and reduces traffic complexity resulting from back-course approaches, circle-to-land operations, etc.
- Lower landing minimum – will improve on-time performance by reducing the frequency of flight disruptions (e.g., missed approaches, diversions, delays, and cancellations).
- Increased numbers of approaches with vertical guidance – will improve safety by reducing the risk of Controlled Flight Into Terrain (CFIT).
- Improved surveillance using SatNav-based ADS-B and Cockpit Display Of Traffic Information (CDTI) – will improve traffic efficiency and reduces the risk of collision.
- Increased navigation accuracy and flexibility – will improve traffic efficiency by facilitating more effective NAS configurations and optimized fuel/time navigation solutions.
- Reduced infrastructure costs – will occur as many surface navigational aids are decommissioned in favor of space-based systems.

Agency Outputs:

The Local Area Augmentation System (LAAS) Test Prototype (LTP) system is being used to test and validate the expected performance of LAAS systems. The LAAS is intended to complement the WAAS, and the systems function together to supply users of the NAS with seamless satellite-based navigation for all phases of flight. The LAAS will be used to meet Category I Precision Approach requirements at those locations where WAAS is unable to meet those requirements. LAAS will also be used to meet the more stringent Category II/III requirements at selected locations throughout the U.S. LAAS will yield the extremely high accuracy, availability, and integrity necessary for Category II/III precision approaches. It is fully expected that the end-state configuration will pinpoint an aircraft's position to within one meter or less.

The FAA has developed and provided a functional Category I LAAS specification, architecture, and Minimum Operational Performance Standards (MOPS) to industry for implementing local area systems across the United States. The FAA will validate the capability to perform Category II/III precision approaches through continued research and development efforts associated with the LAAS Program. An LTP has been developed, and is being used, to conduct nationwide flight tests in cooperation with end-state users of LAAS technology that include United Parcel Service (UPS) and Federal Express (FedEx).

Customer/Stakeholder Involvement:

The program's implementation strategy involves other government agencies, industry, and academia.

The FAA has established and continues to actively participate on various teams addressing immediate needs for operational implementation issues. These teams include the Satellite Operational Implementation Team (SOIT), Satellite Procedures Implementation Team (SPIT), Air Traffic SOIT (ATSOIT), and many other teams and working groups.

The FAA has also founded the Technical Interoperability Working Group (IWG) in which the developers of all worldwide Satellite Based Augmentation Systems (SBAS) [U.S. WAAS, the European Geostationary Navigation Overlay Service (EGNOS), Japan MTSAT Satellite Based Augmentation System (MSAS), and Canadian WAAS] meet on a periodic basis to identify and address potential technical barriers to seamless travel between any of these systems. These meetings began in 1997 and are expected to continue.

The FAA works cooperatively with the Positioning and Navigation Executive Committee, the Joint Precision Approach and Landing System Program, and the Department of Defense to establish and promote a national consensus on Global Positioning System (GPS) management and operation. The FAA also provides active support to the Interagency GPS Executive Board (IGEB) regarding overall GPS modernization issues.

Accomplishments:

On September 2, 1999 a FAA Joint Resource Council (JRC) meeting was held to decide the future direction of satellite navigation programs. This forum also considered information from the recently performed and con-

gressionally-mandated Investment Analysis (IA). The JRC reaffirmed the FAA's commitment to satellite-based navigation and approved the LAAS Acquisition Program Baseline, including quantity (from 143 to 160 systems) and schedule changes resulting from this IA.

Research and development activities to use LAAS to achieve Category I/II/III precision approaches progressed substantially through the use of the LAAS Test Prototype. Tests using the LTP were completed with excellent results at various locations around the nation.

In August 1999, the FAA, in conjunction with UPS and the Air Transport Association (ATA), conducted approximately 40 precision approaches using a wide-body aircraft and the LTP. These tests had very positive results for the use of LAAS and its pseudolite technology on wide-body aircraft. All previous tests had been conducted on narrow-body aircraft.

In October 1999, the FAA, in conjunction with FedEx and ATA, conducted further wide-body flight testing at Memphis International Airport. The purpose of these tests was to verify the reception of the airport pseudolite (APL) signal by a wide body aircraft (MD-10) and the ability to accurately range from that signal. A total of 45 precision LAAS approaches were conducted to all six runway ends. Results of the test indicated the typical horizontal Navigation System Error (NSE) estimate was less than one meter, and the vertical NSE was less than two meters. These results are well within LAAS requirements. These successful flight tests demonstrated the potential of this new technology and the significant contribution LAAS will make to the advancement of satellite-based aviation.

The LAAS Integrity Monitoring Test Bed (IMT) is another tool currently being utilized to validate LAAS requirements and performance. The final version is expected to be deployed at San Francisco International Airport for ground data collection.

Furthermore, LAAS Category I development is proceeding forward. Government Industry Partnerships (GIP) reflecting this effort were signed with Honeywell and Raytheon in April 1999. The LAAS Category I Specification was finalized and approved in September 1999. The Category I MOPS were approved in November 2001. Category II/III research and development efforts are continuing. LAAS development is ongoing with an initial public use expected for 2003 for Category I and late 2005 for Category II / III. Work has begun on a LAAS siting document.

R&D Partnerships:

The FAA has approximately 20 grants, interagency agreements, and contracts in place with industry, academia, and other government agencies to leverage their expertise and capabilities in satellite navigation R&D. Principal participants include Stanford University, Ohio University, the Naval Air Warfare Center Aircraft Division (NAWCAD), and the Central Intelligence Agency (CIA).

In addition, 15 cooperative bilateral agreements are in place, with additional agreements currently in progress, to facilitate and promote the communication and information transfer for a seamless global navigation satellite system.

MAJOR ACTIVITIES AND ANTICIPATED FY 2002 ACCOMPLISHMENTS:

- Continued to conduct research into signal quality monitoring, operations and maintenance, flight control monitoring, and automatic dependent surveillance with participation from Stanford and Ohio Universities.
- Continued to conduct investigation studies and analyses for surface movement guidance, helicopter operations, and advanced LAAS augmentations using pseudolites.
- Continued to develop and mature the LAAS integrity algorithms.
- Continued to install and test LAAS prototype systems at several sites to ensure that the systems will validate the functional specifications required at particularly difficult sites.
- Continued to demonstrate and test international connectivity as a transition to a seamless global navigation system.
- Continued to coordinate with ICAO to produce Standards and Recommendation Practices (SARPS) to define LAAS in the international community.
- Continued interference analyses to identify and mitigate potential threats.
- Continued or completed LAAS Category I Specification Validation efforts.

KEY FY 2003 PRODUCTS AND MILESTONES:

- Develop interference detection and mitigation techniques.
- Analyze impact of additional civil frequencies.

- Develop LAAS Category II/III requirements for autoland.
- Further refine the FAA LAAS Category II/III test prototype.
- Develop and validate LAAS Category II/III Specification.
- Validate LAAS Category II/III Integrity Monitoring.
- Develop Improved Signal Quality Monitoring Techniques for CAT II / III LAAS.
- Investigate Ephemeris Monitoring requirements for CAT II / III LAAS.
- Develop ICAO SARPS Standards for Category II/III LAAS.
- Develop Airport Pseudolite Integration Techniques.

FY 2003 PROGRAM REQUEST:

In FY 2003, the program request of $2.8M will focus on developing and implementing the Local Area Augmentation System to further the transition to satellite-based navigation technology. Current research efforts will focus on better utilization of present and future global navigation satellite systems, analysis of LAAS VHF data broadcast characteristics, and LAAS category I/II/III evaluations at various locations across the country.

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2001)	$12,039
FY 2002 Enacted	2,800
FY 2003 Request	2,800
Out-Year Planning Levels (FY 2004-2007)	11,200
Total	$28,839

Budget Authority ($000)	FY 1999 Enacted	FY 2000 Enacted	FY 2001 Enacted	FY 2002 Enacted	FY 2003 Request
Contracts:					
Navigation - LAAS	4,000	2,900	4,000	2,800	2,800
Personnel Costs	1,138	0	0	0	0
Other In-house Costs	0	0	0	0	0
Total	**5,138**	**2,900**	**4,000**	**2,800**	**2,800**

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
Basic	0	0	0	0	0
Applied	0	0	0	0	0
Development (includes prototypes)	5,138	2,900	4,000	2,800	2,800
Total	**5,138**	**2,900**	**4,000**	**2,800**	**2,800**

Navigation Products and Activities – LAAS	FY 2003 Request ($000)	Program Schedule					
		FY 2002	FY 2003	FY 2004	FY 2005	FY 2006	FY2007
Navigation							
Local Area Augmentation System (LAAS)	$2,800						
Validate LAAS Category I (CAT I) Integrity		◆	◇				
Develop LAAS CAT II/III Executive Monitor Algorithm		◆	◇	◇	◇		
CAT II/III Implementation and Testing		◆		◇	◇	◇	◇
Develop Improved Signal Quality Monitoring Techniques for CAT III LAAS		◆		◇	◇	◇	
Develop Improved Integrity Algorithms for CAT III LAAS		◆				◇	◇
Investigate Ionospheric Monitor Requirements for CAT II/III		◆	◇	◇			
Develop Airport Pseudolite Integration Techniques		◆	◇	◇			
Total Budget Authority	$2,800	$2,800	$2,800	$2,800	$2,800	$2,800	$2,800

Notes:

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

– In the Facilities and Equipment appropriations, personnel and other costs are budgeted in Activity 5, not the program budget line item.

NAVIGATION – WIDE AREA AUGMENTATION SYSTEM (WAAS)

GOALS:

Intended Outcomes: The FAA intends to provide time efficiencies and cost savings through satellite-based navigation implementation. This technology allows direct point-to-point navigation, optimum routing, and other capacity improvements. Efficiencies and savings realized by the airlines, the traveling public, and the FAA include:

- Increased air traffic control efficiencies and NAS capacity through an airspace system that is restructured to accommodate direct routings between airports, as well as reduced separation standards.
- Reduced fuel cost to airlines and reduced travel time to the public through use of more economical air routes.
- Reduced FAA operating costs through the potential decommissioning of existing ground-based navigation equipment.
- Simplified Global Positioning System (GPS) augmentation infrastructure through introduction of wide area and local area interoperability that provides satellite navigation services at a reduced cost.

Agency Outputs:

Wide Area Augmentation System (WAAS)

The FAA uses the National Satellite Test Bed (NSTB) as the foundation for all current research and development activities associated with implementing the Wide Area Augmentation System (WAAS). The NSTB is essential to GPS development and implementation, as well as to the system's WAAS augmentations. Findings from the NSTB help the FAA develop required user equipment through avionics manufacturers, continue development of GPS user procedures, gain international acceptance of a seamless Global Navigation Satellite System (GNSS), and monitor and evaluate system performance of both the basic GPS service and the WAAS during implementation activities. During these evaluations, large quantities of complex technical data will be collected, analyzed, and archived.

The data will be made available to the FAA and other government agencies (as well as to industry, academia, and international entities) to facilitate information exchange, foster cooperation around the world, and achieve a seamless global air navigation system.

The results of this "live" data collection and analysis will assist the FAA in: (1) analyzing and defining the satellite-based navigation technology requirements of air traffic and airway facilities; and (2) determining connectivity and interoperability requirements for international augmentation systems being developed by other countries. The information obtained from these performance evaluations will also allow the FAA to monitor the WAAS system contractor performance.

When WAAS becomes operational, the FAA plans to approve the use of WAAS as a primary means of navigation for en route through non-precision approaches. Initial WAAS capability will provide Lateral Navigation/Vertical Navigation (LNAV/VNAV) capabilities. Future phases of WAAS are expected to provide precision approach capabilities, which will increase the numbers of airfields with a precision approach capability, and potentially enable the decommissioning of some existing ground-based navigation equipment throughout the U.S.

Customer/Stakeholder Involvement:

The program's implementation strategy involves other government agencies, industry, and academia.

The FAA has established and continues to actively participate on various teams addressing immediate needs for operational implementation issues. Participants include the Satellite Operational Implementation Team (SOIT), Satellite Procedures Implementation Team (SPIT), Air Traffic SOIT (AT-SOIT), and many other teams and working groups.

The FAA has also founded the Technical Interoperability Working Group (IWG) in which the developers of all worldwide Satellite Based Augmentation Systems (SBAS) [U.S. WAAS, the European Geostationary Navigation Overlay Service (EGNOS), Japan MTSAT Satellite Based Augmentation System (MSAS), and Canadian WAAS] meet on a periodic basis to identify and address potential technical barriers to seamless travel between any of these systems. These meetings began in 1997 and are expected to continue through 2003.

The FAA works cooperatively with the Positioning and Navigation Executive Committee, the Joint Precision Approach and Landing System Program, and the Department of Defense to establish and promote a national consensus on GPS management and operation. The FAA also provides active support to the Interagency GPS Executive Board (IGEB) regarding overall GPS modernization issues.

Accomplishments:

On September 2, 1999, a FAA Joint Resource Council (JRC) meeting was held to decide the future direction of satellite navigation programs. This forum also considered information from the recently performed and congressionally mandated Investment Analysis (IA). The JRC reaffirmed the FAA's commitment to satellite-based navigation, approved the WAAS Acquisition Program Baseline (APB), and approved additional satellite leasing preparatory activities.

The development of WAAS has continued to achieve programmatic success. The WAAS signal-in-space continues to provide accuracies well within the range required by the WAAS specification and coverage availability over most of the continental United States (CONUS).

To support the expansion of WAAS to the Caribbean and South American Region (CAR/SAM) region, the FAA has secured letters of intent from Mexico and Panama for participation in the operational U.S. WAAS. Additionally, both countries signed bilateral agreements for the installation of NSTB reference stations to be used to prepare for the installation of operational WAAS reference stations in the near future.

Related uses of the reference stations include pre-operational support, technology familiarization, flight tests, certification activities, procedure development, and siting analyses. These agreements may significantly cut the FAA's expenses by potentially reducing the agency's need to field WAAS reference stations along the southern U.S. border.

The FAA has assisted the International Civil Aviation Organization (ICAO) with plans and strategies for the development of a WAAS-based GNSS test bed capability for the CAR/SAM region. The resulting Caribbean/South American Test Bed (CSTB) will pave the way for an operational system in the region that is completely compatible with U.S. systems. This future capability, based on U.S. technology, may also provide cost-sharing opportunities on GEO satellite services, significantly reducing projected FAA leasing expenses for end-state WAAS GEOs.

The successful completion of all flight tests and other activities helped to: (1) demonstrate U.S. technological leadership in satellite navigation; (2) ensure the seamless transfer from one regional satellite-based navigation system to another; (3) promote the adoption of satellite-navigation in regions where improved navigation capability will increase the safety of flight for U.S. citizens traveling abroad. Completion of these activities will provide the groundwork necessary to achieve the ICAO's vision of a future, worldwide, seamless, navigation capability.

In February 2001, the FAA and U.S. Department of Transportation officials met with the Ministry of Civil Aviation of India, the Airports Authority of India, Indian Space and Research Organization regarding development of satellite-based augmentation system for India. Discussions also highlighted India's request for assistance in the development of Communications, Navigation, and Surveillance (CNS) applications related to GNSS.

This meeting resulted in a proposal by the FAA and the U.S. Trade Development Agency (TDA) to jointly sponsor a workshop and seminar to be held in India in 2002. The meetings were agreed to by the government of India and a Memorandum of Agreement was signed in March 2001.

The FAA has also been working closely with the Asia Pacific Economic Cooperation (APEC) on GNSS, and WAAS/LAAS technologies for the implementation of a Southeast Asia Test Bed (SEATB).

In February 2001, the FAA co-hosted a conference and workshop in Taipei on WAAS and LAAS technologies. These meetings resulted in the APEC Group's proposed development of intermodal initiatives through creation of a satellite test bed. In April 2001, the APEC Satellite Navigation and Communication (SN&C) Systems Advisory Committee formally endorsed this proposal.

From August 27- September 7, 2001 the FAA and APEC held four Global Navigation Satellite System (GNSS) workshops in the Southeast Asia region in support of the test bed development.

These regional workshops provided information on the benefits of test bed technology and applications for the region's architecture, how to establish the capability in the region, and steps to test and evaluate the system. As a result, a number of economies stated their interest in a test bed for the regional and their commitment to move forward in the planning stages of such a test bed.

In February 2002, the FAA will participate in the first meeting of the GNSS Implementation Team Meeting for those Southeast Asia economies that have stated intent to participate in the regional Southeast Asia Test Bed. The objective of this meeting will be to define roles, responsibilities, and initial architecture.

Some economies and a user expressed interest and an initial commitment to participate. They include Japan, Chinese Taipei, Hong Kong, the Philippines and FedEx.

R&D Partnerships:

The FAA has approximately 20 grants, interagency agreements, and contracts in place with industry, academia, and other government agencies to leverage their expertise and capabilities in satellite navigation R&D. Principal participants include Stanford University, Ohio University, the Naval Air Warfare Center Aircraft Division (NAWCAD), and the Central Intelligence Agency (CIA).

In addition, 19 cooperative bilateral agreements are in place, with additional agreements currently in progress, to facilitate and promote the communication and information transfer for a seamless global navigation satellite system.

MAJOR ACTIVITIES AND ANTICIPATED FY 2002 ACCOMPLISHMENTS:

- Performed data collection and analyses using the NSTB to further develop WAAS performance-assessment capabilities.
- Developed WAAS interference mitigation and rejection methods.
- Developed safety processor to meet FAA safety assurance standards.
- Analyzed satellite alternatives for WAAS final operating capability.
- Continued to conduct ionosphere data collection and analysis to define WAAS final operational capabilities.

KEY FY 2003 PRODUCTS AND MILESTONES:

- Define optimum SATNAV architecture for Alaska.
- Investigate satellite anomalies.
- Perform time transfer studies for SBAS interoperability.
- Refine WAAS performance monitoring and assessment capabilities.
- Define and test SBAS interoperability scenarios.
- Characterize scintillation effects of ionosphere on WAAS performance for ionospheric algorithm development for future phases of WAAS.
- Develop prototype common reference receiver.
- Develop interference detection and mitigation techniques.
- Analyze impact of additional civil frequencies.
- Begin analysis of use of navigation transponder on GEO satellite.

FY 2003 PROGRAM REQUEST:

In FY 2003, the program request of $3.1M for WAAS will focus on developing and implementing GPS augmentations to further the transition to satellite-based navigation technology. Efforts will focus on research and analysis of issues associated with WAAS accuracy, integrity, and availability to the users, with specific emphasis on the ionosphere and interference to ensure integrity and continuity of service.

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2001)	$12,757
FY 2002 Enacted	2,900
FY 2003 Request	3,100
Out-Year Planning Levels (FY 2004-2007)	13,300
Total	$32,057

Budget Authority ($000)	FY 1999 Enacted	FY 2000 Enacted	FY 2001 Enacted	FY 2002 Enacted	FY 2003 Request
Contracts:					
Navigation - WAAS	6,718	2,000	2,900	2,900	3,100
Personnel Costs	1,139	0	0	0	0
Other In-house Costs	0	0	0	0	0
Total	**7,857**	**2,000**	**2,900**	**2,900**	**3,100**

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
Basic	0	0	0	0	0
Applied	0	0	0	0	0
Development (includes prototypes)	7,857	2,000	2,900	2,900	3,100
Total	**7,857**	**2,000**	**2,900**	**2,900**	**3,100**

*** Contract amount includes $4.0M or Low Cost next Generation Precision Gyroscope Technology earmarked by Congress.**

Navigation Products and Activities – WAAS	FY 2003 Request ($000)	Program Schedule					
		FY 2002	FY 2003	FY 2004	FY 2005	FY 2006	FY2007
Navigation							
Wide Area Augmentation System (WAAS)	$3,100						
Perform Data Collection and Analyses Using the National Satellite Test Bed (NSTB) to Further Develop WAAS		◆	◇	◇	◇	◇	◇
Continue to Conduct Ionosphere Data Collection and Analysis to Define WAAS Final Operational Capabilities and Support the Development of Enhanced WAAS Ionospheric Algorithm		◆	◇	◇	◇	◇	◇
Define Optimum Architecture for Alaska		◆	◇	◇	◇	◇	◇
Investigate Satellite Anomalies							
Continue Interference Analysis to Identify and Mitigate Potential Threats		◆	◇	◇	◇	◇	◇
Develop WAAS Performance Monitoring and Assessment Capabilities		◆	◇	◇	◇	◇	◇
Expand the current Service Volume Model (SVM) capabilities to include all forms of the Global Navigation Satellite System (GNSS).		◆	◇	◇	◇		
Perform Interoperability Analyses to Support Seamless Global Navigation Satellite System (GNSS)		◆	◇	◇	◇		
Total Budget Authority	$3,100	$2,900	$3,100	$3,200	$3,300	$3,300	$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 5, 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 and Surveillance (CNS) technologies through applied research and development. Resulting technologies 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 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 operations: en route communications and navigation, 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.

Vertical flight Terminal Instrument Procedures (TERPS) efforts support the terminal and en route flight environment. Low-altitude CNS research provides critical data and evaluations for future low-altitude en route infrastructure to support Free Flight. TERPS capabilities facilitate implementation and use of advanced technology in the cockpit and controller workstations for GA needs. 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.

The project creates the following types of products and engages in the following activities related to rotorcraft Instrument Flight Rules (IFR) procedures and infrastructure:

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, 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).

Rotorcraft Air Routes

Procedures and test systems designed in an operational environment to work with Global Positioning System (GPS) navigation, surveillance, 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, including the Gulf of Mexico, and can be useful to other GA systems operating at low altitudes.

Avionics and Cockpit Technology

Avionics, equipment, procedures, and related testing to enable the safe, efficient integration of GA aircraft into the NAS. These efforts have become particularly important with the introduction of GPS navigation, landing and surveillance systems, Free Flight, and other advanced concepts.

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.

Customer/Stakeholder Involvement: The GA and VF Technology Program directly supports goals and programs delineated in Challenge 2000, the *Aviation Safety Action Plan*, the RTCA *Free Flight Action Plan*, and NAS architecture development. The program emphasizes the VF community's direct needs related to 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 Vertical Flight Rules (VFR) charts.
- Completed first phase of testing and data collection to support helicopter Instrument Landing System (ILS) approaches to lower minimum weather conditions.

R&D Partnerships: Historically, the GA & VF Technology Program has maintained a unique R&D collaboration with industry. Partnerships, existing or planned for the near future, include:

- Experimental Aircraft Association in advanced technology avionics – for single-pilot GA aircraft.
- Helicopter manufacturers and user organizations – to focus development of IFR procedures (including approaches) as well as systems and equipment to meet user identified and validated operational needs.

MAJOR ACTIVITIES AND ANTICIPATED FY 2002 ACCOMPLISHMENTS:

- Supported the development of procedures and standards to enable SNI operations between fixed-wing and vertical flight aircraft.
- Conducted flight tests and data analysis to investigate the potential improvement in efficiency for time-critical VF operations, such as law enforcement and emergency medical service.
- Evaluated helicopter performance through continued flight tests and data analysis to define aircraft and avionics requirements for steep angle approaches (greater than three degrees) to a heliport and a vertiport.

KEY FY 2003 PRODUCTS AND MILESTONES:

- Enhance standard for application of fixed wing and rotorcraft VFR procedure technology by continuing research that supports the use of advanced avionics (including GPS navigation, dependent surveillance, and cockpit display of traffic and weather information).
- Establish lighting requirements for heliports and vertiports to support ILS and capabilities for vertical flight aircraft.
- Continue efforts to use non-radar surveillance system in the Gulf of Mexico for Federal Air Regulation (FAR) 135.79, Flight Locating Requirements.
- Continue research to support steep angle IFR approaches and missed approach guidance for helicopters and tiltrotors.
- Continue research leading to the establishment of improved low speed GPS precision approach TERPS criteria for vertical flight aircraft operations.
- Improve and expand the distribution of weather information in the Gulf of Mexico to pilots operating helicopters at low altitudes.
- Develop procedures and standards for vertical flight SNI, VFR, and IFR operations in terminal areas.
- Initiate research to improve visual guidance to heliports serving hospitals.

FY 2003 PROGRAM REQUEST:

In FY 2003, the program continues to focus on the areas listed at the beginning of the GOALS section above. Specific areas are SNI operations in the terminal area and precision approaches to heliports and vertiports.

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2001)	$4,302
FY 2002 Enacted	1,000
FY 2003 Request	1,000
Out-Year Planning Levels (FY 2004-2007)	6,400
Total	$12,702

Budget Authority ($000)	FY 1999 Enacted	FY 2000 Enacted	FY 2001 Enacted	FY 2002 Enacted	FY 2003 Request
Contracts:					
General Aviation and Vertical Flight Technology Program	1,462	500	900	1,000	1,000
Personnel Costs	1,440	0	0	0	0
Other In-house Costs	0	0	0	0	0
Total	**2,902**	**500**	**900**	**1,000**	**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
Basic	0	0	0	0	0
Applied	0	0	0	0	0
Development (includes prototypes)	2,902	500	900	1,000	1,000
Total	**2,902**	**500**	**900**	**1,000**	**1,000**

General Aviation and Vertical Flight Technology Program Products and Activities	FY 2003 Request ($000)	Program Schedule					
		FY 2002	FY 2003	FY 2004	FY 2005	FY 2006	FY2007
General Aviation	$200						
Enhance Standard for Application of Fixed Wing/Rotorcraft VFR Procedures Technology by Continuing Research Supporting Use of Advanced Avionics		◆	◇	◇	◇	◇	◇
Vertical Flight	$800						
Evaluate Helicopter Performance Through Continued Flight Tests and Data Analysis to Define Aircraft and Avionics Requirements for Steep Angle Approaches (Greater Than 3 Degrees) to a Heliport or Vertiport		◆	◇	◇	◇	◇	◇
Conducted Flight Test and Data Analysis to Investigate the Potential Improvement in Efficiency for Time-Critical Vertical Flight (VF) Operations, Such as Law Enforcement and Emergency Medical Service		◆					
Support the Development of Procedures and Standards to Enable Simultaneous Non-Interfering (SNI) Operations Between Fixed-Wing and Vertical Flight Aircraft		◆	◇	◇	◇	◇	◇
Continue Efforts to Use Non-Radar Surveillance in the Gulf of Mexico for FAR 135.79 flight Locating Requirements		◆	◇				
Continue Research to Support Steep Angle IFR Approaches and Missed Approach Guidance for Helicopters and Tiltrotors		◆	◇	◇	◇	◇	◇
Improve and Expand the Distribution of Weather Information in the Gulf of Mexico to Pilots Operating Helicopters at Low Altitudes		◆	◇	◇			
Establish Lighting Requirements for Heliports and Vertiports to Support ILS and Capabilities for Vertical Flight Aircraft.			◇	◇	◇		
Initiate Research to Improve Visual Guidance to Heliports serving Hospitals			◇	◇	◇	◇	◇
Total Budget Authority	$1,000	$900	$1,000	$1,400	$1,500	$1,500	$2,000

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 5, not the program budget line item.

SURVEILLANCE

GOALS:

Intended Outcomes: The FAA plans to improve system efficiency and safety by implementing a low-cost surveillance system that enables Free Flight capabilities and enhances safety and efficiency. This program develops domestic and international Automatic Dependent Surveillance – Broadcast (ADS-B) standards to facilitate global system interoperability. It also evaluates specific applications and technologies of ADS-B to support standards development.

ADS-B uses an onboard Global Navigation Satellite System (GNSS) receiver, or other backup source of navigation data, to derive the altitude and position of an ADS-B-equipped aircraft. These data and aircraft identities are broadcast directly to ground receivers as well as to nearby aircraft. An ADS-B message displayed on a neighboring aircraft's airborne Cockpit Display of Traffic Information (CDTI) facilitates the flight crew's situational awareness, conflict detection, and Free Flight capabilities. Ground receivers can provide the information to ATM facilities and other users.

The ADS-B technology's modular design and cooperative nature offer a low cost alternative to the surveillance coverage in existing nonradar areas; they also may be suitable for use in some areas currently served by radars. Through accurate and timely updates directly to pilots, the system offers the potential to reduce current separation standards while still improving overall safety, efficiency, and airspace capacity.

Agency Outputs: Current efforts focus on developing standards for the system's avionics, its applications, and its Cockpit Display of Traffic Information (CDTI) system. Standardization efforts include RTCA minimum aviation system performance standards (MASPS), minimum operational performance standards (MOPS), technical standard orders, and design criteria. Analyses and evaluations will be conducted to provide technical inputs to RTCA MASPS/MOPS on ADS-B links, airborne surveillance and separation assurance processing, and other surveillance system sources necessary to support ADS-B applications. International standards such as the International Civil Aviation Organization's (ICAO) Standards and Recommended Practices (SARPS) will also be developed. These standards must be developed and maintained in order for the designs of avionics, ground and other systems to be compatible and capable of operating together.

Customer/Stakeholder Involvement: Air carrier and general aviation user communities have asked for FAA leadership in developing ADS-B technology. The FAA and the user community are actively involved in the standards development activity at RTCA SC 186. Some of the specific stakeholders include the Cargo Airline Association, Air Transport Association, Airline Pilots Association, Aircraft Owners and Pilots Association, United Airlines, Northwest Airlines, avionics manufacturers, ICAO panels, and the European Work Group on ADS-B.

Accomplishments: Draft ADS-B avionics standards development continues at RTCA. Analysis and simulation have been conducted to develop ADS-B technical standards. Several RTCA Work Groups (WG) have been formed to initiate additional standards as required from industry. Specific accomplishments include:

- Initiated three RTCA SC 186 WGs on ADS-B MOPS/MASPS
  - Universal Access Transceiver (UAT) MOPS
  - 1090 MHz MOPS Revision A
  - ADS-B MASPS Revision A
- Published RTCA document DO-263, Application of Airborne Conflict Management: Detection, Prevention, & Resolution.
- Published a technical report on the results of the flight test of 1090 MHz ADS-B at Frankfurt, Germany in conjunction with DFS of Germany, and EUROCONTROL. Flight test data and analysis results have been used to support the ADS-B technical-link assessment and incorporated in the ADS-B MOPS.

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

MAJOR ACTIVITIES AND ANTICIPATED FY 2002 ACCOMPLISHMENTS:

- Completed ADS-B on Universal Access Transceiver (UAT) MOPS for RTCA SC-186 Plenary review.
- Completed ADS-B 1090 MHz MOPS Revision A for RTCA SC-186 Plenary review.
- Completed Traffic Information Service-Broadcast (TIS-B) MASPS for RTCA SC-186 Plenary review.
- Completed Airborne Separation Assurance (ASA) MASPS for RTCA Plenary review.
- Completed ADS-B MASPS Revision A for RTCA Plenary review.
- Initiated Airborne Surveillance and Separation Assurance Processing (ASSAP) MOPS.
- Initiated ICAO SARPS on UAT.

KEY FY 2003 PRODUCTS AND MILESTONES:

- Publish the following RTCA MOPS/MASPS:
  - UAT MOPS
  - TIS-B MASPS
  - 1090 MHz MOPS Revision A
  - ASA MASPS

FY 2003 PROGRAM REQUEST:

The FAA and RTCA will complete the five ADS-B-related MASPS/MOPS under FY 2003 Products and Milestones in the form of published documents. Analysis and simulation will be initiated to develop standards for two Revision A RTCA MASPS (ASA and TIS-B). Additionally, work will continue on ASSAP MOPS and UAT SARPS development.

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2001)	$8,790
FY 2002 Enacted	2,800
FY 2003 Request	1,500
Out-Year Planning Levels (FY 2004-2007)	10,200
Total	$23,290

Budget Authority ($000)	FY 1999 Enacted	FY 2000 Enacted	FY 2001 Enacted	FY 2002 Enacted	FY 2003 Request
Contracts:					
Surveillance	3,506	1,900	2,600	2,800	1,500
Personnel Costs	784	0	0	0	0
Other In-house Costs	0	0	0	0	0
Total	**4,290**	**1,900**	**2,600**	**2,800**	**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
Basic	0	0	0	0	0
Applied	0	0	0	0	0
Development (includes prototypes)	4,290	1,900	2,600	2,800	1,500
Total	**4,290**	**1,900**	**2,600**	**2,800**	**1,500**

Surveillance Products and Activities	FY 2003 Request ($000)	Program Schedule					
		FY 2002	FY 2003	FY 2004	FY 2005	FY 2006	FY2007
Automatic Dependent Surveillance-Broadcast (ADS-B)							
Plans, Standards, and Analysis							
Minimum Operational Performance Standards (MOPS) and Standards and Recommended Practices (SARPs)	$1,500						
Develop Universal Access Transceiver (UAT), MOPS Rev. A		◆	◇	◇			
Develop 1090 MHz MOPS, Rev. A		◆	◇	◇			
Develop Airborne Separation Assurance (ASA) MASPS		◆	◇	◇			
Develop Airborne Surveillance and Separation Assurance Processing (ASSAP) MOPS			◇	◇	◇		
Develop ASA MASPS, Rev. A				◇	◇		
Develop Traffic Information Service – Broadcast (TIS-B) MASPS		◆	◇	◇			
Develop TIS-B MASPS, Rev. A				◇	◇	◇	
Develop Automatic Dependent Surveillance Broadcast (ADS-B), Rev. A		◆	◇	◇			
Develop UAT SARPs			◇	◇	◇		
Provide Updates to MASPS / MOPS						◇	◇
Total Budget Authority	$1,500	$2,800	$1,500	$2,000	$2,000	$3,400	$2,800

Notes:

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

– In the Facilities and Equipment appropriations, personnel and other costs are budgeted in Activity 5, not the program budget line item.

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 Automatic Dependent Surveillance-Broadcast (ADS-B), Flight Information Services-Broadcast (FIS-B), and Traffic Information Service-Broadcast (TIS-B) as enabling technologies.

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) 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: 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 ADS-B, FIS-B, TIS-B, and Controlled Flight Into Terrain (CFIT).

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 CFIT avoidance through graphical position display.
- ADS-B surveillance in non-radar airspace.

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:

- Initiated use of ADS-B at the Anchorage Air Route Traffic Control Center on January 1, 2001 with a single Ground-Based Transceiver (GBT) to provide radar-like services in the Bethel, AK area.
- Installed eight operational remote GBTs as part of the Capstone Program in the Yukon-Kuskokwim (Y-K) Delta region of southwestern Alaska.
- Installed Certified Capstone avionics in over 140 of the planned 150 commercial aircraft operating in the Bethel area.
- Installed and commissioned nine of ten planned Automated Weather Observation Systems (AWOS) with weather cameras.
- 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 Safe Flight 21 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 – 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 2002 ACCOMPLISHMENTS:

In FY 2002, the FAA anticipates accomplishing the following activities in support of Safe Flight 21 in the Ohio River Valley and 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.
- Conducted a Capstone Joint Resource Council (JRC) for Bethel Phase 1 Operations and Maintenance (O&M) requirements in 2nd quarter FY 2002.
- Continued planning for the provision of ADS-B surveillance services, navigation capabilities via Wide Area Augmentation System (WAAS), and surface monitoring (through multilateration) to southeast Alaska.
- Procured second generation ADS-B avionics for up to 200 aircraft for use in southeast Alaska, and begin installation.

KEY FY 2003 PRODUCTS AND MILESTONES:

Key FY 2003 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.
- Continue installation of ADS-B ground-based transceivers in Bethel and southeast Alaska.
- Conduct end-to-end evaluations.

FY 2003 PROGRAM REQUEST:

FY 2003 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 1982-2001)	$29,200
FY 2002 Enacted	20,000
FY 2003 Request	15,000
Out-Year Planning Levels (FY 2004-2007)	71,300
Total	$135,500

Budget Authority ($000)	FY 1999 Enacted	FY 2000 Enacted	FY 2001 Enacted	FY 2002 Enacted	FY 2003 Request
Contracts:					
Safe Flight 21 - Alaska Capstone	11,000	6,000	12,200	20,000	15,000
Personnel Costs	0	0	0	0	0
Other In-house Costs	0	0	0	0	0
Total	**11,000**	**6,000**	**12,200**	**20,000**	**15,000**

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
Basic	0	0	0	0	0
Applied	0	0	0	0	0
Development (includes prototypes)	11,000	6,000	12,200	20,000	15,000
Total	**11,000**	**6,000**	**12,200**	**20,000**	**15,000**

Safe Flight 21 – Alaska Capstone Products and Activities	FY 2003 Request ($000)	Program Schedule					
		FY 2002	FY 2003	FY 2004	FY 2005	FY 2006	FY2007
Safe Flight 21 – Alaska Capstone							
Operational Enhancements	$15,000						
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		◆	◇	◇	◇	◇	◇
Data Link Evaluation		◆					
Program Management and Support		◆	◇	◇	◇	◇	◇
Safety Assessment		◆	◇	◇	◇	◇	◇
Total Budget Authority	$15,000	$20,000	$15,000	$21,100	$19,100	$14,500	$16,600

Notes:

– Out year numbers are for planning purposes only. Actual funding needs will be determined through the annual budget process.
– In the Facilities and Equipment appropriations, personnel and other costs are budgeted in Activity 5, not the program budget line item.
– The FY 1999 Facilities and Equipment appropriation allocated $11M for the Alaska Capstone project and $5 for the Ohio Valley project.
– In FY 2000 Safe Flight 21 was Funded in F&E Budget Activity 1.

SAFER SKIES

GOALS:

Intended Outcomes: The White House Commission on Safety and Security set a goal of sharply reducing fatal aviation accidents within 10 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 2002 ACCOMPLISHMENTS:

No funding available in FY 2002.

KEY FY 2003 PRODUCTS AND MILESTONES:

During FY 2003, 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 2003 PROGRAM REQUEST:

For FY 2003, 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 1982-2001)	$0
FY 2002 Enacted	0
FY 2003 Request	3,000
Out-Year Planning Levels (FY 2004-2007)	12,000
Total	$15,000

Budget Authority ($000)	FY 1999 Enacted	FY 2000 Enacted	FY 2001 Enacted	FY 2002 Enacted	FY 2003 Request
Contracts:					
Safer Skies	0	0	0	0	3,000
Personnel Costs	0	0	0	0	0
Other In-house Costs	0	0	0	0	0
Total	**0**	**0**	**0**	**0**	**3,000**

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
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**	**3,000**

Note: Out year funding is under review.

Safer Skies Products and Activities	FY 2003 Request ($000)	Program Schedule					
		FY 2002	FY 2003	FY 2004	FY 2005	FY 2006	FY2007
Safer Skies Implementation	**$3,000**						
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	**$3,000**		**$3,000**	**$3,000**	**$3,000**	**$3,000**	**$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 5, not the program budget line item

– Out year Funding Request Under Review. FY 2002 is the First Year of Funding under Facilities and Equipment Advanced Technology Development and Prototyping

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 caused by hidden in-flight fires and fuel tank explosions and by eliminating burning cabin materials as a factor in post-crash fire survivability. The fire research and safety program focuses principally on:

- Long-term research to develop new interior materials that meet fire resistance criteria mandated in the Aviation Safety Research Act of 1988.
- 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. Additionally, the program provides industry with new safety products developed through long-term applied research. These products are typically embodied in new materials and formulations, new test methods, government-owned patents, reports, and journal publications.

Customer/Stakeholder Involvement: The FAA has 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 (REDAC) has repeatedly endorsed the fire research and safety program and placed high priority on its activities.
- Long-term research in fire resistant materials is required by specific language in the Aviation Safety Research Act of 1988 and is directly supported by the aircraft industry and materials producers through university-based FAA research consortia.
- 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.
- The aircraft manufacturers and airlines have 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 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), related to the investigation of the Swiss Air MD-11 fatal in-flight fire, are addressed by this program.
- The U.S. National Transportation Safety Board (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:

- Issued Notice of Proposed Rulemaking (NPRM) on September 20, 2000 to significantly improve the fire performance of thermal acoustic insulation.
- Conducted first-ever, ground-based aircraft fuel tank inerting flight tests with Boeing in a 737BBJ, demonstrating viability of Ground-Based Inerting (GBI) concept.
- Designed, developed and validated an On-Board Oxygen Analysis System (OBOAS) which was the critical instrumentation on the successful FAA/Boeing fuel tank inerting flight tests.
- Procured a 747SP from United Airlines for use as a test bed, to design, develop and evaluate an on-board fuel tank inerting system.
- Completed a study documenting the high incidence of cargo smoke detector false alarms (200:1), demonstrating the need for improved and standardized approval standards that can be applied to new detectors designed to discriminate between real fires and nuisance alarm sources.
- Published "Solid State Thermochemistry of Flaming Combustion" in Fire Retardancy of Polymeric Mate-

rials, the most comprehensive treatise on this subject since the early 1970s.

- Published a doctoral thesis describing the synthesis and characterization of chlorinated bisphenoly polymers, found to be among the most fire resistant polymers ever tested.
- Presented papers describing the improved fire resistance and retained mechanical properties of chloral-based epoxy and cynate ester resins for use in aircraft interior composites.
- Presented a paper describing the development and characterization of smouldering and flaming cargo fire sources that are providing the basis for developing smoke detector approval criteria.

In addition, approximately two dozen reports and published papers are generated yearly from in-house activity. Fire test laboratories are used annually to train FAA certification engineers, and program personnel participate in major accident and incident investigations involving fire at the request of the NTSB. 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. This group 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. The FAA and NASA operate 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 interagency working group on fire and materials to provide a vehicle for technology exchange among U.S. Government agencies and prevent unwarranted duplication of work. The FAA has an interagency 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 institutions. Several Fortune 100 companies share costs of developing new fire resistant materials at university-based FAA research consortia. The FAA is in the process of licensing a patented heat release calorimeter for commercialization and to foster the development of ultra-fire resistant materials. The FAA is a member of the Advanced Fire Protection Consortium comprised of fire research laboratories in NJ, PA, MD and DE.

MAJOR ACTIVITIES AND ANTICIPATED FY 2002 ACCOMPLISHMENTS:

Fire Resistant Materials

- Demonstrated fiber for seat upholstery, carpet, drapes and decorative murals with 50% reduction in heat release rate.
- Demonstrated thermoset resin for cabin decorative panels, composites and adhesives with order-of-magnitude reduction in heat release rate.
- Licensed FAA-patented pyrolysis combustion flow calorimeter (PCFC) to industry for commercialization.

Fire Safety Improvements

- Installed on-board fuel tank inerting system in 747SP and initiated test and development of the prototype system.
- Determined the lower flammability limit (LFL) curve for Jet A fuel vapor as a function of altitude.
- Determined EE Bay and attic area design conditions relevant in hidden fires and constructed test rigs.
- Evaluated aircraft wiring behavior under large and full-scale fire test conditions.
- Validated a mathematical model to predict the transport of in-flight fire products throughout a cargo compartment.
- Determined the ability of an on-board fuel tank inerting system to suppress cargo compartment fires, as a replacement for halon, and the associated weight savings.
- Completed construction of a full-scale Very Large Transport Aircraft (VLTA) test article.
- Determined replacement agents (CF_3I and HFC-125) quantities for equivalent performance to halon as specified by engine nacelle minimum performance standard.

KEY FY 2003 PRODUCTS AND MILESTONES:

Fire Resistant Materials

- Demonstrate thermoplastic for use in molded or thermoformed parts with an order of magnitude reduction in heat release rate.
- Fabricate ultra-fire resistant thermoset resin samples for physical and chemical property tests and flammability tests.
- Select optimal resin(s) for fabrication of full-scale cabin components.

Fire Safety and Improvement

- Complete testing and development of an on-board fuel tank inerting system in 747SP.
- Develop improved fire test criteria for aircraft electrical wiring.
- Develop EE Bay fire detection and suppression system and applicable design criteria.
- Revise Advisory Circular (AC) 25-9a with improved, standardized approval testing criteria for cargo smoke detectors, including new designs that minimize false alarms.
- Characterize fires in Very Large Transport Aircraft under full-scale fire test conditions.
- Initiate a study of aircraft emergency oxygen systems and related accidents/incidents.

FY 2003 PROGRAM REQUEST:

Ongoing Activities

In FY 2003, research on fuel tank protection will focus on the completion of testing to develop a practical and cost-effective on-board fuel tank inerting system, designed to inert fuel tanks on the ground. In order to improve its cost/effectiveness, the inerting system is designed to also suppress in-flight cargo fires, as an alternative to halon extinguishing agents. The testing and development of the inerting system will be done in a 747SP with operational auxiliary power unit (APU) and engines, purchased and delivered in FY 2001.

In FY 2003, improvements will be identified to safeguard against hidden in-flight fires in inaccessible areas. This new research is driven by recommendations issued by Canada's TSB in 2001 arising from the fatal Swiss Air MD-11 accident (9/2/98, 229 fatalities). The development of new fire test criteria for electrical wiring will be completed. Also, in FY 2003 the development and evaluation of a detection and suppression system for the electronics (EE) bay will be completed, including the derivation of design criteria.

In FY 2003, a revision to Advisory Circular (AC) 25-9a, "Smoke Detection, Penetration, and Evacuation Tests and Related Flight Manual Procedures", will be completed. The revised AC will culminate a multi-year research effort to develop test criteria that assures the use of detection systems that quickly detect actual fires but also minimize false alarms due to nonfire sources. Also, in FY 2003 full-scale fire tests will be completed in a Very Large Transport Aircraft (VLTA) test article, to characterize the fire hazards in double-deck mega transports, in order to determine the need for enhanced fire safety criteria in the new Airbus A380.

In FY 2003, research will continue to develop the enabling technology for ultra-fire resistant aircraft interior materials in four major categories (resins, plastics, elastomers and fibers). A thermoplastic for use in molded or thermoformed parts with an order of magnitude reduction in heat release rate will be demonstrated. Also, previously demonstrated low heat release thermoset resins will be fabricated into small coupons representative of their end-use application. The new coupons will be tested for physical and chemical properties and flammability characteristics. From this data, a resin or resins will be selected to fabricate full-scale cabin components; e.g., sidewalls, stowage bins and ceiling panels.

New Initiatives

In FY 2003, a study will be undertaken to document the design of current aircraft oxygen systems and oxygen-related fires in commercial transports. This study is the first part of a new initiative to safeguard or redesign emergency oxygen systems, which have caused or contributed to fatal fire accidents and have been the source of numerous hull losses caused by system malfunction.

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2001)	$ 100,816
FY 2002 Enacted	5,242
FY 2003 Request	6,429
Out-Year Planning Levels (FY 2004-2007)	26,225
Total	$ 138,712

Budget Authority ($000)	FY 1999 Enacted	FY 2000 Enacted	FY 2001 Enacted	FY 2002 Enacted	FY 2003 Request
Contracts:					
Fire Research and Safety	2,098	1,292	1,671	2,340	3,077
Personnel Costs	2,315	3,116	2,856	2,621	3,100
Other In-house Costs	337	342	213	281	252
Total	**4,750**	**4,750**	**4,740**	**5,242**	**6,429**

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
Basic	0	0	0	0	0
Applied	4,750	4,750	4,740	5,242	6,429
Development (includes prototypes)	0	0	0	0	0
Total	**4,750**	**4,750**	**4,740**	**5,242**	**6,429**

A11a – Fire Research and Safety Products and Activities	FY 2003 Request ($000)	Program Schedule					
		FY 2002	FY 2003	FY 2004	FY 2005	FY 2006	FY2007
061-110 Fire Research & Safety							
Fire Resistant Materials	$1,056						
Demonstrated Fiber for Seat Upholstery with 50% Reduction in Heat Release Rate		◆					
Demonstrate Resin, Thermoplastic, Elastomer & Fiber with Order of Magnitude Reduction in Heat Release, Respectively		◆	◇	◇	◇		
Down Select Polymers for Scale Up & Development of Panels, Molded Parts, Cushions & Textiles, Respectively			◇	◇	◇	◇	
Completed FAA/DFW MOA for Surface Test Bed Upgrade						◇	
Fire Safety Improvement	$2,021						
Designed and Installed a Prototype Airborne GBI Fuel Tank Inerting System		◆					
Test and Develop GBI System			◇				
Flight Test GBI Fuel Tank Inerting System				◇			
Recommend Design Criteria for a GBI Fuel Tank Protection System					◇		
Develop & Standardize Improved Fire Test Criteria for All Hidden Materials					◇		
Recommend Fire Detection & Suppression Systems for All Hidden Areas					◇		
Validated Math Model to Predict Transport of Cargo Fire Products		◆					
Revise Draft Advisory Circular for Smoke/Fire Detection			◇				
Designed & Constructed a Full-Scale VLTA Fuselage Test Article		◆					
Characterize Cabin & Fuselage Fires in VLTA			◇				
Define VLTA Fire Protection Methodology					◇		
Current Oxygen Systems Design & Accident/Incident Fire Experience			◇				
Improved Oxygen System Design Guidelines/Requirements						◇	
Personnel and Other In-House Costs	$3,352						
Total Budget Authority	**$6,429**	**$5,242**	**$6,429**	**$6,270**	**$6,455**	**$6,649**	**$6,851**

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, as well as their propellers, fuels, and fuel management systems. The major outcomes from this program include:

- Contributed to the 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 improving and standardizing 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.
- Reduced turbine engine failure/downtime and improved maintenance efficiency through advanced monitoring/diagnostic hardware and software.
- Contributed to the continued reliability and safe use of Jet A fuel containing red dye contamination.
- Provided engineering support for the certification of the next generation general aviation piston and turbine engine.

Agency Outputs: The FAA issues certification and advisory standards and supports technical society specifications and recommended practices to help ensure the continued airworthiness of aircraft engines, fuels, and airframe fuel management systems. 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, a body that 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 participates through working committees under the Aerospace Industries Association (AIA). These groups include 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 contributes leadership and participation to the testing capabilities of the Coordinating Research Council (CRC) Unleaded Aviation Gasoline Development Group. EPA regulations and the Clean Air Act of 1990 mandate removal of lead from all gasoline. The CRC group was formed in February 1995 to oversee research and testing for the development of the required next generation of high octane unleaded aviation gasoline. The critical need for the development of this fuel is reflected by the level of CRC group participants including: most major U.S. and other-national oil companies; 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 FAA Engine and Propeller Directorate in New England Region (the research sponsor); and the FAA Small Airplane Directorate in Central Region.
- The FAA sponsored Technical Oversight Group On Aging Aircraft (TOGAA) reviews technical aspects of the airworthiness assurance R&D activities. The group has provided feedback on the progress of the turbine engine program over the last four years.
- The Subcommittee on Aircraft Safety of the FAA Research, Engineering and Development Advisory Committee (REDAC) was briefed on the propulsion program, an initiative that the subcommittee strongly supports.

- 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 (AC) on the correlation, operation, design, and modification of turbofan/jet engine test cells.
- Completed a training video production entitled "Aircraft Turbine Engine Test Cell Correlation."
- Sponsored, hosted, and published the proceedings of four annual joint FAA/Air Force public workshops on the application of probabilistic design methodology to gas turbine rotating components.
- Demonstrated an integrated probabilistic rotor design and life management code (DARWIN™ version 3.2) for titanium alloys to provide commercial aircraft turbine engine manufacturers a tool to augment their current "safe life" management philosophy approach.
- Conducted the 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 for use in developing candidate fuel formulations.
- Completed motor octane tests on 202 fuel formulations from candidate matrix.
- Completed the engine endurance test on an industry-supplied fuel formulation.
- Completed a 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 the final unleaded fuel replacement determination showing that fleet high performance piston engines require over 100 octane to function properly.
- Drafted the final report on in-service Jet A fuel sample analysis volatility survey.
- Completed a report on the results of titanium melting enhancements.
- Issued the interim report that defines an acceptable concentration of red dye contamination in Jet A fuel for continuous turbine engine operation.

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 (AlliedSignal), and Rolls Royce-Allison. Work funded through this grant 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, which conducts complementary research, and with ongoing research activities of the FAA Engine Titanium Consortium sponsored under R,E&D budget item A11e, Aging Aircraft. The FAA transfers the completed probabilistic engine design code versions for use by the industry 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 include Texaco, Exxon, Phillips Petroleum, Chevron, British Petroleum, Cessna, Raytheon (Beech), Teledyne Continental, and Textron Lycoming.

Research performed under an FAA contract with the Southwest Research Institute allowed for continuous safe turbine engine operation by determining an acceptable level of fuel dye contamination. 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 (AlliedSignal) and Boeing.

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

The program is benefiting from a close working relationship with the Airworthiness Assurance Center of Excellence. All research sponsored by this center is leveraged by the monetary and intellectual contributions of its university members.

MAJOR ACTIVITIES AND ANTICIPATED FY 2002 ACCOMPLISHMENTS:

- Completed a rotor manufacturing induced anomaly database.
- Validated a DEFORM™ forging microcode for tracking subsurface anomalies.
- Demonstrated a DARWIN™ code version for application to surface anomalies.
- Continued laboratory characterization and engine ground testing of industry-supplied candidate unleaded fuels using FAA test facilities.
- Completed the final report that defines an acceptable concentration of red dye contamination in Jet A fuel for continuous engine operation.
- Completed the feasibility demonstration of a temporary safety net, high octane, unleaded piston fuel.
- Began flight tests on candidate unleaded fuels.
- Began 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.

KEY FY 2003 PRODUCTS AND MILESTONES:

- Complete turbine fuel freeze point investigation.
- Complete database of physical and mechanical properties of micro-structural elements relative to the cold dwell effect.
- Complete constitutive equations for finite element modeling of cold dwell fatigue.
- Begin fleet evaluation of successful candidate unleaded fuels.
- Complete demonstration of safety net unleaded fuel.

FY 2003 PROGRAM REQUEST:

Ongoing Activities

In FY 2003, the program continues development of a probabilistically based turbine engine rotor design code with damage tolerance assessment. This code will be a life and risk management tool to augment the current "safe life" design approach for integration into engine manufacturer rotor design procedures. The application of this tool, as an FAA-approved design certification standard, is intended to improve turbine rotor structural integrity while reducing the risk of failure.

The program also continues research on industry-provided lead free fuel formulation candidates to replace the low lead aviation gasoline (ASTM D910 100LL) currently in use. These tests evaluate new fuel formulation effects on engine detonation, material compatibility, volatility, engine performance, storage stability, water reaction, emissions, fuel consumption and engine durability. Fleet evaluations of successful candidate unleaded fuels will begin in FY03.

The program continues to develop rotor disk alloy material melt processes to establish commercial manufacturing standards that will eliminate metallurgical defects to produce premium quality, rotor grade alloy materials. Commercial aircraft accident history has shown that the presence of these defects in rotor disks has been the initiating cause of uncontained rotor failures. These failures are a

major contributor to the engine failure and fatal accident rates.

The program continues research to establish an improved understanding of the metallurgical, cold dwell time factors that shorten fatigue life in titanium rotor disk alloys. The microstructure-based modeling capability developed by this activity will enable more accurate prediction of the risk of serious engine caused accidents.

New Initiatives

In FY 2003, the program will initiate R&D support of the AIA Rotor Manufacturing Subcommittee to develop advanced manufacturing technologies. The purpose of this activity will be to qualify and control the final surface manufacturing processes that could impact rotor disk fatigue life.

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2001)	$ 54,394
FY 2002 Enacted	8,568
FY 2003 Request	5,711
Out-Year Planning Levels (FY 2004-2007)	23,565
Total	$ 92,238

Budget Authority ($000)	FY 1999 Enacted	FY 2000 Enacted	FY 2001 Enacted	FY 2002 Enacted	FY 2003 Request
Contracts:					
Propulsion Systems Research	1,761	1,754	6,994	7,344	4,279
Personnel Costs	932	1,230	1,114	1,079	1,345
Other In-house Costs	138	142	74	145	87
Total	**2,831**	**3,126**	**8,182**	**8,568**	**5,711**

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
Basic	0	0	0	0	0
Applied	2,831	3,126	8,182	8,568	5,711
Development (includes prototypes)	0	0	0	0	0
Total	**2,831**	**3,126**	**8,182**	**8,568**	**5,711**

A11b – Propulsion and Fuel Systems Products and Activities	FY 2003 Request ($000)	Program Schedule					
		FY 2002	FY 2003	FY 2004	FY 2005	FY 2006	FY2007
063-110 Propulsion and Fuel Systems Research							
Turbine Engine Research	$3,071						
Demonstrated Probabilistic integration Design Code - Surface		◆					
Deliver Probabilistic Rotor Design Code – Nickel Alloys		◆	◇	◇			
Develop Model for Residual Rotor Disk Life Assessment				◇	◇	◇	◇
Completed Rotor Manufacturing Induced Anomaly Database		◆					
Complete Equations for Finite Element Modeling of Cold Dwell		◆	◇				
Unleaded Fuels and Fuel System Safety Research	$1,208						
Characterize Engine Ground Test Candidate unleaded Fuels		◆	◇				
Determined Acceptable Concentration of Red Dye Contamination		◆					
Conduct Flight Tests on Industry Supplied Candidate Fuels		◆	◇	◇	◇		
Conduct Fleet Evaluation of Candidate Unleaded Aviation			◇	◇	◇	◇	
Complete Demonstration of Safety Net Unleaded Fuel		◆	◇				
Evaluate Ethanol Based Piston Fuel		◆	◇	◇			
Complete Turbine Fuel Freeze Point Investigation		◆	◇				
Personnel and Other In-House Costs	$1,432						
Total Budget Authority	$5,711	$8,568	$5,711	$5,698	$5,822	$5,955	$6,090

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:

- Standardized analysis and test methods for worldwide harmonization.
- Better understanding of the effects of repeated loads, damage, and joint configurations and 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 and modeling capabilities to develop understanding of aircraft crash events to lead to 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 to regulatory personnel through technical reports, handbooks, and guidance by the FAA National Resource Specialist. The goal is to develop pertinent data so that the regulatory processes keep pace with industry advances, including state-of-the-art 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 an 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.
- The Challenge 2000 report concludes that the FAA should enhance its already effective program of gathering data and improving the certification of composite structures.
- A recent 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 with attendance of approximately 1,200 experts. A three volume report on test methods for composites was disseminated to industry and government to provide an authoritative compendium on state-of-the-art composites testing with recommendations for

usage and identified gaps. One of the gaps 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 it 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 (recent example, the General Electric 90 fan blades) and has been adopted as a worldwide practice.

In the structural safety area, eight reports on in-house commuter crash testing, as well as reports on aircraft ditching and aircraft 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 a crash impact modeling code developed by the FAA 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. Currently, the FAA supports NASA's efforts to develop a composite property database for General Aviation (GA) aircraft under the NASA Advanced GA Transport Experiments (AGATE)/ Integrated Design and Manufacturing (IDM) Program. The FAA also partners with the Rotorcraft Industry Technology Association (RITA) to share in rotorcraft composite materials research.

With the U.S. Army, the FAA cosponsors MIL-HDBK-17, a primary and authoritative source for statistically based characterization data of current and emerging composite materials. This international reference reflects the best available data and technology for testing and analysis, and includes data development and usage guidelines. The handbook is used by FAA officials 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.

The agency has coordinated research efforts in the crash testing area with the French and Italian Governments through memoranda of cooperation and an exchange of personnel. 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 to develop crash dynamic models and experimental energy absorbing seats.

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 2002 ACCOMPLISHMENTS:

Advanced Materials

- Established criteria for surface preparation of adhesive joints.
- Completed database on in-plane shear test methods and developed a new improved standard.
- 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 commuter aircraft with wing main spar seating.
- Concluded overhead stowage bin and auxiliary fuel tank research.
- Published data on crash resistance of transport aircraft stowage bins.

KEY FY 2003 PRODUCTS AND MILESTONES:

Advanced Materials

- Develop standardized materials and process specification to better control material properties.
- Develop software and establish guidelines for in-flight loads and environmental criteria to be used in certification of GA aircraft.

Structural Safety

- Complete rotorcraft ditching research in conjunction with the Navy.
- Develop in-house capability to model aircraft crash events.
- Complete analytical modeling of seat cushions.

FY 2003 PROGRAM REQUEST:

Ongoing Activities

In FY 2003, the program continues to focus on the areas listed above at the beginning of the GOALS section. Specific areas are the standardization of material and process specifications and the development of software to predict concurrently in-flight aircraft loads and environment so as to better define these parameters for certification of general aviation airplanes. Modeling of textiles and their characterization will continue in order to understand their load resistance and damage tolerance characteristics. In addition, work will continue to develop data applicable to rotorcraft and fan blades, including high-cycle fatigue.

Within the structural safety area, a unified analytical modeling capability will be under development in order to reduce costly testing. The models will include the response of seats, restraint systems, seat attachments, and airframes under dynamic crash conditions. In FY2003 seat cushion modeling will be a specific area of activity.

Other areas of research to be continued are crash resistance of fuel systems, determination of occupant injury protection criteria applicable to side facing seating in business jets. After conducting the vertical drop test of a currently in-service commuter aircraft, sufficient data will be available to compile a crash test database for all types of aircraft.

New Initiatives

In out-years several new initiatives are envisioned in advanced materials. These would address the use ceramics and nanomaterials in aircraft parts and in particular in aircraft engines. These applications will necessarily involve standardization of testing at elevated temperatures.

In crashworthiness, more emphasis will be placed on rotorcraft issues. For that purpose, a drop test is scheduled for FY2004 with studies of Medivac configurations and roll-over to follow. In out-years, the use of airbags in airplane crash scenarios will be studied to judge their effectiveness.

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2001)	$ 62,583
FY 2002 Enacted	2,974
FY 2003 Request	3,053
Out-Year Planning Levels (FY 2004-2007)	12,582
Total	$ 81,192

Budget Authority ($000)	FY 1999 Enacted	FY 2000 Enacted	FY 2001 Enacted	FY 2002 Enacted	FY 2003 Request
Contracts:					
Advanced Materials	347	596	975	962	971
Structural Safety	462	493	819	808	845
Personnel Costs	803	1,109	937	1,091	1,162
Other In-house Costs	122	140	60	113	75
Total	**1,734**	**2,338**	**2,791**	**2,974**	**3,053**

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
Basic	0	0	0	0	0
Applied	1,734	2,338	2,791	2,974	3,053
Development (includes prototypes)	0	0	0	0	0
Total	**1,734**	**2,338**	**2,791**	**2,974**	**3,053**

A11c – Advanced materials/Structural Safety Products and Activities	FY 2003 Request ($000)	Program Schedule					
		FY 2002	FY 2003	FY 2004	FY 2005	FY 2006	FY2007
062-111 Advanced Materials Structures							
Advanced Materials	$971						
Established Criteria for Surface Preparation of Adhesive Joints		◆					
Completed Database on In-Plane Shear Test Methods		◆					
Developed Analytical Methods for Bonded Joints		◆					
Developed Analytical Methods for Sandwich Structures		◆					
Develop Software and Criteria for Environment and Loads			◇				
Develop Standard Specifications			◇				
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	$845						
Published Data on Crash Resistance of Transport Aircraft Stowage Bins		◆					
Concluded Overhead Storage Bin and Fuel Tank Research		◆					
Concluded a Vertical Drop Test of Commuter Aircraft		◆					
Develop Analytical Capability to Model Aircraft Crash Events			◇				
Complete Rotorcraft Ditching Research in Conjunction with the Seat Cushion Modeling			◇				
Establish Crash Test Database				◇			
Rotorcraft Drop Test				◇			
Seat/Occupant Modeling					◇		
Improve Crash Resistance of Transport Fuel Systems						◇	
Rotorcraft Rollover Study						◇	
Determine Airbag Effectiveness							◇
Personnel and Other In-House Costs	$1,237						
Total Budget Authority	$3,053	$2,974	$3,053	$3,023	$3,102	$3,185	$3,272

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 they 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. It also develops technology (ice protection and detection) and data packages to support certification requirements and advisory material to ensure that aircraft meet performance, stability, and control safety standards during or after in-flight operation in icing conditions.

The software and digital systems safety program addresses aircraft safety and certification issues that involve the use of emerging, highly complex, software-based digital flight controls and avionics systems in flight-essential and flight-critical applications. Research on electromagnetic hazards to aircraft systems 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, such as tape players, laptop computers, cellular phones, etc.

Agency Outputs: The FAA establishes rules for aircraft operation in icing conditions and the electromagnetic environment. The agency also regulates conditions involving aircraft software, digital flight controls, avionics systems, and electromagnetic hazards. It publishes Advisory Circulars (AC) to outline acceptable means for meeting the rules and disseminates various forms of technical information to agency certification and airworthiness specialists, agency inspectors, and the aircraft and avionics industry. The program fosters development of promising technologies, such as sensors, to detect frozen contamination and anti-icing fluid failure. The aircraft icing project joins with Transport Canada in providing annual updates to the aircraft holdover time guidelines concerning time of effectiveness of de/anti-icing fluids.

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."* Also, the program directly supports the Safety Strategic Focus Area of Accident Prevention through enhancements to aircraft certification, inspection, and maintenance relative to atmospheric hazards and advanced software and digital systems. The program further supports Challenge 2000 through research and increased awareness in the area of software and standardization efforts among the certification directorates. In addition, it supports the Free Flight initiative, addressing highly integrated avionics and ground-based systems safety and certification issues involving the use of very complex software. Research also provides key support to the Aviation Rulemaking Advisory Committee (ARAC) Electromagnetic Effects Harmonization Working Group (EEHWG).

The ARAC Flight Test Harmonization Working Group (FTHWG) addresses performance and handling requirements standardization, and guidance material for operation in icing conditions. The ARAC Ice Protection Harmonization Working Group (IPHWG) addresses the definition of an icing environment that includes Supercooled Large Droplets (SLD). It provides means, such as ice detectors, to discriminate between conditions within and outside the icing certification envelopes and to warn flight crews of ice accumulation on critical surfaces. Both of these ARAC working groups are 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 up-

dates, 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. in the form of technical reports, handbooks, information bulletins, ACs and rules. Since 1992, the program has updated or issued two ACs, six technical bulletins, and the Aircraft Icing Handbook (thrice), and it has published more than 50 technical reports or papers, including reports on ice phobic technologies. It has held international conferences on aircraft ground deicing (more than 600 participants from more than 10 countries), on aircraft in-flight icing (more than 400 participants from 20 countries), and on mixed-phase and glaciated icing conditions (more than 50 participants from five countries). It has also issued holdover time guidelines for deicing and anti-icing fluids.

In the area of software and digital systems safety, a Modified Condition Decision Coverage (MCDC) report 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 aircraft software as well as hardware, were developed. A detailed design data and hardware implementation plan formed part of a published complex electronic hardware case study, and acceptance criteria for using Software Service History (SSH) on certification projects were also published. In addition, an Advanced Flight Control Systems research plan 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. 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 interagency 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 with Transport Canada on research on aircraft ground deicing issues.
- An international memorandum of cooperation with the Meteorological Service of Canada for research on in-flight icing conditions.
- An Interagency agreement with the Air Force for development of a new icing tanker for military and commercial use.
- Direct support to the ARAC IPHWG with data on and analysis of SLD conditions in the atmosphere.

MAJOR ACTIVITIES AND ANTICIPATED FY 2002 ACCOMPLISHMENTS:

Aircraft Icing

- Continued consolidating and assessing atmospheric icing data aloft.
- Evaluated time effectiveness and aerodynamic performance of environmentally friendly and other modern fluids.

- Completed study of airfoil sensitivity to location, size, and shape of geometric representations of ice shapes.
- Published report on recycled glycol technologies/utilization.
- Recommended practices for icing simulation tools.
- Published interim report on procedures and methods for laboratory determination of fluid holdover times.

Software and Digital Systems Safety.

- Completed study and published a report on acceptance criteria/guidelines for verification issues in Object Oriented Technology (OOT).
- Completed study and published a report on COTS operating systems software and protection schemes.
- Completed work in the complex electronic hardware case study and published report.
- Completed study and published report on Advanced Flight Control Systems.

Electromagnetic Hazards to Aircraft Systems

- Published interim NASA report on spurious emissions from cell phones and Portable Electronic Devices and the effects on aircraft navigation equipment.
- Published final report from lightning strike characterization study for definition of aircraft lightning environment.
- Revised RTCA DO-160 and prepared advisory circular with updated electromagnetic compatibility test methods and requirements for large systems.
- Continued "Electro Magnetic Interference/Electro Magnetic Compatibility (EMI/EMC) Continued Protection Integrity Investigation" for aging aircraft systems and components and recommend methods for detecting EMC performance degradation.
- Published Protection Integrity Report.

KEY FY 2003 PRODUCTS AND MILESTONES:

Aircraft Icing

- Evaluate time effectiveness and aerodynamic performance of environmentally friendly and other modern fluids.
- Report on global atmospheric icing environment.
- Report on acquisition of atmospheric icing data from operational aircraft.

Software and Digital Systems Safety

- Complete investigation of Phase 1 of protection architectures as a protection methodology for safety of COTS software in airborne systems.
- Complete phase 1 for a study of OOT for issues other than verification.
- Report on Research of Software Development Tools.

Electromagnetic Hazards to Aircraft Systems.

- Revise AC 20-136 and release AC 20-xx with updated lightning environment and test waveform definitions.
- Release HIRF protection certification test method assessments for Aircraft Certification Office (ACO) engineer training.
- Provide advisory materials and test methods for HIRF protection certification on complex, highly integrated, and flight-critical electronic and electrical systems.
- Provide technical data on the effects of portable electronic devices on aircraft radio systems, considering new wireless RF technology being introduced.
- Continue Electro Magnetic Interference/Electro Magnetic Compatibility (EMI/EMC) continued protection integrity investigation for aging aircraft systems and components.

New Initiatives

Aircraft Icing

- Assess risk of airplane takeoff operations with inadvertent ice accumulation between deicing/anti-icing and takeoff.
- Study icing simulation improvement for SLD conditions.

Software and Digital System Safety

- Research the partitioning and projection of the Avionics Computer Resource concept.
- Research software quality metrics and indicators for the safety and integrity factors applicable to software products and services.
- Investigate/define criteria to be employed in the safe operation of aircraft so as to provide effective protection from abnormal operation of ground-based COTS components.
- Investigate tool qualification of complex electronic hardware for development and verification purposes.

- Research the class of operating systems called the real-time operating system, which will handle operations within set maximum times.
- Research software development tools to improve software development process.

Electromagnetic Hazards to Aircraft Systems

- Define the Single Event Effects (SEE) environment as an essential step to ensure safe operation of new-generation electronics in flight-critical systems. The current and future SEE avionics systems risk will help define the appropriate role of future regulations.

FY 2003 PROGRAM REQUEST:

Ongoing Activities

Aircraft Icing

- Continue to collect and assess the global atmospheric icing environment data, including steps to acquire data from operational aircraft.
- Continue to investigate procedures and methods for laboratory determination of fluid holdover times.
- Continue to investigate and assess ice detection technologies.

Software and Digital System Safety

- Continue to research emerging flight safety and certification issues identified by CAST and RTCA subcommittee efforts.
- Continue to research COTS software and hardware issues involving protection architectures.

Electromagnetic Hazards to Aircraft Systems

- Continue to research lightning protection, HIRF protection, electromagnetic compatibility, in-service lightning data, and continued EMI/EMC integrity.

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2001)	$ 58,403
FY 2002 Enacted	6,420
FY 2003 Request	4,430
Out-Year Planning Levels (FY 2004-2007)	18,298
Total	$ 87,551

Budget Authority ($000)	FY 1999 Enacted	FY 2000 Enacted	FY 2001 Enacted	FY 2002 Enacted	FY 2003 Request
Contracts:					
Flight Safety	261	345	167	165	788
Atmospheric Hazards	1,233	1,598	2,490	4,722	1,990
Personnel Costs	973	1,744	1,349	1,388	1,546
Other In-house Costs	152	157	94	145	106
Total	**2,619**	**3,844**	**4,100**	**6,420**	**4,430**

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
Basic	0	0	0	0	0
Applied	2,619	3,844	4,100	6,420	4,430
Development (includes prototypes)	0	0	0	0	0
Total	**2,619**	**3,844**	**4,100**	**6,420**	**4,430**

A11d – Flight Safety/Atmospheric Hazards Research Products and Activities	FY 2003 Request ($000)	Program Schedule					
		FY 2002	FY 2003	FY 2004	FY 2005	FY 2006	FY2007
064-110 Flight Safety							
Software and Digital Systems Safety	$788						
Published Report on COTS Operating Systems		◆					
Evaluate COTS Software and Hardware Protection			◇	◇			
Published Report on Verification Issues for Object Oriented		◆					
Published Report on Acceptance Criteria for using Software Service History		◆					
Report on Research of Software Quality Metrics and Indicators			◇	◇	◇		
Report on Research of Ground-Based COTS Components			◇	◇	◇		
Report on Research of Software Development Tools			◇	◇	◇	◇	◇
064-111 Atmospheric Hazards							
Aircraft Icing	$1,446						
Continue Consolidating and Assessing Atmospheric Icing Data		◆	◇				
Evaluate Time of Effectiveness & Aerodynamic Performance		◆	◇				
Report on Acquisition of Atmospheric Icing Data from Operational Aircraft			◇				
Report on Global Atmospheric Icing Environment			◇				
Published Fluid Failure & Holdover Times Procedures				◇			
Report on Icing Simulation Improvement for SLD Conditions					◇		
Report on Investigation and Assessment of Ice Detection						◇	
Report on Airplane Takeoff Operations and Performance in Icing Conditions							◇
Electromagnetic Hazards to Aircraft Systems	$544						
Published High Intensity Radiated Fields (HIRF) User's Guide		◆					
Published Report on Characterization of Aircraft Lighting		◆					
Publish Lighting User's Manual for AC 20-136			◇				
Revised RTCA DO-160 Section 20 for Electromagnetic Capability		◆					
Publish Protection Integrity Reports		◆	◇	◇	◇		
Publish HIRF Protection Analysis Techniques Report			◇				
Publish Reports on Single Event Effects and Upset				◇	◇	◇	◇
Personnel and Other In-House Costs	$1,652						
Total Budget Authority	$4,430	$6,420	$4,430	$4,401	$4,513	$4,631	$4,753

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.
- Design and conduct of flight and landing load 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 agency 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 used 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:

- The Aviation Rulemaking Advisory Committee (ARAC)—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 FAA chartered Technical Oversight Group on Aging Aircraft (TOGAA)—a forum of recognized experts in the areas of aircraft design and maintenance that meets several times a year to assess program progress and plans and promote the effective coordination of aging aircraft program activities with related activities in DOD and industry.
- The Subcommittee on Aircraft Safety (SAS) of the FAA Research, Engineering and Development Advisory Committee (REDAC)—a permanent forum of experts from industry, academia, and government agencies who periodically review the Aging Aircraft and other safety-related research programs.

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 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 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's 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, by about a third, the number of

flight cycles required to grow a fatigue crack to a predetermined length. 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, continues to expand its resources. The Center 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.

AANC Researchers 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 the ARAC 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 aging aircraft. Promising techniques include a novel 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 have been reestablished for both large and small transport aircraft. To collect flight loads data, optical quick access recorders have been installed on several B-737, B-757, 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 and CRJ commuter 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, five 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 have developed repair assessment software that automatically determines the critical locations for cracks and uses two-dimensional finite element analysis to assess continuing crack growth through multiple rivet holes. A fully-detailed design report is automatically generated to assist users in the development documents required for FAA airworthiness approval. To date, hundreds of copies of the Rapid Assessment Procedure and Integrated Design for Commuters (RAPID and RAPIDC) have been requested and furnished to FAA Aircraft Certification Office (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 (SSID). 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 manufacturers. These research areas address the FAA and rotorcraft industry's 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's 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. Interagency agreements are in place between the FAA and NASA, the U.S. Navy, the U.S. Air Force, and DOE. The FAA, DOD, and NASA have cosponsored five 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 four universities, Iowa State University, Northwestern University, Wayne State, and Ohio State University, formed to develop advanced inspection technologies.
- The Airworthiness Assurance Nondestructive Inspection Validation Center (AANC)—an 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)—a collaborative body 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 (CRDA) are in place with several airline operators as part of the flight loads data collection program.

International agreements are in place between the FAA and the regulatory authorities in the Netherlands, Russia, and China.

MAJOR ACTIVITIES AND ANTICIPATED FY 2002 ACCOMPLISHMENTS:

- Published a major technical report on the analysis widespread fatigue damage. The report contains guidance regarding the analysis of the effects of widespread fatigue damage on the residual strength of aircraft structure and the prediction of its onset.
- Completed a draft report on ultrasensitive eddy-current technique for early fatigue crack detection.
- Completed data analysis for a probability-of-detection study addressing composite inspection techniques.
- Completed an Airworthiness Assurance Working Group (AAWG)-requested round-robin assessment of emerging nondestructive inspection systems for crack detection.
- Published a report on comparative analysis of corrosion detection techniques.
- Published a report on the development of a neural-net based methodology for the prediction of the in-flight loads in the empennage of a general aviation aircraft.
- Published flight-load data reports for the Airbus A-320 model aircraft.
- Drafted landing-load reports from video landing parameter survey at London's Heathrow airport.
- Installed enhanced flight data recorders on Cessna 172 model aircraft.
- Released an enhanced version of RAPIDC, a user-friendly software tool for damage tolerance analysis and design of aircraft repairs for commuter aircraft.
- Published a report on Helicopter Usage Monitoring Systems (HUMS) with structural monitoring capabilities. The report will contain draft requirements for certification of HUMS.
- 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 examining curved entry surfaces.
- Published a report on crack-growth-based predictive methodology for inspection and maintenance programs for non-rotating, safety critical components of aircraft engines.
- Completed flight testing of a first generation, prototype arc-fault circuit interrupter for aircraft applications.
- Characterized and configured AANC 747 test-bed aircraft for testing of select electrical and mechanical systems.
- Published results of aged circuit breaker tests to determine whether their trip characteristics change over time.

KEY FY 2003 PRODUCTS AND MILESTONES:

- Complete teardown of a high-time large transport aircraft. Results will be used to provide FAA field personnel with technical and policy guidance regarding use of teardown inspection results for validation of continued airworthiness.
- Update Mil-Handbook 5 or publish commercial equivalent.
- Complete development of field prototype thermosonic inspection system for small crack detection.
- Complete a draft AC on the use of composite patches for the repair of metallic fuselage structure.
- Publish a report on Boeing 747 flight loads survey.
- Publish a report on lateral acceleration loads.
- Publish a commuter SSID Handbook with instructions for developing maintenance programs for aircraft at or near their design service objectives.
- Working with SAE, publish a revised specification for high speed bolt hole eddy current inspection (AS4787).
- Publish a report assessing the detectability of high-density inclusions in billets and forgings.
- Complete a validation study on liquid penetrant inspection methodology.
- Publish a final report on the destructive testing of flight control mechanisms.
- Complete development of first-prototype risk assessment algorithms for in-service evaluation of original and modified aircraft wiring installations.
- Complete 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.

FY 2003 PROGRAM REQUEST:

Ongoing Activities

In FY 2002, the program continues to focus on the areas listed above at the beginning of the GOALS section. The near-term emphasis will be on a better understanding of the effects of Widespread Fatigue Damage (WFD), collecting more comprehensive data on aircraft loads, and developing and validating enhanced inspection techniques. Application-specific efforts continue in the areas of commuter aircraft, rotorcraft, and turbine engines.

New Initiatives

Electrical and Mechanical Systems tasking continues to evolve as requirements emerge from preliminary studies and the recommendations of ATSRAC. New tasking in the area of electrical systems research includes assessments of the effects of corrosion inhibitor and accidental abuse on electrical wiring. Mechanical systems tasks focusing on flight control mechanisms beginning in late FY01 will continue through 2002 and 2003. A series of mechanical systems risk assessments will begin with an analysis of flight control systems.

Research initiatives focusing on the application of damage tolerance concepts to aircraft propellers are currently in the planning stage.

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2001)	$ 235,678
FY 2002 Enacted	32,000
FY 2003 Request	26,217
Out-Year Planning Levels (FY 2004-2007)	108,840
Total	$ 402,735

Budget Authority ($000)	FY 1999 Enacted	FY 2000 Enacted	FY 2001 Enacted	FY 2002 Enacted	FY 2003 Request
Contracts:					
Aging Aircraft	11,945	17,714	29,250	27,351	21,429
Personnel Costs	2,381	3,547	3,451	4,041	4,480
Other In-house Costs	368	333	610	608	308
Total	**14,694**	**21,594**	**33,311**	**32,000**	**26,217**

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
Basic	0	0	0	0	0
Applied	14,694	21,594	33,311	32,000	26,217
Development (includes prototypes)	0	0	0	0	0
Total	**14,694**	**21,594**	**33,311**	**32,000**	**26,217**

A11e – Aging Aircraft Products and Activities	FY 2003 Request ($000)	Program Schedule					
		FY 2002	FY 2003	FY 2004	FY 2005	FY 2006	FY2007
065-110 Aging Aircraft							
Structural Response Simulation and Modeling	$1,513						
Conduct Teardown of High Time Large Transport Aircraft		◆	◇	◇			
Continue Support for Mill-Handbook 5 (Standard Reference)		◆	◇	◇	◇	◇	◇
Conduct Curved Panel Testing at FASTER Facility		◆	◇	◇	◇		
Inspection Systems Research and Development	$5,250						
Develop Crack Detection Technologies		◆	◇	◇			
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	$1,302						
Conduct Large Transports and Commuter Loads Surveys		◆	◇	◇	◇		
Conduct Landing Parameter Surveys		◆	◇	◇			
Publish Flight Loads Reports			◇				
Structural integrity of Commuter Aircraft	$379						
Publish Guidance Material for Development of SSIDs		◆	◇				
Complete Validation and Enhancement of Repair Assessment		◆	◇				
Rotorcraft Structural Integrity and Safety	$2,703						
Develop Hums Requirements		◆	◇	◇	◇		
Develop Rotorcraft Damage Tolerance Methodologies		◆	◇	◇	◇		
Continued Airworthiness of Aircraft Engines	$2,051						
Develop Enhanced Production Inspection Systems		◆	◇	◇			
Complete Validation of Enhanced In-Service Inspection Tools		◆	◇				
Assess and Verify Inspection Systems Performance		◆	◇	◇	◇		
Conduct Propeller Damage Tolerance Evaluation			◇	◇	◇	◇	
Aging Mechanical Systems	$735						
Publish Report on Destruction Testing of Flight Control		◆	◇				
Conduct Risk Assessment for Aging Mechanical Systems		◆	◇	◇	◇	◇	
Aging Electrical Systems	$7,496						
Completed Arc-Fault Circuit Breaker for Aircraft		◆					
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	$4,788						
Total Budget Authority	**$26,217**	**$32,000**	**$26,217**	**$26,387**	**$26,916**	**$27,480**	**$28,057**

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 malfunctions and potential solutions (with the help of industry).
- Explosive fuel tank issues, where the current focus is on the fuel quantity indication system wiring and the impact of sulfide deposits.

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)—an 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) provides guidance to this program for the update of AC20-128.
- A series of FAA-sponsored workshops on turbine engine uncontainment characterization, modeling, and mitigation. These meetings brings together industry and government (civil and military) to review progress on specific subjects and recommend future courses of action.
- FAA partnerships with industry developed through the ARAC PPIHWG to collaborate in developing a modeling toolkit for the modeling of engine uncontainment events.
- The Aerospace Industries Association (AIA) - Transport Committee (TC)—a group that, with the participation of industry and FAA, periodically examines and reports on propulsion system malfunctions and inappropriate crew response. This project recommend courses of action to foster safety and to develop associated regulations and advisory materials.

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 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.
- Initiated cooperative evaluation of vulnerability models with the U.S. Air Force as part of two ongoing aircraft modifications.
- Continued modifications to vulnerability code based on airframe manufacturers' evaluations.
- Developed generic twin and business jet aircraft vulnerability models in support of ARAC
- 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.

Explosive Fuel Tank Issues

- Continued research to develop and implement corrective actions to eliminate the ignition risk posed by silver-sulfide deposits on fuel quantity indication system components inside fuel tanks.

Propulsion Malfunction

- In conjunction with sponsors, developed a plan for supporting ARAC. Initiated work on Indications of Propulsion System Malfunctions.

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

- Interagency agreement with Naval Air Warfare Center Weapons Division, 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.
- Interagency agreement with Lawrence Livermore National Laboratory, which partners with Boeing, Honeywell Engines, and Pratt & Whitney, to develop a modeling toolkit to model turbine engine uncontainment events.
- Center of Excellence contract with SRI, which partners with University of Dayton Research Labs and Arizona State University, with in-kind support provided by Boeing and B. F. Goodrich.
- Interagency Agreement with NASA Glenn for cooperation on turbine engine uncontainment. NASA provides test support to the new Center of Excellence Grant for Engine Containment.

MAJOR ACTIVITIES AND ANTICIPATED FY 2002 ACCOMPLISHMENTS:

Engine Uncontainment Research

- Completed the Uncontained Engine Debris Damage Assessment Model (UEDDAM) vulnerability code.
- Completed work on a calibrated design tool to model engine uncontainment debris impact with titanium and aluminum aircraft materials.
- Completed advanced containment and mitigation material DYNA-3D model for designers.
- In response to uncontained engine initiated fires at Philadelphia in 2000 and Atlanta in 1995, undertook a study to develop a mitigation program for severed pressurized fuel line fires in dry bays.
- Completed calibrated design system for certification purposes.

Propulsion Malfunction

- Developed definitions and recommendations for the three top engine malfunctions (surge, asymmetric thrust and engine failure) that trigger incidents.

Explosive Fuel Tank Issues

- Continued research into explosive fuel tank issues, focusing on ignition. Developed guidance in support of the fuel tank safety Special Federal Aviation Regulation (SFAR) that supports certification of systems that eliminate the ignition risk of silver-sulfide deposits.

KEY FY 2003 PRODUCTS AND MILESTONES:

Engine Uncontainment Research

- Complete the Uncontained Engine Debris Damage Assessment Model (UEDDAM) vulnerability code with composite material penetration equations.
- Complete work on a calibrated design tool to model engine uncontainment debris impact with thick plate shielding of titanium and aluminum aircraft materials.

FY 2003 PROGRAM REQUEST:

Ongoing Activities

Work will continue in collaboration with industry and DOD to refine and validate the uncontainment tool kit. New materials will be characterized and added to the validated tool kit, including composite materials for general aviation aircraft.

The program continues to modify aircraft vulnerability codes to incorporate suggestions obtained from airframe manufacturers' evaluations. It continues to work toward the certification of a calibrated design system that examines engine uncontainment by modeling the mitigation effects of advanced materials and improving penetration equations for aluminum and titanium. Uncontained engine failures are the result of rotating component failures.

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

The program will close out efforts related to examining issues and potential solutions to the explosive fuel tank issue in FY 2003.

New Initiatives

All work in this program is covered under Ongoing Activities.

- Complete Center of Excellence effort on advanced multi-layer composite containment DYNA-3D model for designers.

Propulsion Malfunction

- Continue research in propulsion malfunction identifications and monitoring.

Explosive Fuel Tank Issues

- Close out research related to ignition sources and publish reports.

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2001)	$ 22,586
FY 2002 Enacted	2,794
FY 2003 Request	1,920
Out-Year Planning Levels (FY 2004-2007)	8,074
Total	$ 35,374

Budget Authority ($000)	FY 1999 Enacted	FY 2000 Enacted	FY 2001 Enacted	FY 2002 Enacted	FY 2003 Request
Contracts:					
Aircraft Catastrophic Failure Prevention	1,329	1,308	2,131	2,101	1,391
Personnel Costs	397	607	610	621	502
Other In-house Costs	61	66	35	72	27
Total	**1,787**	**1,981**	**2,776**	**2,794**	**1,920**

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
Basic	0	0	0	0	0
Applied	1,787	1,981	2,776	2,794	1,920
Development (includes prototypes)	0	0	0	0	0
Total	**1,787**	**1,981**	**2,776**	**2,794**	**1,920**

A11f – Aircraft Catastrophic Failure Prevention Research Products and Activities	FY 2003 Request ($000)	Program Schedule					
		FY 2002	FY 2003	FY 2004	FY 2005	FY 2006	FY2007
066-110 Aircraft Catastrophic Failure Prevention Research							
Engine Uncontainment Research	$566						
Completed Calibrated Design Tool to Model Uncontainment Debris Impact with Titanium and Aluminum		◆					
Completed DYNA-3D Model of Advanced Containment & Mitigation Materials		◆					
Completed UEDDAM Vulnerability Model		◆					
Completed Calibrated Design System for Certification Purposes		◆					
Expand Vulnerability Material Database for Thick Metal Shields			◇				
Expand Vulnerability Material Database to Include Composite Structure				◇			
Complete Containment Modeling Development for Metal/Multi-Layer Fabric Structure				◇			
Develop Dry Bay Mitigation Recommendations				◇			
Explosive Fuel Tank Issues	$0						
Completed Second Interim Report on Sulfide Deposits		◆					
Complete Work on Sulfide Deposits			◇				
Propulsion Malfunction	$825						
Develop Recommendations for Propulsion Malfunction Indications		◆	◇				
Demonstrate Advanced Monitoring Capabilities				◇			
Develop Recommendations for Propulsion Monitoring System					◇		
Personnel and Other In-House Costs	$529						
Total Budget Authority	$1,920	$2,794	$1,920	$1,949	$1,994	$2,041	$2,090

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 assessment, 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 methods 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 guidelines for using on-board Built-in Test Equipment (BITE) as approval to return aircraft to service after maintenance.
- Development, with input from the industry, of 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 Regulation (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 FAR and aviation safety standards. The outputs from the Aviation Safety Risk Analysis research program improve hazard/risk identification/prioritization, data, data gathering techniques, analysis, and risk management/decision support tools needed for FAA oversight (certification, surveillance, investigation, and certificate management) processes. 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 in an automated environment by using a well-trained workforce equipped with reengineered business processes, and comprehensive safety data and risk management/decision support tools and models. In support of this effort, the ASRA program will provide: systems engineering; analyses of the 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 (FMECAs), 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.

Several analytical tools, such as SPAS, will be used by the Department of Defense in their oversight of defense contract carriers and charters.

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 recommends that 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: Full deployment of SPAS II was completed by December 1999. SPAS is a computer-based analytical tool used by FAA aviation safety inspectors and certification engineers, as well as DOD aviation analysts, to support the oversight activities of FAA certificate holders (i.e., air operators, air agencies, aircraft, and air personnel). Research in support of SPAS was completed in FY02 with the release of a FAR-145 analytical module and other aircraft-specific performance measures. Functional models of air carrier operations, repair station operations, and training simulators were completed with a focus on "system safety." Initial DSS studies of decision support system tools have been completed. In addition, the FAA and NASA have co-sponsored workshop on risk analysis and safety performance measures. The focus of these workshops has been to promote the knowledge-sharing of philosophies, approaches, models, and methodologies among the air carriers and various air operators, including major carriers, 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, Rutgers University is contributing to the development of the Aviation System Risk Model and Aviation Safety Analysis and Robust Statistical Methodology.

MAJOR ACTIVITIES AND ANTICIPATED FY 2002 ACCOMPLISHMENTS:

Risk Management Decision Support

- Continued development of systems engineering models of FAA-certificated entities (or FAR parts) within the air transportation system.
- Continued development of risk/hazard/accident models and tools derived from FAA- and industry-accepted FAR system safety oversight models.
- Continued the design of next generation safety critical performance measures and risk indicators based on system engineering and system safety models. These tasks were accomplished in conjunction with industry.
- Began to integrate system models with 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 and incorporation of safety critical performance measures and repair station module into flight standards (SPAS).
- Continued a decision support system requirements study.
- Continued workshops with industry to discuss aviation risk analysis and safety performance measurement methodologies and tools.
- Completed the development of the Aviation Safety Risk Management System.

- Initiated SASO information requirements study and analysis.
- Initiated the development of methodological and operations research studies to determine 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 one-time or 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 it into the web-based Maintenance Malfunction Information Reporting (MMIR) system to track actual flight hours/flight profiles of helicopters.
- Completed a generic model for the continuing analysis and surveillance (CASS) of the performance and effectiveness of a carrier's inspection program covering the carrier's maintenance, preventive maintenance, and alterations.

Safety Analysis Methodology

- Continued the analysis of airworthiness information to identify unsafe conditions and assess their relative impact on continued airworthiness.
- Continued to establish the standard probability of values of encountering the subject conditions as addressed in Appendix 4 of Advisory Circular 25.1309-1B.
- Initiated the development of a methodology for evaluating flight crew interface design features relevant to pilot response to failure conditions.
- Completed a review of FAA-maintained certification and continued airworthiness data and began development of methods for the sorting and evaluating of certification and continuous airworthiness data to identify technical problems posing a fleet-wide safety risk.

KEY FY 2003 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 the 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 hosting workshops with industry to discuss aviation risk analysis and safety performance measurement models and methods.
- Complete the development of the Aviation Safety Risk Management System.
- Continue the design of decision support system options analysis.
- Continue the development of Risk/Hazard/ Accident models and tools.
- Continue the development of methodological and operations research studies to determine the target level of safety for relevant safety parameters for air carrier operations.

Aircraft Maintenance - Maintainability and Reliability

- Continue 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.
- Complete the 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 the analysis of airworthiness information to identify unsafe conditions and assess their relative impact on continued airworthiness.
- Release a prototype tool for determining historical hazards ratios of unsafe conditions of power plant and auxiliary power unit on transport category airplane.
- Continue to establish the standard probability of values of encountering the subject conditions as addressed in Appendix 4 of Advisory Circular 25.1309-1B.
- Continue the development of a method for evaluating flight crew interface design features relevant to pilot response to failure conditions.
- Complete development of methods for sorting and evaluating certification and continuous airworthiness data to identify technical problems posing a fleet-wide safety risk.

FY 2003 PROGRAM REQUEST:

ONGOING ACTIVITIES

- In FY 2003 research continues to focus on the areas listed at the beginning of the GOALS section above. Data assimilation, analysis, and tool development continue in support of program initiatives. The analysts 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 investigates, tests, and recommends improvements, including standardization, to the quality (and quantity) of data used in the performance measures. It also completes studies to identify and verify flight standards and aircraft certification safety information requirements.

NEW INITIATIVES

Aircraft Maintenance - Maintainability and Reliability

- Initiate an assessment, and where appropriate, identify methods, techniques, etc. to improve certification and maintenance processes that are currently in place throughout the airplane's service life.

Terminal Area Safety

- Provide improved safety and efficiency in terminal area operations and facilitate increased system capacity within the National Airspace System (NAS). The initial impetus will be to address Land and Hold Short Operations (LAHSO). Some critical tasks will be to:
- Develop a definitive index of the landing distances associated with aircraft that currently comprise the U.S. fleet of both general aviation, commuter and commercial aircraft.
- Validate and document braking system performance for both general aviation and commercial aircraft.
- Analyze data from digital flight data recorders and air traffic control radar to provide landing performance data. The data will be used to provide direct answers about field experience and to validate simulator models.
- Establish a new or improve an existing tracking system. Data currently does not specifically identify LAHSO incidents. There are also indications that some events are not reported. In addition, analyze other possible sources of data that may not have the drawbacks of manual self-reporting.
- Validate the 1000-foot cushion allowed in the LAHSO Order 7110.118.
- Conduct advanced simulation studies to quantify the any advantages of using visual vertical guidance, such as precision approach path indicator or visual approach slope indicator equipment, as determined by touchdown performance with and without the systems.

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2001)	$ 30,478
FY 2002 Enacted	5,784
FY 2003 Request	6,926
Out-Year Planning Levels (FY 2004-2007)	28,584
Total	$ 71,772

Budget Authority ($000)	FY 1999 Enacted	FY 2000 Enacted	FY 2001 Enacted	FY 2002 Enacted	FY 2003 Request
Contracts:					
Aviation Safety Risk Analysis	5,555	5,286	5,150	4,377	5,400
Personnel Costs	794	1,393	1,414	1,253	1,428
Other In-house Costs	122	145	78	154	98
Total	**6,471**	**6,824**	**6,642**	**5,784**	**6,926**

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
Basic	0	0	0	0	0
Applied	6,471	6,824	6,642	5,784	6,926
Development (includes prototypes)	0	0	0	0	0
Total	**6,471**	**6,824**	**6,642**	**5,784**	**6,926**

A11h – Aviation Safety Risk Analysis Products and Activities	FY 2003 Request ($000)	Program Schedule					
		FY 2002	FY 2003	FY 2004	FY 2005	FY 2006	FY2007
060-110 Aviation Safety Risk Analysis							
Risk Management Decision Support	$3,046						
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		◆	◇	◇	◇	◇	◇
Develop the Aviation Safety Risk Management System		◆	◇				
Implement the Repair Station Module into SPAS		◆					
Aircraft Maintenance – Maintainability & Reliability	$630						
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 On-Board Built-In Test Equipment (RTTF)		◆	◇				
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.**

Continued on next page.

A11h – Aviation Safety Risk Analysis (cont.) Products and Activities	FY 2003 Request ($000)	Program Schedule					
		FY 2002	FY 2003	FY 2004	FY 2005	FY 2006	FY2007
Safety Analysis Methodology	$464						
Release a Prototype Tool for Determining Historical Hazards Rations of Unsafe Conditions of Power Plant and Auxiliary Power Unit on Transport Category Airplane		◆	◇				
Continue the Analysis of Airworthiness Information to Identify Unsafe Conditions and Assess Their Relative Impact on Continued Airworthiness		◆	◇	◇			
Develop a Method for Evaluating Flight Crew Interface Design Features Relevant to Pilot Response to Failure Conditions		◆	◇	◇			
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 Continuous Airworthiness Data in Ways That Identify Technical Problems That Pose a Fleet-Wide Safety Risk			◇				
Terminal Area Safety	$1,260						
Complete a Definitive Compilation of Landing Distance Performance for as Many Aircraft as Possible			◇	◇	◇	◇	
Complete the Development of Methods for Sorting and Evaluating That Data in Ways That Identify Technical That Pose a Fleet-Wide Safety Risk			◇				
Complete Braking System Performance			◇	◇	◇	◇	
Validate the 100-foot Cushion Allowed in Order 7110.118			◇	◇			
Personnel and Other In-House Costs	$1,526						
Total Budget Authority	$6,926	$5,784	$6,926	$6,920	$7,066	$7,220	$7,378

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. Increasing numbers of wildlife requires 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)**

* Interagency 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 2002 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 2003 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 2003 PROGRAM REQUEST:

The Airport Technology FY 2002 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 1982-2001)	$5,877
FY 2002 Enacted	2,450
FY 2003 Request	* 7,600
Out-Year Planning Levels (FY 2004-2007)	37,200
Total	$53,127

Budget Authority ($000)	FY 1999 Enacted	FY 2000 Enacted	FY 2001 Enacted	FY 2002 Enacted	FY 2003 Request
Contracts:					
Airport - Safety	1,745	2,712	6,068	2,450	* 7,600
Personnel Costs	1,301	0	0	0	0
Other In-house Costs	181	0	0	0	0
Total	**3,227**	**2,712**	**6,068**	**2,450**	**7,600**

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
Basic	0	0	0	0	0
Applied	0	0	0	0	0
Development (includes prototypes)	3,227	2,712	6,068	2,450	* 7,600
Total	**3,227**	**2,712**	**6,068**	**2,450**	**7,600**

*** This money is in AIP in the FY 2003 budget submittal and reflects only the contract dollars.**

Airport Technology – Safety Products and Activities	FY 2003 Request ($000)	Program Schedule					
		FY 2002	FY 2003	FY 2004	FY 2005	FY 2006	FY2007
Airport Technology – Safety Goal	* $7,600						
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	*** $7,600**	**$2,450**	*** $7,600**	**$6,950**	**$10,250**	**$10,000**	**$10,000**

Note:
- Out year numbers are for planning purposes only. Actual funding needs will be determined through the annual budget process.
* This money is in AIP in the FY 2003 budget submittal and reflects only the contract dollars.

COMMERCIAL SPACE TRANSPORTATION SAFETY

GOALS:

Intended Outcomes:

Commercial Space Integration into the NAS

The FAA intends to investigate and analyze means to integrate commercial space transportation operations seamlessly into the National Airspace System (NAS) in order to minimize impacts on overall NAS efficiency. Specifically, the FAA's Space and Air Traffic Management System initiative, as led by the Commercial Space Transportation (CST) line of business, seeks to examine methods to integrate new spaceport and vehicle operations in the NAS in a safe and efficient manner.

Reusable Launch Vehicles Operation and Maintenance

The FAA intends to investigate and analyze standards and processes applicable to commercial Reusable Launch Vehicle (RLV) Operations and Maintenance (O&M) activities to ensure these activities are conducted with adequate protection of public safety. A thorough review of the Space Shuttle operations and maintenance activities will be conducted to determine the "best practices" used by the world's only reusable launch vehicle and their applicability to commercial RLV O&M activities. The FAA will also study the airline industry to determine which "best practices" and "lessons learned" from the aircraft industry could be applicable to commercial RLV activities in terms of their operations and maintenance activities and the effects on safety.

Criteria for Determining "Unproven" vs. "Proven" RLVs

The FAA intends to improve public safety regarding the operation of unproven and proven commercial RLVs by the development of criteria that formulate a basic methodology to assist in the determination of when an RLV progresses from an "unproven" to "proven" status. The major objectives of this program are to:

- Continue public safety that is associated with RLV activities by providing additional criteria for the safe operation of RLVs.
- Ensure that for proven RLV the projected instantaneous impact point (IIP) for any RLV mission or reentry shall not have substantial dwell time over densely populated areas.
- Ensure that for unproven RLVs:
  - The projected instantaneous impact point (IIP) of the vehicle does not have substantial dwell time over populated areas; or
  - The expected average number of casualties to members of the public does not exceed 30×10^{-6} ($E_c \leq 30 \times 10^{-6}$) given a probability of vehicle failure equal to 1 ($p_f=1$) at any time the IIP is over a populated area.
- Provide criteria that can be used to assist in judging the public safety relevance of methodologies associated with proven RLV.

Reentry Vehicle Maneuverabililty and its Effect on Public Safety

The FAA intends to improve public safety regarding reentry of RLVs and reentry vehicles (RV) by understanding the safety issues associated with the level of maneuverability the vehicles have during earth reentry. The foremost issue is the differentiation between maneuverable and non-maneuverable reentry vehicles. Although many trajectory analyses should be performed for both maneuverable and non-maneuverable RLVs/RVs, the results of the analyses and their relative importance toward public safety may differ greatly depending upon the maneuverability capability of the vehicle. The major outcomes from this program include:

- Continue improvement of public safety associated with RLV activities.
- Refine the RLV regulations to improve public safety and ensure that they are not overly burdensome.
- Establish guidance and understanding of a vehicle's reentry 3σ left and right, minimum, and maximum Instantaneous Impact Point (IIP) trajectories that will indicate where a non-maneuverable vehicle will start its landing cycle (i.e., deploy its parachute) and land.
- Establish guidance and understanding of a maneuverable vehicle's reentry 3σ limiting trajectories and the "maneuverability landing-ellipse" for the vehicle.
- Develop criteria that address maneuverable vehicles landing ellipse borders defined as a group of termi-

nation (impact) points for trajectories from which the vehicle could still maneuver sufficiently to attain a nominal landing location.

- Determine what trajectory information would be required to evaluate non-maneuverable and maneuverable RLVs/RVs.

Agency Outputs:

Commercial Space Integration into the NAS

- Develop a study of launch/reentry impacts from Kennedy Space Center on air traffic.
- Investigate policy options for improving "user access" to airspace.
- Develop a Spaceport Simulation and Assessment Model (SSAM).

Reusable Launch Vehicles Operation and Maintenance

The FAA establishes licensing criteria for reusable launch vehicle activities and Advisory Circulars (AC) to provide guidance for meeting these rules. The results of these commercial RLV O&M studies will be utilized to provide inputs to a draft Notice of Proposed Rule Making (NPRM) for commercial RLV operations and maintenance.

Criteria for Determining "Unproven" vs. "Proven" RLVs

The FAA maintains public safety associated with RLV launch and reentry activities by the development of regulations that identify the requirements for safe RLV operations. The FAA published on September 19, 2000, the following documents that are related to RLVs:

- Commercial Space Transportation Reusable launch Vehicle licensing regulations.
- Advisory Circular 431.35-1: Expected Casualty Calculations for Commercial Space Launch and Reentry Missions.
- Advisory Circular 431.35-2: Reusable launch and Reentry Vehicle System Safety Process.

This research program provides the resources to address the concerns regarding how to determine when an RLV is a proven vehicle. To establish that an RLV has been proven is highly dependent upon such issues as the vehicle design, launch environment, ascent and decent environment, operational process, and test programs (vehicle and operations). Furthermore, it may not, at this time, be beneficial to develop a set of requirements that could be applied to all RLVs without AST obtaining a broad knowledge of commercial RLV designs and operations. To accomplish this, a commercial RLV industry similar to the present aircraft industry must exist. However, a research program could be developed to frame the type of criteria and/or methodology that can be applied to today's RLV concepts. These criteria could provide a method for determining, on a case by case basis, if a particular RLV should be upgraded to proven status.

Reentry Vehicle Maneuverabililty and its Effect on Public Safety

The FAA maintains public safety associated with RLV launch and reentry activities by the development of regulations that identify the requirements for safe RLV operations. The FAA published on September 19, 2000, the following documents that are related to RLVs:

- Commercial Space Transportation Reusable launch Vehicle licensing regulations.
- Advisory Circular 431.35-1: Expected Casualty Calculations for Commercial Space Launch and Reentry Missions.
- Advisory Circular 431.35-2: Reusable launch and Reentry Vehicle System Safety Process.

This research program provides the resources to address the concerns regarding how to address the public safety issues associated with reentry of vehicles that are non-maneuverable and maneuverable. The research program could develop and frame the type of criteria and/or methodology that can be applied to the RLV concepts to provide a method for determining, on a case by case basis, the vehicle reentry maneuverability safety issues.

Customer/Stakeholder Involvement:

Commercial Space Integration into the NAS

In response to the projected growth and increased complexity of the commercial space transportation industry, the Commercial Space Transportation Space Systems Development Division has been actively leading an effort to integrate new operations seamlessly into the NAS. The Space and Air Traffic Management System Program Management Plan is a key Systems Integration effort in support of FAA's strategic goals.

Reusable Launch Vehicles Operation and Maintenance

The FAA Commercial Space Transportation Advisory Committee (COMSTAC) provides industry expertise to the Administrator and the Associate Administrator for Commercial Space Transportation (AST). The COMSTAC Reusable Launch Vehicle Working Group gives the FAA insight into the members' backgrounds and knowledge of systems and methodologies capable of protecting the public safety from the hazards associated with operations of RLVs.

The FAA Commercial Space Transportation Integrated Product Team (CST IPT) brings together the different FAA Lines of Business that will ensure the safety aspects of commercial RLV activities gets proper FAA corporate-wide review and coordination.

Criteria for Determining "Unproven" vs. "Proven" RLVs

Criteria for determining unproven versus proven RLVs research includes:

- Support the FAA Associate Administrator for Commercial Space Transportation (AST) by providing a foundation to address and improve the process to determine the public safety issues regarding upgrading an RLV from unproven to proven.
- Provide the RLV industry with a less burdensome approach to classifying an RLV as a proven vehicle.
- Provide the customer with guidelines to furnish AST with the appropriate data regarding upgrading its RLV to a proven vehicle status. AST would evaluate and address the data public safety validity.
- The research and development project for "Criteria for determining unproven versus proven RLVs" might involve researching the following areas:
  - The Space Shuttle operation
  - Aircraft air worthiness
  - Automobile testing
  - Other related items that require approval for operation

Reentry Vehicle Maneuverabililty and its Effect on Public Safety

The reentry vehicle's maneuverability and its effect on public safety research:

- Supports the FAA Associate Administrator for Commercial Space Transportation (AST) by providing a foundation to address and improve the process to determine the public safety issues regarding reentry of maneuverable vehicles.
- Provide the RLV industry with a less burdensome approach to regulate reentry of maneuverable vehicles.
- Provide customer guidelines to furnish AST with the appropriate data regarding reentry of maneuverable vehicles.
- The research and development project for "Reentry vehicle maneuverability and its effect on public safety" might involve researching the following areas:
  - The Space Shuttle operation
  - Aircraft air worthiness
  - Automobile testing
  - Other related items that require approval for operation

Accomplishments:

Commercial Space Integration into the NAS

The following R&D projects were accomplished in FY2001:

- Completed version 2.0 of the Commercial Space Transportation Concept of Operations in the National Airspace System.
- Completed a Space and Air Traffic Management System (SATMS) needs assessment.
- Completed phase IV of a study to examine efficiency impacts of alternative policy options for accommodating space vehicle launch operations in the National Airspace System (NAS).

Reusable Launch Vehicles Operation and Maintenance

The FAA has initiated a reusable launch vehicle operations and maintenance feasibility study. This research will outline space shuttle operations and maintenance procedures and show how they relate to flight safety.

Criteria for Determining "Unproven" vs. "Proven" RLVs

- Completed a white paper that addressed key issues associated with unproven vs. proven RLVs.

Reentry Vehicle Maneuverabililty and its Effect on Public Safety

- Completed a final draft report on public safety and technical concerns associated with reentry maneuverability.
- Completed first phase development of a reentry maneuverability tool.

R&D Partnerships:

Commercial Space Integration into the NAS

- National Center of Excellence in Aviation Operations Research (NEXTOR).
- Space and Air Traffic Working Council (SATWC).
- NAS Architecture Core Team.
- RTCA Working Group.

Reusable Launch Vehicles Operation and Maintenance

The FAA and NASA have a Memorandum of Understanding (MOU) Concerning Future Space Transportation Systems. It describes the FAA/ NASA cooperative activities that will be conducted under the category of future space transportation systems and reusable launch vehicle technology, research and development. The FAA is developing a Memorandum of Agreement (MOA) with NASA/Kennedy Space Center on Future Spaceport Infrastructure Development.

The FAA is actively involved with NASA and DOD activities that involve RLV technology demonstrations through programs such as X-40A, X-37, and X-43, especially as related to public safety and environmental concerns.

Criteria for Determining "Unproven" vs. "Proven" RLVs

This program will work closely with various agencies and groups, such as:

- NASA Headquarters (HQ)
- NASA Kennedy Space Center (KSC)
- NASA Johnson Space Center (JSC)
- NASA Marshall Space Flight Center (MSFC)
- Aircraft certification (AIR)
- Flight standards (AFS)

Reentry Vehicle Maneuverabililty and its Effect on Public Safety

This program will work closely with various agencies and groups, such as:

- NASA HQ
- NASA KSC
- NASA JSC
- NASA MSFC
- Aircraft certification (AIR)
- Flight standards (AFS)
- Air traffic (AAT)

MAJOR ACTIVITIES AND ANTICIPATED FY 2002 ACCOMPLISHMENTS:

Commercial Space Integration into the NAS

- Conducted research investigating the impacts of RLVs on aviation traffic.
- Validated an analytical conflict airspace modeling tool with extensions to further predict airspace allocation, aircraft deviations, and impacts on air traffic control.

Reusable Launch Vehicles Operation and Maintenance

- Continued to review and analyze the Space Shuttle operations and maintenance activities to determine "best practices" applicable to commercial RLV O&M activities.
- Initiated a study to review the airline industry operations and maintenance activities to determine the "best practices" and "lessons learned" that may be applicable to commercial RLV O&M activities.

Criteria for Determining "Unproven" vs. "Proven" RLVs

- Developed a white paper addressing some of the public safety issue regarding unproven and proven RLVs.

Reentry Vehicle Maneuverabililty and its Effect on Public Safety.

- Refine a reentry maneuverability tool that can be used to ascertain safety issues.
- Evaluate reentry maneuverability report conclusions.

KEY FY 2003 PRODUCTS AND MILESTONES:

Commercial Space Integration into the NAS

(None currently identified.)

Reusable Launch Vehicles Operation and Maintenance

- Continue studies of Space Shuttle and airline operations and maintenance activities applicable to RLVs.
- Develop a draft NPRM to initiate the rulemaking activity for commercial RLV O&M activities to ensure that the public receives adequate protection during the course of these activities.

Criteria for Determining "Unproven" vs. "Proven" RLVs

- Develop a methodology that could lead to criteria for judging whether an unproven RLV can be upgraded to proven status.
- Develop a report on the research findings.

Reentry Vehicle Maneuverabililty and its Effect on Public Safety

- Develop a methodology that could lead to criteria for judging the public safety validity resulting from the reentry vehicle maneuverability.
- Develop a report on the research findings.

FY 2003 PROGRAM REQUEST: Authorized commercial space transportation research is currently included in the Operations budget.

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2000)	$0
FY 2001 Enacted	0
FY 2002 Request	0
Out-Year Planning Levels (FY 2003-2006)	0
Total	$0

Budget Authority ($000)	FY 1998 Enacted	FY 1999 Enacted	FY 2000 Enacted	FY 2001 Enacted	FY 2002 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 1998 Enacted	FY 1999 Enacted	FY 2000 Enacted	FY 2001 Enacted	FY 2002 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 2003 Request ($000)	Program Schedule					
		FY 2002	FY 2003	FY 2004	FY 2005	FY 2006	FY2007
Commercial Space Integration into the NAS							
Execute SATMS Program Management Plan	*						
Impacts of RLV's on Air Traffic		◆					
Reusable Launch Vehicle Operations & Maintenance							
Conduct Studies on Aerospace Operations & Maintenance	*						
Investigate Space Shuttle O&M for Best Practices		◆	◇	◇			
Analyze Airline O&M Activities for Best Practices		◆	◇	◇	◇	◇	
Study Airline O&M Activities for Lessons Learned		◆	◇	◇	◇	◇	◇
Criteria for Determining "Unproven" versus "Proven" RLVs							
Program Management Plan	*						
Establish and implement near term research approach		◆	◇				
Develop draft criteria		◆	◇	◇			
Develop mid term report		◆	◇	◇	◇		
Final report		◆	◇	◇	◇	◇	
Reentry Vehicle Maneuverability and its Effect on Public Safety							
Program Management Plan	*						
Establish and implement near term research approach		◆					
Develop draft criteria		◆	◇				
Develop mid term report		◆	◇	◇			
Final report		◆	◇	◇			
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.

INFORMATION SYSTEMS SECURITY AND TECHNOLOGY

GOALS: The increasing growth of cyber attacks and terrorism on critical infrastructures such as the National Airspace System (NAS) calls for a national-level effort to protect the increasingly vulnerable and interconnected U.S. computer and communications infrastructures. Executive Order 13010 identifies aviation transportation among one of the key protection areas. This budget submission focuses on extraordinarily difficult and challenging technical problems that must be addressed as a part of protecting the FAA's system infrastructure.

The FAA has developed a hierarchical layered model and has shown that FAA Information System Security (ISS) architectural requirements for the NAS are unique as they focus first on Integrity and Availability while most other models such as DOD's focus first on Confidentiality and access control. It is impractical in the FAA operational environment for ATC specialists to log on and off the network when other personnel relieve them. Commercially available systems security solutions do not meet the FAA's unique needs because most of these solutions are based on the log-on mode of operation.

The FAA's ISS R,E&D program is attempting to develop efficient and effective mechanisms to secure the NAS and non-NAS infrastructures against an ever evolving and lethal set of threats. This effort is in direct support of both the DOT and FAA goals for Safety by promoting safe and trusted Information Systems that will help eliminate transportation related deaths and injuries that could be caused by computer mishaps and also the National Security goal that ensures the security of the transportation system for the movement of people and goods, and supports the National Security Strategy. In that regard, this effort is an integral component of the President's Critical Infrastructure Protection R&D program.

Intended Outcomes: The FAA's ISS R,E&D program will reduce the vulnerability of the NAS and its users to threats posed by illicit agents such as terrorists and criminals. Equally important, is the need to assure that the NAS and FAA's administrative and support systems are robust enough to protect, detect and respond and if necessary reconstitute themselves to the ever-evolving cyber threats.

Agency Outputs: The research will transition into both future and legacy information systems used for all aspects of agency business, including the NAS, mission support, and administrative systems. Those systems will be more secure as a result of applying the new technology, improving the safety of the flying public, better protecting the nation's critical infrastructure, and enabling uninterrupted operations of the FAA. The initial R,E&D program will focus its attention into three output areas: Real Time Intrusion Protection, Detection, Response and Recovery; Development of Trustworthy Systems from Untrustworthy Components; and the Development of PKI structures for the unique dynamics found in the air-ground communication environment.

Customer/Stakeholder

- Internal stakeholders include all agency personnel since everyone routinely uses information systems for their business. Of special note are air traffic controllers (system availability and integrity), maintenance personnel (response to intrusions including system recovery), Aviation Security (incident analysis and enforcement), Regulation and Certification, Research and Acquisition, and the FAA Chief Information Officer (security system oversight).
- Federal stakeholders such as the President's Commission on Critical Infrastructure Protection, and the General Accounting Office have raised concerns about protecting the NAS information infrastructure in formal reports.
- External stakeholders include airlines and passengers (safety, efficiency, equipage, and maintenance); aircraft operators (safety, efficiency, equipage, and maintenance); pilots (safety); and International Civil Aviation Organization (standards and recommended practices).

Accomplishments: This is a new research, engineering and development program. However, internal studies during FY 2001 have focused our attention on high priority requirements of availability and integrity of our data and systems resulting in unique architectural constructs for the NAS. Reports of these studies have been published in both National Academy of Sciences and DOD R&D publications.

R&D Partnerships: Intended partners include Lincoln Laboratory, Massachusetts Institute of Technology, Computer Emergency Response Team –Coordinating Center (CERT-CC) at the Software Engineering Institute (SEI) at Carnegie-Mellon University, University of Maryland, National Security Agency, Department of Defense (AFRL, NRL, DARPA), Department of Treasury, and NASA.

KEY FY 2003 PRODUCTS AND MILESTONES:

The field of Information Systems Security (ISS) and Information Assurance (IA) is changing so rapidly that continued vigilance in evaluating and developing new ISS technologies is critical. Such technologies have a short "shelf-life." As soon as one threat has been discovered and new protection mechanisms have been developed to address it, more lethal threats are developed requiring newer and more robust mechanisms. The FY 2003 program will broaden the set of technologies evaluated and mature the technologies developed so they can be rapidly inserted into operational information systems.

In FY 2003, a small number of information systems will be selected to prototype the application of emerging ISS technologies. For example, emerging neural net and intelligent agent technologies are beginning to mature. This enables analysis of large complex networks for vulnerabilities and can detect attacks in real-time. It is not clear yet whether those technologies can scale to the size and complexity of the FAA's information systems infrastructure. Experiments will determine their robustness, scalability, and accuracy in finding vulnerabilities and detecting attacks using the new FAA CSIRC and existing WJHTC facilities.

As another example, a relatively new but very powerful way to specify information systems security requirements is through a standard product called "Common Criteria" (CC). These requirements become an integral part of the architecture, making it much easier for developers to understand how to build in protections when creating new information systems. A challenge facing the FAA is determining how to apply the CC and to correctly allocate security requirements to the various parts of the FAA's architecture. Research will determine how to best apply the CC and make the necessary allocations to the FAA ISS architecture and to use the outputs of the Protection Profiles developed in accordance with the CC in future FAA system acquisitions.

The FAA is currently investigating cooperative relationships with the Air Force Research Laboratory in Rome, NY, the Naval Research Laboratory in Washington, DC, the National Security Agency, the SEI, the University of Maryland and Lincoln Laboratory at MIT to address these and other potential R&D efforts. Our aim is to leverage, to the highest degree, on-going R&D efforts from other government agencies and FFRDCs and to focus our investments to address unique FAA issues and requirements that would not be addressed without additional R,E&D funding and that cannot be met by commercial products. The three key ISS R,E&D areas discussed have the best potential for major payoffs to the FAA when leveraging other on-going R&D efforts.

FY 2003 PROGRAM REQUEST:

Funds are sought for three particular purposes:

Real Time Intrusion Protection, Detection, Response and Recovery—The FAA deployed its initial Computer Security Incident Response Capability (CSIRC) in FY 2001. However, significant engineering shortfalls requiring new R&D are necessary to build and deploy Intrusion Protection, Detection, Response and Recovery mechanisms to meet a rapidly evolving threat base. Current F&E and OPS funded efforts focus on today's threats and do not address the future evolving requirements that this R&D effort is planned to address. Current Intrusion Detection (ID) systems cannot effectively function within the unique NAS environment due to its unique traffic flows and heavy demand for integration with a large number of partners and stakeholders such as the airlines, airports, etc. Current technology results in high false alarm rates and missed detection of actual intruders. The volume of audit data for the NAS requires a large personnel staff to analyze the reports and determine and develop effective ID algorithms. Integrating security data from the very large number of separate NAS subsystems will provide an unparalleled technical challenge. A research and development program is needed to develop intrusion detection technology tailored to FAA requirements and to integrate and tailor state of the art commercial intrusion detection technology into

FAA information systems. Additionally, there is a need to address how the FAA can execute specific actions both to respond and recover when attacks are detected. This area is of critical importance and not addressed by current F&E and OPS efforts. This effort will leverage on-going R&D efforts by the USAF and the SEI and accelerate technology insertion into both legacy and new FAA systems.

Trustworthy Systems from Untrustworthy Components—The FAA information infrastructure is one of the largest and most complex in the world. Current techniques to architect the security of information systems need to be significantly improved to ensure that the points of greatest vulnerability have the greatest protection and that those protections remain as the information systems evolve. It is understood that no system can be completely secure and large systems of systems such as NAS have unique vulnerabilities due to the need to construct trustworthy systems recognizing that not all the components of the systems are trustworthy. A research and development program is needed to develop new architectural approaches and to integrate those state of the art approaches into the FAA's information systems security architecture (ISSA). According to our interactions with the National Information Assurance Partnership (NIAP) and MITRE, the FAA has been judged to be in the forefront of these efforts and cannot depend on commercial and other governmental ef

forts to continue to provide the best protection to our future networks without continued R,E&D funding.

Public Key Infrastructure (PKI) in a unique Air-Ground Dynamic Environment—The FAA will improve information systems security by researching and developing technologies, technical information, and procedures for public key infrastructure to address unique air-ground digital networked communications requirements due to dynamic identification and addressing requirements. Such improvements will enable secure transactions over the Internet, intranet, and in non-TCP/IP based networks for air to ground communications in systems such as the Controller Pilot Data Link Communications (CPDLC) program. This R&D effort will develop new and innovative PKI concepts that can meet unique FAA requirements due to the mobile environment and the dynamic user configurations. In particular, there is a need to address how certificates will be generated and reused as pilots move from plane to plane and how the algorithms that depend upon trust can be met in this unique mobile environment requiring trusted identification of pilots, aircraft and controllers. This effort is in direct support of the FAA's safety and security goals.

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2001)	$0
FY 2002 Enacted	2,581
FY 2003 Request	2,625
Out-Year Planning Levels (FY 2004-2007)	23,000
Total	$28,206

Budget Authority ($000)	FY 1999 Enacted	FY 2000 Enacted	FY 2001 Enacted	FY 2002 Enacted	FY 2003 Request
Contracts:					
Information Systems Security and Technology	0	0	0	2,581	2,625
Personnel Costs	0	0	0	0	0
Other In-house Costs	0	0	0	0	0
Total	**0**	**0**	**0**	**2,581**	**2,625**

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
Basic	0	0	0	0	0
Applied	0	0	0	2,581	2,625
Development (includes prototypes)	0	0	0	0	0
Total	**0**	**0**	**0**	**2,581**	**2,625**

Note: Out year funding is under review.

Information Systems Security and Technology Products and Activities	FY 2003 Request ($000)	Program Schedule					
		FY 2002	FY 2003	FY 2004	FY 2005	FY 2006	FY2007
011-170 Information Systems Security							
Real Time Intrusion Protection, Detection, Response and Recovery	$1,125						
Develop and Tailor Intrusion Detection Algorithms to the NAS and other FAA System Requirements		◆	◇	◇		◇	◇
Build and Test a New Proof of Concept Intrusion Detection System		◆	◇	◇	◇	◇	
Develop and Test Effectiveness of Intelligent Agents in Improving Intrusion Detection		◆	◇	◇	◇	◇	◇
Develop and Test Response and Recovery Algorithms in NAS Subsystems				◇	◇	◇	
Identify Countermeasures		◆	◇	◇	◇	◇	◇
Trustworthy Systems From Untrustworthy Components	$650						
Techniques to Improve Effectiveness Against Unauthorized Access		◆	◇	◇			
Integrate State of the Art Architectural Approaches in the NAS ISS Architecture		◆	◇	◇			
Integrate ISS into the FAA Architecture		◆	◇	◇	◇		
Examine Impact of Component Integration into Trusted NAS Subsystems (Trusted System Composition)		◆	◇	◇	◇	◇	◇
Public Key Infrastructure (PKI) in a Unique Air-Ground Environment	$850						
Research and Develop Technologies, Technical Information and Procedures for PKI within the NAS		◆	◇	◇	◇		
Integrate and Test Developed PKI Technology into the FAA Architecture for Secure Transactions over the Internet, Intranet, and in Non-TCP/IP Based Networks for Systems such as Controller pilot Data Link Communications (CPDLC)		◆	◇	◇	◇	◇	
Total Budget Authority	$2,625	$2,581	$2,625	$4,000	$5,500	$6,500	$7,000

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

FLIGHT DECK/ MAINTENANCE/SYSTEM INTEGRATION HUMAN FACTORS

GOALS:

Intended Outcomes: The FAA intends to improve air transportation 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 Program conducts and manages research that provides the technical information necessary to generate these products and services.

Customer/Stakeholder Involvement: The Human Factors Program directly supports a number of aviation community initiatives:

- The FAA Strategic Plan Mission Goal for Safety: "By FY 2007, reduce U.S. aviation fatal accident rates by 80% from 1996 levels."
- FY 2002 ARA Performance Plan: Goal 1. Contribute to the FAA goal to reduce the fatal aviation accident 80% by FY 2007 as compared to 1994 -1995 baseline rate.
- 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 the 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 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. This manual has been adopted by International Civil Aviation Organization (ICAO) for distribution to its member states.
- Published the Aviation Maintenance Human Factors Guide.
- Developed and implemented the Agency's first virtual collaborative research team to communicate and disseminate information in real time regardless of distance or other constraints on research team members.
- 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 incorporating simplified English and utilizing advanced technology to standardize aviation maintenance documentation.
- Developed guidance and recommendations on human factors best practices in fluorescent penetrant inspection. This project provided a more systematic view of human/system interaction.
- 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, Version 1.0 and Version 2.0.
- 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 Version 1.0 and Version 2.0 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 prototype Automated Performance Measurement System (APMS) which allows air carriers to gather and analyze flight data from aircraft data recorders. This information and analysis capability provides the backbone for the Flight Operations Quality Assurance Program (FOQA), a joint FAA, industry and labor initiative to enhance aviation safety.
- Provided industry and the 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 turn over 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.
- Provided expanded APMS methodologies and analysis capabilities in order that air carriers can collect and analyze increasing amounts of flight and simulator data.
- Developed initial mapping of flight data parameters onto AQP qualification standards.
- Completed assessment of the utility 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 (HFACS).

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 that is 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 40,000 domestic air carrier pilots. The study examined pilots' perceptions of training effectiveness across the entire U.S. aviation industry.
- Developed Line Audit Methodology used by air carriers to help determine safety vulnerabilities. This methodology has been adopted by ICAO and was distributed to member states.
- Provided industry and the FAA with preliminary guidelines on training for flight deck interruptions and for the performance of concurrent critical tasks.
- Provided industry and the FAA with training guidelines for pilot decision-making, addressing first officer's hesitancy to challenge the captain in potentially high risk situations.
- 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.
- Incorporated air carrier and FAA user comments into an enhanced reconfigurable event set scenario development system.
- 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.
- Developed the Maintenance Resource Management (MRM) handbook for use by industry.
- Completed the prototype MRM distance learning project that will be implemented and used by the U.S. Navy for training their Naval Aviation Maintenance Technicians. Further application can be applied to U.S. Coast Guard Aviation Maintenance Technicians.
- Developed an Advisory Circular 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.
- Developed a CD-ROM training program which describes the structured decision-making style of experienced general aviation pilots compared to less experienced pilots. The program stresses situational awareness, diagnosis, resolution, and vigilance.
- Developed a CD-ROM training program which teaches general aviation pilots to recognize the cues associated with deteriorating weather while in-flight, and to take appropriate action to avoid weather.
- Defined critical flight task performance that decays over time in air carriers.
- Developed methodologies to analyze cognitive strategies for using automation systems in air carrier cockpits.
- Investigated the impact of realistic radio communications in simulator training on pilot performance.
- Developed methods to incorporate automation specific training scenarios into the system, which reconfigures event sets for unique training sessions.
- Developed advanced data analysis methods for linking FOQA and simulator training data.
- Analyzed data from line observations and laboratory studies to provide training guidance on human error management.

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 (JSATs) developed as part of the Safer Skies agenda. The human factors program is linked to NASA and DOD under the auspices of the *National Plan for Civil Aviation Human Factors: An Initiative for Research and Application.* Specific areas of coordinated program execution with NASA include cockpit automation, CRM, team decision-making, air-ground communication, and aviation maintenance. DOD joint efforts are in team performance, decision-making, aviation MRM, distance learning, and human error risk analysis. 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 (JAA) and Transport Canada (TCC) to produce human factors input for the harmonization of regulatory guidance material.

Through aviation maintenance partnerships with industry, 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 human factors 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 2002 ACCOMPLISHMENTS:

Information Management and Display

- Developed flight data recording and analysis capability for flight simulators.
- Completed human factors design and evaluation considerations for Electronic Flight Bags, Version 3.0.
- Developed and implement guidelines for maintenance error investigating and reporting systems.

- Determined operational criteria and training guidance for night vision goggles in rotorcraft operations.
- Defined display location boundaries that correspond to established eye position/head position for general aviation aircraft during actual operations.

Human-centered Automation

- Provided industry and FAA expanded guidance addressing training for automated cockpits. These guidelines will encompass the performance difficulties associated with increased coupling, complexity, and autonomy of modern cockpit technology.
- Completed human factors Certification Job Aid, version 3.0 for FAR Part 25 flightdeck displays.

Human Performance Assessment

- Identified human factors trends in aviation accident/incident data to produce data driven research initiatives.
- Refined flight and simulator data analysis tools.
- Provided guidance on the effectiveness of realistic radio communications in line oriented evaluations.
- Provided expanded APMS methodologies and analysis capabilities in order that air carriers can collect and analyze increasing amounts of flight and simulator data.
- Defined general aviation pilot decision-making skills required for training module development.
- Examined simultaneous non-interfering operations for visual flight rules (VFR) helicopter and fixed wing visual flight rules/instrument flight rules (VFR/IFR) to determine human performance implications.
- Completed a comprehensive human factors analysis of scheduled air carrier and general aviation accidents using the human factors analysis and classification system (HFACS).
- Completed simulator and aircraft investigation of pilot performance following ADI failure during instrument conditions.
- Identified human factors considerations and training requirements for "highway-in-the-sky" and multifunction displays proposed for future general aviation aircraft.
- Identified human error trends associated with general aviation controlled-flight-into-terrain (CFIT) and weather related accidents.
- Completed a comprehensive analysis and review of available literature regarding CFIT and alarms/alerts on the flight deck.
- Completed usability testing of display technology associated with Safe Flight 21.
- Completed usability survey of Capstone Phase I displays.
- Completed comparative analysis to determine if any substantial degradation in visual search is concurrent with the presence and/or use of the "head up" or "head down" displays.

Selection and Training

- Refined and validated training guidelines and training schedules for degradation vulnerable flight tasks.
- Refined training guidelines for automated flight decks.
- Analyzed data from line observations and laboratory studies to provide training guidance on human error management
- Provided guidance and recommendations to FAA Flight Standards for training regulations on simulator motion requirements for recurrent pilot training.
- Developed training guidelines for flight deck error management.
- Distributed advanced analysis methods linking FOQA and simulator data.
- Develop materials to increase general aviation pilot skills to intervene in the causable chain of events leading to accidents.
- Identified human factors error trends associated with general aviation pilot training.
- Demonstrated and validated the effectiveness of the MRM change program.
- Determined the application of military aviation maintenance training and experience based on FAA requirements.

KEY FY 2003 PRODUCTS AND MILESTONES:

Information Management and Display

- Complete initial computational model to assess information accessibility for air transport head-up display/head-down display combinations.
- Define display location boundaries that correspond to established eye position/head position for general aviation aircraft during actual operations.

- Develop guidance specifications for optimal flight instrument designs to counter CFIT accidents in general aviation.
- Conduct human factors investigations of advanced terrain and weather displays.

Human-centered Automation

- Complete human factors Certification Job Aid Version 4.0 for FAR Part 25 flightdeck displays.
- Provide human factors technical information on airport surface maps and vertical profile displays for FAA Technical Standard Order on moving map displays.
- Update certification guidelines for integrated technology in general aviation cockpits.

Human Performance Assessment

- Develop improved human factors guidelines for aircraft accident investigation and reporting systems.
- Provide human factors technical guidance to "land-and-hold-short" operations.
- Develop aviation maintenance proactive safety assessment tool.
- Initiate analysis of the safety implications of monitored approaches.
- Examine simultaneous non-interfering operations for visual flight rules (VFR) helicopter and fixed wing visual flight rules/instrument flight rules.
- Define general aviation pilot decision-making skills required for training module development.

Selection and Training

- Expand Realistic Radio Communications in simulator training to include data link and other forms of nonverbal communication.
- Develop and distribute "best practices" guidance.
- Distribute report on tools and methods to support the training of cognitive skills for automation performance in air carrier cockpits.
- Distribute to FAA and industry training development guidelines for the integration of crew resource and technical skills in air carrier AQP training programs.
- Develop methodologies to link performance data to curriculum modification procedures in AQP programs.
- Develop report on methodology for integrating Aviation Safety Action Program data, FOQA and AQP data.
- Develop report on training guidelines to handle interruptions, distractions, and lapses of attention in air carrier cockpits.
- Complete validation of training intervals for pilot training programs.
- Develop training guidelines for risk management in air carrier cockpits.
- Complete validation of simulator requirements for pilot training.

FY 2003 PROGRAM REQUEST:

The program continues to focus on providing technical information and consultation 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.

NEW INITIATIVES

Information Management and Display

- Evaluate advanced terrain and weather displays.

Human Performance Assessment

- Analyze the safety implications of monitored approaches.

ONGOING ACTIVITIES

Information Management and Display

- Assess air transport and general aviation head-up/head-down displays.
- Develop methods to counter CFIT accidents in general aviation.
- Develop and implement guidelines for maintenance error investigation and reporting.
- Develop a flight data recording and analysis capability for flight simulators.
- Develop operational criteria/training guidance for night vision goggles in rotorcraft operations.

Human-centered Automation

- Establish expanded guidance addressing training for automated cockpits.
- Develop the human factors Certification Job Aid.

- Evaluate airport surface maps and vertical profile displays.
- Analyze general aviation cockpit displays.

Human Performance Assessment

- Develop improved guidelines for accident investigation and reporting.
- Develop and implement guidance for "land-and-hold-short" operations.
- Refine flight and simulator data analysis tools.
- Develop and implement guidance on the effectiveness of realistic radio communications in simulator evaluations.
- Define the general aviation pilot decision-making skills required for training module development.
- Examine simultaneous non-interfering operations for helicopter and fixed-wing aircraft to determine human performance implications.
- Develop aviation maintenance proactive safety assessment tools.

Selection and Training

- Establish guidance on simulator motion requirements for recurrent pilot training.
- Expand realistic radio communications in simulator training.
- Develop initial training guidelines for flight deck error management.
- Develop advanced analysis methods linking FOQA and simulator data.
- Develop materials to increase general aviation pilot skills to intervene in accident causation chain.
- Determine the application of military aviation maintenance training to FAA requirements.
- Develop and distribute aviation maintenance "best practices" guidance.
- Develop Web-based general aviation training.
- Develop methodologies to link pilot performance data to curriculum modification.
- Develop guidelines for pilot training intervals.

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2001)	$ 148,058
FY 2002 Enacted	9,906
FY 2003 Request	10,411
Out-Year Planning Levels (FY 2004-2007)	43,128
Total	$ 211,503

Budget Authority ($000)	FY 1999 Enacted	FY 2000 Enacted	FY 2001 Enacted	FY 2002 Enacted	FY 2003 Request
Contracts:					
Flightdeck/Maintenance/System	8,497	6,289	7,016	6,617	6,711
Personnel Costs	1,940	2,367	2,283	2,398	2,855
Other In-house Costs	563	486	779	891	845
Total	**11,000**	**9,142**	**10,078**	**9,906**	**10,411**

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
Basic	0	0	0	0	0
Applied	11,000	9,142	10,078	9,906	10,411
Development (includes prototypes)	0	0	0	0	0
Total	**11,000**	**9,142**	**10,078**	**9,906**	**10,411**

A11g – Flight Deck/Maintenance/System Integration Human Factors Products and Activities	FY 2003 Request ($000)	Program Schedule					
		FY 2002	FY 2003	FY 2004	FY 2005	FY 2006	FY2007
081-110 Flight Deck/Maintenance/System Integration Human Factors							
Selection and Training	$2,653						
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 Flight Deck Error Management		◆	◇	◇			
Develop materials to Increase General Aviation Pilot Skills to Intervene in Accident Chain of Events		◆	◇	◇	◇	◇	◇
Develop Error Avoidance Strategies in Aviation Maintenance and Inspection		◆	◇	◇	◇	◇	◇
Demonstrate and Validate Effectiveness of MRM		◆	◇	◇			
Human Performance Assessment	$450						
Provide Expanded APMS Methodologies and Analysis Capabilities		◆	◇	◇	◇	◇	◇
Provide Guidance on Effectiveness of Realistic Radio Communications in Line-Oriented Evaluations		◆	◇				
Develop Improved Guidelines for Accident Investigations		◆	◇				
Human Centered Automation	$1,855						
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	$1,753						
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	$3,700						
Total Budget Authority	$10,411	$9,906	$10,411	$10,381	$10,639	$10,913	$11,195

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

AIR TRAFFIC CONTROL/ AIRWAY FACILILTIES 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 operational errors and deviations.
- Developing human factors educational aids to mitigate runway incursions and underlying human performance issues.
- Developing human factors educational aids to mitigate controller fatigue resulting from shiftwork.
- Increasing human factors integration in the acquisition and design of air traffic control automation systems.
- Improving techniques for forecasting hiring requirements and selecting applicants for Air Traffic (AT) and Airway Facilities (AF) positions.

Agency Outputs: Human performance constraints and other human factors issues pose risks to the acquisition, design, operation, and maintenance of ATC systems. Taxonomic analysis of operational errors including runway incursions identifies improvements in how errors are investigated and reported, which in turn is leading to more effective safety interventions. The study of the relationship between shift work schedules and fatigue identifies techniques for mitigating impacts on controller performance. Human factors research provides guidelines and other information for the design and development of ATC systems and product improvements. Tests and criteria for the selection of operational personnel will improve applicant screening efficiency and validity and reduce costs associated with attrition and training failures.

Customer/Stakeholder Involvement: The ATC/ Airways Facilities (AF) Human Factors Research Program is directly tied to the following ARA Safety Performance Goals:

Goal 1. *Aviation Safety:* In support of the FAA 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 2. *Human Factors:* In support of FAA performance goals, ARA will, by FY 2005, ensure human factors policies, processes, and best practices are integrated in the research and acquisition of 100 percent of FAA aviation systems and applications. Goal 2 implementation uses strategies involving research on NAS integration and human error that respond to Air Traffic Service (ATS) research requirements, and acquisition engineering activities associated with the design, analysis, development, test, and implementation of FAA systems and applications.

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 ATS customer base through the Air Traffic Requirements Service (ARS). The detailed research portfolio is coordinated with several organizational elements: the Air Traffic Services Office of Evaluations and Investigations (AAT-20), Air Traffic Procedures (ATP-400), Air Traffic Tactical Operations (ATT), NAS Operations (AOP-30), Resource Management Program (AFZ-100; ATX), and Research and Requirements Directorate (ARQ). In addition, Integrated Product Teams in the Office of Communication, Navigation, and Surveillance Systems (AND) and the Office of Air Traffic Systems Development (AUA), as well as the Free Flight program office (AOZ), share in identifying research requirements through AAR-100 representatives. Projects are also coordinated with the Office of System Architecture and Investment Analysis (ASD).

Research is addressing 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. This research addresses human performance issues associated with mid- and long-term capacity enhancements identified in the *Operational Evolution Plan* (OEP) as well as safety issues contained in the DOT *Strategic Plan*. The program examines advanced automation and technologies integrated as part of the RTCA National Airspace System (NAS) Concept of Operations, the AF maintenance concept for NAS Infrastructure Management, and the NAS Architecture Version 4.0. Research activities will develop the information necessary to understand human capabili-

ties and limitations in different operational environments. Human factors engineering will then be applied to identify and resolve risks, and to assess costs, benefits, and trade-offs. The ATC/AF Human Factors Research Program is also responsive to the recommendations of the congressionally mandated Research, Engineering, and Development Advisory Committee (REDAC).

This research program is coordinated with NASA and DOD through the *National Plan for Civil Aviation Human Factors: An Initiative for Research and Application* published in 1995. This document outlines a coherent national agenda for human factors research and application leading to significant improvements in NAS safety and efficiency. Human factors research is organized around the following four thrusts:

- Information Management and Display – Determine when and how one might best display what, 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

- Standard Terminal Automation Replacement System (STARS) – Conducted comprehensive assessment of the STARS operational radar display and maintenance control workstations. A related initiative yielded a definitive process to integrate human factors in other NAS acquisitions.
- Human Factors Design Guide (HFDG) – Updated the HFDG to provide Integrated Product Teams (IPT) with guidelines for effective human factors design of automation and Communication, Navigation, and Surveillance (CNS) technologies.
- Human-System Interface (HSI) Integration – Risk assessment for IPTs identifying inconsistencies in the design of human-system interfaces between baseline systems and their anticipated product improvements and other subsystems to be integrated as part of NAS evolution.

Human-Centered Automation

- Flight Strip Studies – Identified operational functions in controller use of paper flight progress strips to support transition to Free Flight Phase 1 decision support automation.
- Enhanced Vision Systems – Demonstrated how use of enhanced vision technology supports tower controller information requirements under reduced visibility conditions.
- 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 medium term conflict probe.
- Auditory Alarm Database – Developed a database of alarms for use in the design of future AF alerting systems for centralized maintenance centers.

Human Performance Assessment

- ATC Operational Errors – Harmonized a taxonomy of causal factors and completed an initial field beta test of a new methodology for reporting and analyzing human factors associated with ATC operational errors.
- Runway Safety Booklet – Developed a booklet for controllers and pilots containing relevant human factors information on communications, attention, memory, and threats to performance in order to help prevent runway incursions.
- Controller Work Schedules – Completed the second element of the congressionally mandated study through field biomedical studies of controller work schedules and rest cycles.
- Human Factors Booklet for Controllers - Prepared a brochure providing controllers with helpful informa-

tion about human factors they can use to enhance job performance.

- Impact of Shared Separation on Air Traffic Control Specialist (ATCS) Situation Awareness – Conducted a study of impacts from distributed air/ground separation responsibility on air traffic controller performance.
- Dynamic Airspace Boundaries – Delivered findings and recommendations from simulation and modeling of the impact of airspace restructuring on controller performance.

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 air traffic control.
- Statistical Attrition and Retirements Model (SCRAM) – Developed prototype model for projecting attrition and retirements for AT/AF critical occupations from historical data.
- AFSS Color Vision Screening Tool – Completed validation of color vision screening test for AFSS personnel using the color weather radar.

R&D Partnerships: Research is coordinated with NASA in the areas of distributed air/ground separation responsibility and human error through the Inter-Agency Air Traffic Management Integrated Product Team (IAIPT), which also provides a framework for coordination with MITRE. University grants are addressing human factors with advanced surveillance technology and collaborative decision making in Air Traffic Management (ATM). Research is coordinated with acquisition offices to support mission need analysis and system requirements. Internationally, collaborative human factors research with EUROCONTROL addresses the management and reduction of human error in ATM, airborne separation assurance, decision support tools, and advanced CNS technologies.

MAJOR ACTIVITIES AND ANTICIPATED FY 2002 ACCOMPLISHMENTS:

Information Management and Display

- Human-System Interface (HSI) Integration – Detailed assessments of HSI inconsistencies and other human factors risks in integration of enhanced capabilities in terminal legacy systems to ensure compatibility with design guidelines and human performance considerations.
- Human Factors Design Standard – Updated the Human Factors Design Guide and publish as an FAA standard.
- AF aural information transfer – Evaluated aural effectiveness of current audible alarms in relation to new COTS applications.
- AF visual symbology – Reported to the NAS Operations Program (AOP) on human factors design guidance to resolve identified CHI inconsistencies in the NAS Infrastructure Management System (NIMS).

Human-centered Automation

- Multi-tool inter-operability assessment – Completed an engineering assessment of human factors issues involving the inter-operability of decision support and data link capabilities collocated in en route controller workstations.
- Tower paper flight strips – Evaluated controller flight progress information requirements for tower controller positions.
- Multi-sector planning position assessment – Evaluated controller performance and inter-sector communications, and identified information requirements for decision support automation, associated with a new en route operational position to facilitate traffic flow.
- Situational awareness in centralized monitor and control – Identified necessary information and feedback for the AF System Specialist (AFSS) to stay aware of automated processes in relation to workload, performance, and error mitigation.

Human Performance Assessment

- Beta testing of improved incident investigation methodology – Verified through field assessments an improved approach to identifying causal factors of operational errors and for targeting performance remediation strategies.

- Runway Safety Training – Developed a training package for controllers providing useful information on best practices to mitigate runway incursions.
- ATC sector teamwork and collaborative decision-making - Assessed how enhanced decision support and automated coordination tools affect intra- and inter-sector communications and coordination.
- Shift work and fatigue – Completed the development of fatigue countermeasure recommendations resulting from field and laboratory biomedical studies of controller work schedules and rest cycles, conducted as part of the Congressionally mandated study. Complete laboratory assessment of forward and backward rotating 2-2-1 ATC shift schedule
- Display System Replacement (DSR) incident re-creation capability – Completed validation of the en route tool for replaying operational incidents, called the Systematic Air Traffic Operations Research Initiative (SATORI).
- Team processes in centralized monitor and control systems - Developed team and organizational guidelines to enhance effective team operations.
- Organizational assessment - Assessed successful organizational practices and human factors issues in developing a Model Work Environment.

Selection and Training

- Prototype Air Traffic Applicant Screening System – Developed a prototype biographical assessment tool for screening job applicants.
- Airway Facilities Job/Task Analysis – Completed a selection-oriented job/task analysis for AF field maintenance positions supporting development of a new AF selection system.
- Workforce Planning – Developed a Statistical Controller Requirements/Attribution Model (SCRAM) for estimating future retirements, attrition, and hiring.

KEY FY 2003 PRODUCTS AND MILESTONES:

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

Information Management and Display

- HSI integration issues – Perform detailed assessments of HSI inconsistencies and other human factors risks in integration of enhanced capabilities in en route and oceanic legacy systems.
- Electronic fight data – Assess alternate display techniques for flight progress data to meet controller information needs in using multiple en route decision aids; develop automation guidelines and design recommendations to ensure a human-centered approach.
- Information needs for dynamic airspace resectorization – Assess controller operational information requirements to achieve efficiency gains promised by dynamic resectorization.
- AF workstation design and crew coordination – Evaluate human performance limitations in transitioning to a paperless centralized maintenance work environment and changes in crew communications.

Human-Centered Automation

- Centralized maintenance procedure limitations – Examine "lessons learned" with design of centralized maintenance procedures to develop guidelines for effective handling of system maintenance events.
- Inter-operability between advanced decision aids – Assess the cumulative impact on controller performance and workload resulting from the incremental integration of terminal and en route decision aids developed in Free Flight Phase 2 relative to achieving intended benefits.
- Reduction in use of paper flight progress strips – Develop refinements to automation, procedures and training to facilitate reducing the operational need for paper flight progress strips.
- Shared air/ground separation responsibility – Assess controller performance effects of distributed air/ground responsibility for pilot self-spacing and separation.
- Human-in-the-loop simulation of centralized maintenance – Assess AFSS information requirements and decision making through simulations of monitor and control functions and procedures.

Human Performance Assessment

- Incident causal factors – Determine the feasibility of a Web-based incident reporting data collection system for integrating data and information on causal factors of operational errors and runway incursions.
- Airway Facilities (AF) incident reporting – Identify requirements for a prototype capability to anonymously identify and report human errors in AF maintenance incidents.

- Impacts of increased controller workload – Assess controller workload using concurrent behavioral, physiological and biochemical indices.
- ATC sector teamwork and collaborative decision-making - Assess how enhanced decision support and automated coordination tools affect Air Traffic Management and intra- and inter-sector communications and coordination.
- Shift work and fatigue – Assess fatigue countermeasure recommendations developed by the Scientific Steering Group as based on findings from the Congressionally mandated research on shift patterns.
- Organizational assessment – Report on lessons learned, organizational issues, and successful practices in developing a Model Work Environment.
- Task load and performance assessments – Assess use of objective task load and performance measures in Performance and Objective Workload Evaluation Research (POWER) to compare different ATC systems and identify controller efficiencies.

Selection and Training

- Selection of applicants into Air Traffic Services (ATS) positions – Develop, technically enhance, and continue longitudinal validation of screening and testing tools for selection of applicants into ATS positions.
- Complete development of a prototype workforce analysis tool – Support the identification and analysis of gaps between current and future ATS workforce skills and staffing profiles.

FY 2003 PROGRAM REQUEST

The FY 2003 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.

NEW INITIATIVES

Information Management and Display

- Develop design guidelines addressing human factors issues in integrating collocated decision support tools in en route controller workstations.

Human-centered Automation

- Examine limitations with centralized maintenance procedures.

Human Performance Assessment

- Evaluate an intranet-based prototype system to manage and integrate operational error and runway incursion reports for analysis.
- Assess Airway Facilities maintenance error reporting needs.
- Assess controller workload using concurrent behavioral, physiological and biochemical indices.

ONGOING ACTIVITIES

Information Management and Display

- Examine HSI integration issues with product improvements.
- Identify changes in information requirements driven by dynamic airspace resectorization.
- Assess AF transitions in workstation design and crew coordination.

Human-centered Automation

- Develop baseline of tower controller flight data information needs.
- Assess inter-operability between advanced decision aids.
- Evaluate the distribution of separation responsibility between controllers and pilots.
- Assess information requirements and decision making in centralized maintenance.

Human Performance Assessment

- Evaluate sector teamwork and collaborative decision-making.
- Complete the congressionally mandated study of shift work, fatigue, and work schedules.

- Identify best practices through an organizational assessment addressing the Model Work Environment.
- Validate task load and performance measures for pre- and post DSR implementation to identify controller performance efficiencies.

Selection and Training

- Develop assessment tools for screening and selecting job applicants.
- Develop a workforce analysis prototype tool.

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2001)	$ 108,767
FY 2002 Enacted	8,500
FY 2003 Request	10,317
Out-Year Planning Levels (FY 2004-2007)	42,639
Total	$ 170,223

Budget Authority ($000)	FY 1999 Enacted	FY 2000 Enacted	FY 2001 Enacted	FY 2002 Enacted	FY 2003 Request
Contracts:					
Air Traffic Control/Airway Facilities Human Factors	5,711	1,661	2,277	2,756	4,214
Personnel Costs	3,117	5,034	3,984	4,071	4,457
Other In-house Costs	1,172	1,305	1,721	1,673	1,646
Total	**10,000**	**8,000**	**7,982**	**8,500**	**10,317**

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
Basic	0	0	0	0	0
Applied	10,000	8,000	7,982	8,500	10,317
Development (includes prototypes)	0	0	0	0	0
Total	**10,000**	**8,000**	**7,982**	**8,500**	**10,317**

A11i – Air Traffic Control/Airway Facilities Human Factors Products and Activities	FY 2003 Request ($000)	Program Schedule					
		FY 2002	FY 2003	FY 2004	FY 2005	FY 2006	FY2007
082-110 Air Traffic Control/Airway Facilities Human Factors							
Human Performance Assessment	$1,275						
Examination of Causal factors Related to Operational Errors		◆	◇	◇	◇	◇	◇
Runway Safety Analysis and Guidance/Booklet		◆	◇				
Airway Facilities Human Error Reporting Prototype		◆	◇	◇	◇		
Sector Team Communications		◆	◇				
ATC Sector Teamwork and Communications		◆	◇	◇	◇	◇	◇
Controller Shift Work, Work Schedules, and Fatigue		◆	◇				
POWER Task Load and Performance Assessment of the Display System Replacement		◆	◇	◇			
Team Processes in Centralized Monitor and Control Systems		◆	◇	◇	◇	◇	◇
Organizational Assessment		◆	◇	◇	◇	◇	◇
Human Centered Automation	$1,504						
Incremental Decision Support Tool Inter-Operability Assessments		◆	◇	◇	◇	◇	◇
Tower Controller Flight Data Information Requirements		◆	◇	◇			
Enhanced Vision Systems		◆	◇				
Situational Awareness in Centralized Monitor and Control		◆	◇	◇	◇	◇	◇
Information Management and Display	$935						
Human Factors Design Guidance		◆	◇	◇	◇	◇	◇
Human-System Interface Integration		◆	◇	◇			
AF Information Display and Management		◆	◇	◇	◇	◇	◇
Selection and Training	$500						
Prototype Air Traffic Applicant Screening Systems		◆	◇				
Develop and Validate Computerized Application Evaluation Systems		◆	◇	◇	◇	◇	◇
Prototype Workforce Analysis Tool Development and Analysis		◆	◇	◇	◇	◇	◇
Personnel and Other In-House Costs	$6,103						
Total Budget Authority	$10,317	$8,500	$10,317	$10,162	$10,483	$10,822	$11,172

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 the agency:

- Investigate and meticulously analyze injury and death patterns in civilian flight accidents to determine cause and prevention strategies.
- Develop recommendations for protective equipment and procedures.
- Regulatory and medical certification staff who, on behalf of the agency, propose safety and health regulations affecting all aircraft cabin occupants carefully evaluate the full range of options.

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 aircraft passengers and aircrews. This research program identifies human tolerances, capabilities, and failure modes (physiological, psychological, and performance) both in uneventful flight, and during aircraft incidents and accidents. Formal recommendations for protective and supportive counter measures and techniques are derived from in-house research.

The FAA is able to impose existing and develop new bioaeronautical guidelines, standards, and models for aircraft cabin equipment, procedures, and environments that have potential to enhance appropriate human performance at minimum cost to the aviation industry. The agency's review of pilot medical histories, flight histories, and information from accidents and incidents, existing and advanced biomedical criteria, standards and assessment/certification procedures provides the knowledge to propose means to ensure optimal performance capabilities. Assessments of pilot, flight attendant, air traffic controller, and passenger work, environmental, behavioral, and disease issues provide the rigorous scientific criteria needed to identify and propose actions with potential to improve the health and safety of all aircraft occupants.

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

- Quantitative bioengineering criteria to support optimum aircraft seat and restraint system certification.
- Quantitative bioaeronautical criteria to 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.
- Identification of biomedical/toxicological factors in aviation incidents and accidents.
- Recommendations for aircrew medical criteria, standards, assessment/certification procedures, and special issuance.
- Quantitative data about the occupational health risks of flight attendants to support regulatory oversight.
- Quantitative data about the aerospace radiation and other aircraft environmental factors and their threats to aircraft occupants.

Customer/Stakeholder Involvement: This program contributes to meeting the *FAA Strategic Plan* Mission Goal for Safety and *ARA FY 2002 Performance Plan* Goals for Safety and Human Factors. The program provides the primary bioaeronautical research (i.e., study of the bioengineering, biomedicine, and biochemistry issues associated with safety and performance) called for in the *National Plan for Civil Aviation Human Factors*. This program contributes significantly to the application of emerging technologies, as highlighted in the FAA *Aviation Safety Plan*. The program is an integral participant and research provider under 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 aircraft 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 approved by the FAA's institutional review board for use of human test subjects. Multi-year collaborative studies performed by the FAA and the National Institute for Occupational Safety and Health (NIOSH) into flight attendant 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.

Accomplishments: Based on aeromedical research at the Civil Aerospace Medical Institute (CAMI), the FAA Administrator announced, in FY 2000, the Agency's intention to proceed with regulations for the requirements concerning the performance and use of child restraints in aircraft. Standards and test criteria for child restraints developed at CAMI were adopted by the Society of Automotive Engineers (SAE). Specialized quantitative crashworthiness assessments were continued exploring such issues as side-facing aircraft seats and airbag restraint systems, and using new state-of-the-art anthropomorphic test dummies with enhanced injury assessment capabilities.

Data are continuously provided to the research sponsor on the role of toxicological and clinical factors associated with each aircraft accident and significant incident. Current findings indicate that about one of 7 pilots fatally injured in a civilian aircraft accident show evidence of using a prescription drug; one of 6 has taken an over-the-counter drug; one of 25 has ingested significant positive alcohol; and 1 of 15 is using a significantly dangerous controlled substance.

Long-term aviation forensic and epidemiological research has helped the FAA to identify bioaeronautical roles in accident/incident causation. Specialized clinical evaluations have been applied to cases associated with aircraft decompression. 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 previously-described FAA partnerships (e.g., with JAA, TCA; and NIOSH), the agency maximally leverages other academic, industrial, and governmental coordination and cooperation in its research activities. In each program area output category, 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. The agency maintains a liaison with the American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE) committee addressing aircraft cabin air quality status and research. 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 is maintained with military organizations, NASA, or international entities 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, through the European Union, or through collaborations in scientific organizations.

MAJOR ACTIVITIES AND ANTICIPATED FY 2002 ACCOMPLISHMENTS

The following program results have been achieved or are expected to be achieved in FY 2002:

- Performed epidemiological assessment of biochemical and toxicological factors from fatal civilian aviation accidents.
- Assessed the results of automatic external defibrillators on commercial aircraft.
- Evaluated autopsy data from fatal aviation accidents for improvement of protective equipment and design practices.
- Completed assessment of flight attendant reproductive and environmental health hazards (Congressionally requested FAA-NIOSH study).
- Initiated use of computer simulation (dynamic modeling) of crash responses for seat-occupant-aircraft

interface and utilized biodynamic sled test results to validate and expand system capability.

- Conducted human performance testing to quantify the synergistic effects of altitude and antihistamine use by airmen.
- Conducted performance and protection assessment of pilot eye-respiratory protective equipment, including protection from chemical/biological agents.
- Completed an evaluation of the effects of passageway, exit hatch, passenger density, and passenger motivation on the efficiency of cabin evacuation.
- Developed biodynamic test data on side-facing seats and restraint devices to support rulemaking organizations.
- Utilized 747 Aircraft Cabin Environment Research Facility to define time requirements for a NASA developed clear air turbulence detection system relative to the need for the cabin crew preparation.

KEY FY 2003 PRODUCTS AND MILESTONES

The following program results are being scheduled in FY 2003:

- Develop bioaeronautical research data to support aeromedical certification aimed at reduction of in-flight sudden/subtle incapacitation.
- Complete an interactive database to aid in the evaluation of autopsy data related to fatal aviation accidents in order to guide development of protective equipment, aircraft design practices, and new aircrew medical certification standards.
- Provide enhanced guidelines for aircraft cabin occupant health maintenance, including verifying the CARI-6 radiobiologic computer program that covers large solar particle events.
- Continue engineering enhancement of the 747 Aircraft Cabin Environmental Research Facility.
- Evaluate pilot reported medication usage with actual toxicology findings to determine the accuracy of self-reporting.
- Establish cabin air-flow characteristics in the 747 to support evaluation of cabin environmental quality and health.
- Initiate molecular biological laboratory techniques to enhance forensic toxicological aspects of aircraft accident investigation.
- Initiate use of a cabin evacuation simulation model updated with data from completed experimental studies.
- Assess the potential for improved aircraft seat test criteria based on determining the correlation between neck injury and the measurement of impact dynamics through use of anthropomorphic test mannequins.
- Begin to upgrade the narrow body cabin egress test facility to allow the flexible simulation of aircraft types and configurations.
- Begin to determine crew and passenger safety requirements in advanced technology, very high altitude transport air or spacecraft.

FY 2003 PROGRAM REQUEST:

The Office of Aviation 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, 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.

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.
- Assess guidelines for aircraft cabin crew and passenger environmental management.
- Assess effectiveness of new programs dedicated to the enhancement of passenger performance in emergencies.
- Evaluate the in-flight use of medical kits and determine the adequacy of the 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 capabilities, and produces advanced statistical and graphics analysis.

- Develop dynamic modeling capabilities in support of cabin safety research, biodynamic protection/ survivability research, and aircraft accident investigation research.

NEW INITIATIVES

- Initiate molecular biological techniques to enhance forensic toxicological aspects of aircraft accident investigations.

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2001)	$ 77,603
FY 2002 Enacted	6,121
FY 2003 Request	6,603
Out-Year Planning Levels (FY 2004-2007)	27,894
Total	$ 118,221

Budget Authority ($000)	FY 1999 Enacted	FY 2000 Enacted	FY 2001 Enacted	FY 2002 Enacted	FY 2003 Request
Contracts:					
Aeromedical Research	313	394	938	491	498
Personnel Costs	3,155	3,858	3,893	4,268	4,748
Other In-house Costs	597	577	1,156	1,362	1,357
Total	**4,065**	**4,829**	**5,987**	**6,121**	**6,603**

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
Basic	0	0	0	0	0
Applied	4,065	4,829	5,987	6,121	6,603
Development (includes prototypes)	0	0	0	0	0
Total	**4,065**	**4,829**	**5,987**	**6,121**	**6,603**

A11j – Aeromedical Research Product and Activities	FY 2003 Request ($000)	Program Schedule					
		FY 2002	FY 2003	FY 2004	FY 2005	FY 2006	FY2007
086-110 Aeromedical Research							
Cabin Health and Environmental Guidelines	$0						
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	$110						
Analyze the Suitability for Component Tests as an Alternative for Showing Regulatory Compliance with Crashworthiness Standard for Aircraft		◆	◇	◇	◇	◇	◇
Assess Impact Protection Performance of Aircraft Seating Systems		◆	◇	◇			
Develop Performance-Based Narrow and Wide Bodied Aircraft Cabin Evacuation Approval Guidelines		◆	◇	◇	◇	◇	◇
Develop Aircraft Cabin Evacuation Model as a Partial Replacement for Evacuation Tests with Human Subjects			◇	◇	◇	◇	◇
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	$388						
Perform Epidemiological Assessment of Toxicology Factors from Fatal civilian Aviation Accidents		◆	◇	◇	◇	◇	◇
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		◆	◇	◇	◇		
Survey of In-Flight Medical Emergencies and Defibrillator Usage on Commercial Airline Flights		◆					
Establish an Aircraft Accident Medical Database		◆	◇	◇	◇	◇	◇
Personnel and Other In-House Costs	$6,105						
Total Budget Authority	$6,603	$6,121	$6,603	$6,553	$6,825	$7,110	$7,406

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 FY 2003 R&D that will be devoted to the support of Aviation Efficiency research.

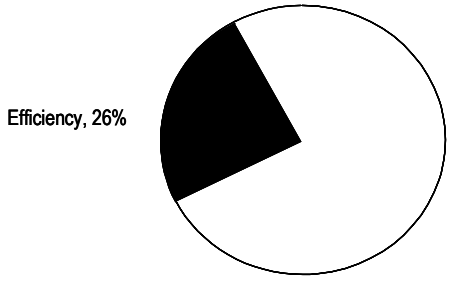

Figure 2.2-1: Percentage of Total FY 03 R&D Funding Supporting FAA Aviation Efficiency Goal

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, will help to ensure efficient management of aviation traffic while maintaining optimal safety and facilitating collaborative decision making between air traffic managers and National Aviation System (NAS) users.

For FY 2003, the primary Aviation Efficiency R&D performance goal is to*:* "*Improve the efficiency of the Air Traffic Control System.*" All research and development within the Aviation Efficiency R&D Program Area will be directed toward satisfying one of the following Derived Efficiency Performance Goals:

1. Maximize the level of service experienced by users of the NAS.
2. Minimize the cost to users of the NAS.
3. Reduce the cost of providing NAS infrastructure and operations.

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.

The development and availability of more efficient, less costly NAS infrastructure and services directly support the 2001 ARA Performance Plan strategy to: "*Improve the planning, development and deployment of capabilities/systems and services."* Proper delivery of these improvements also provides vital aviation safety benefits to the NAS, as described in a separate goal area.

Benefits derived from the Aviation Efficiency Weather R&D Program include increased system capacity, improved flight planning and efficiency, increased productivity, reduced air traffic controller and pilot workload, and enhanced mutual system awareness among controllers, airline officials, and pilots. Program outcomes also directly support the goals of the FAA "Safer Skies" initiatives.

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.

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.

Products of the Aviation Efficiency Weather R&D Program include: improved weather forecasting algorithms and technical input to the development of safe standards and procedures for the efficient avoidance or mitigation of weather-related aviation hazards.

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.

Program Area Structure

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

- Aviation Weather Efficiency Research (new program designation)
  - Terminal Ceiling and Visibility
  - Convective Weather
  - Oceanic Weather
  - Wake Vortex Effects Mitigation
  - Water Vapor Sensing System
- Airports Technology
  - Airport Pavement Design
  - Airports Planning and Design
- Advanced Technology Development and Prototyping Program
  - Aviation System Capacity Improvement (ASCI)
  - Operations Concept Validation
  - Software Engineering
  - Airspace Management Laboratory
  - Separation Standards
  - Domestic Reduced Vertical Separation Minima (DRVSM)
  - Development Systems Assurance
  - NAS Requirements Developments
- Safe Flight 21
  - Ohio River Valley

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

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 policy and goals.
- 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).

Long-Range View

Much work remains to be done before the timely and accurate forecasting of weather can optimally help the FAA to stay abreast of demands for increasing NAS efficiency without compromising safety. New and better algorithms must be found, and better use must be made of automation and communications to make information available to all who need it.

Airports Technology support for friction testing of new products to eliminate runway slipperiness as a cause of accidents will continue beyond 2005. 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.

ATS 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.

WEATHER PROGRAM – EFFICIENCY

GOALS:

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

The weather program directly supports FAA Strategic Goal in the performance area of Efficiency by reducing delays.

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

The R,E&D weather program, in collaboration with National Weather Service (NWS) programs, produces weather algorithms (technology), more accurate and rapid means of forecasting and disseminating forecasts (delivery), and means to enhance the intuitive capabilities of 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 and more efficient wake turbulence standards and procedures. Weather algorithms are being developed for implementation on appropriate National Airspace System (NAS) platforms (including the weather and radar processor, and the integrated terminal weather system) and on NWS systems. They also continue to be transferred to private weather service companies in support of the NAS. This transfer of technology enables these companies 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:

- Interactive data assimilation, and forecast tools to improve aviation advisories and forecasts issued by the NWS.
- Tools that locate, time, and gauge the severity of convective weather hazards in order to improve flight safety and enhance capacity.
- Short-term forecasts and prediction of ceiling and visibility in the terminal area for enhanced capacity.

In addition, the weather program is conducting wake turbulence research that focuses on closely spaced parallel runways.

Customer/Stakeholder Involvement: Weather research priorities and plans are consistent with user needs. The program works in concert with the Aerospace Weather Policy and Standards staff and Flight Standards (AFS) to derive research projects and priorities from the interagency National Aviation Weather Initiatives (1999) and merge them with other NAS drivers, such as "Safer Skies," Free Flight implementation, and the NAS operational concept documents. The weather program continually revalidates air traffic management 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 the analyzed aviation weather service user needs and requirements documented 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:

- Began flight test of humidity sensor on United Parcel Service (UPS) aircraft, as part of the Water Vapor Sensing System (WVSS) program that is leveraged with NOAA. The availability of detailed, real-time water vapor data will be utilized to make more accurate in-flight icing, ceiling, and visibility forecasts.
- Completed convective storm growth and decay field tests in Dallas, Orlando, Memphis, and New York. Test results are enhancing safety and capacity at these sites through more accurate short-term predictions of the initiation, growth, and decay of storm cells. Aircraft

now have the ability to avoid hazardous weather, planners can improve strategic and tactical flow management, and controllers can more effectively route traffic to/from these airports.

- In May 2001, enabled a joint FAA/NWS board to declare operational a national convective weather forecast product that provides a one-hour forecast of convective weather. This product will favorably impact NAS operations.
- Installed a wake turbulence monitoring system at San Francisco International Airport to support the Simultaneous Offset Instrument Approach (SOIA) safety and capacity initiative.

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 partnership with the FAA's Aerospace 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 interagency agreements, university grants and Memorandums of Agreement (MOAs).

Principal partners include the National Center for Atmospheric Research; NOAA's Forecast Systems Laboratory; the 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 facilities of 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, AccuWeather, Jeppesen, Sonalyst, and Radian.

Wake turbulence research is conducted through the Volpe Center and is coordinated with other research organizations.

MAJOR ACTIVITIES AND ANTICIPATED FY 2002 ACCOMPLISHMENTS:

- Began a convective weather field experiment in Northeast Corridor.
- Conducted a field test of consensus forecast product of marine stratus burn-off at San Francisco International Airport (SFO).
- Began implementation of a combined temperature/humidity sensor as part of the Water Vapor Sensing System (WVSS) program.
- Began development of oceanic weather products.
- Completed the installation and validation of wake turbulence safety prediction capability in the AFS ASAT terminal simulation model.

KEY FY 2003 PRODUCTS AND MILESTONES:

- Deliver a terminal convective weather forecast product for implementation wtih the Integrated Terminal Weather System (ITWS).
- Begin evaluation of a combined temperature/humidity sensor for the WVSS program.
- Complete the improved oceanic flight levels wind product.
- Complete analysis of northeast corridor data for the Terminal C&V program.
- Implement the consensus forecast product at SFO.
- Complete the data collection and analysis required for wake turbulence mitigation for airports with closely spaced parallel runways.

FY 2003 PROGRAM REQUEST:

Ongoing Activities

- Continue to develop automated data analysis and assimilation techniques.
- Transition weather research products to operations in the NWS, the FAA, and industry automation and weather systems.

- Develop oceanic weather nowcasting products.
- Enhance wake impact modeling, data collection and analysis for airports having closely spaces parallel runways.

New Initiatives

- None

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2001)	$ 64,604
FY 2002 Enacted	9,905
FY 2003 Request	9,099
Out-Year Planning Levels (FY 2004-2007)	32,105
Total	$ 115,713

Budget Authority ($000)	FY 1999 Enacted	FY 2000 Enacted	FY 2001 Enacted	FY 2002 Enacted	FY 2003 Request
Contracts:					
Weather Program - Efficiency	7,227	6,739	6,826	9,044	8,344
Personnel Costs	233	179	201	680	695
Other In-house Costs	9	10	24	181	60
Total	**7,469**	**6,928**	**7,051**	**9,905**	**9,099**

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
Basic	0	0	0	0	0
Applied	7,469	6,928	7,051	9,905	9,099
Development (includes prototypes)	0	0	0	0	0
Total	**7,469**	**6,928**	**7,051**	**9,905**	**9,099**

A12a – Weather Program – Efficiency Products and Activities	FY 2003 Request ($000)	Program Schedule					
		FY 2002	FY 2003	FY 2004	FY 2005	FY 2006	FY2007
041-110 Aviation Weather Analysis and Forecasting							
Convective Weather	$3,887						
Commenced Convective WX Field Experiment in NE Corridor		◆					
Deliver TCWF Product to ITWS for Implementation			◇				
Terminal Ceiling and Visibility	$1,089						
Implemented Consensus Forecast Product of Marine Stratus burn-off at SFO		◆					
Airborne Humidity Sensor	$515						
Commence Evaluation of Combined Temp/Humidity Sensor			◇				
Oceanic Weather	$1,853						
Commence Development of Oceanic Weather Products		◆					
Complete Improved Oceanic Flight Level Winds Product			◇				
041-150 Wake Turbulence	$1,000						
Complete SFO Wake Vortex Analysis to Enable Development of Revised Wake Separation Standards or Alternative Mitigation Procedures			◇				
Complete ASAT Modeling at 2 to 3 Airports TBD for SOIA Application at Closely Spaced Parallel Runways			◇				
Complete Comprehensive Benefit Assessment at 4 to 6 Airports TBD, Based on Results of FY 02 Airport-Specific Data Collection Efforts			◇				
Personnel and Other In-House Costs	$755						
Total Budget Authority	$9,099	$9,905	$9,099	$7,826	$7,955	$8,092	$8,232

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

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 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 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.

Aircraft manufacturers 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 agency's 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 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 Boe-

ing/$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)***

* 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 2002 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 2003 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.
- 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 2003 PROGRAM REQUEST:

The Airport Technology FY 2003 research program is a collaborative effort among many government organizations, universities, and industry associations. The program funding requested 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 1982-2001)	$10,703
FY 2002 Enacted	2,675
FY 2003 Request	* 6,586
Out-Year Planning Levels (FY 2004-2007)	35,070
Total	$55,034

Budget Authority ($000)	FY 1999 Enacted	FY 2000 Enacted	FY 2001 Enacted	FY 2002 Enacted	FY 2003 Request
Contracts:					
Airport - Efficiency	958	1,488	3,331	2,675	* 6,586
Personnel Costs	714	0	0	0	0
Other In-house Costs	100	0	0	0	0
Total	**1,772**	**1,488**	**3,331**	**2,675**	**6,586**

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
Basic	0	0	0	0	0
Applied	0	0	0	0	0
Development (includes prototypes)	1,772	1,488	3,331	2,675	* 6,586
Total	**1,772**	**1,488**	**3,331**	**2,675**	**6,586**

*** This money is in AIP in the FY 2003 budget submittal and reflects only the contract dollars.**

Airport Technology - Efficiency Products and Activities	FY 2003 Request ($000)	Program Schedule					
		FY 2002	FY 2003	FY 2004	FY 2005	FY 2006	FY2007
Airport Technology – Efficiency Goal	* $6,586						
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	* $6,586	$4,930	* $6,586	$9,320	$9,750	$8,000	$8,000

Note: Out year numbers are for planning purposes only. Actual funding needs will be determined through the annual budget process.
* This money is in AIP in the FY 2003 budget submittal and reflects only the contract dollars.

AVIATION SYSTEM CAPACITY IMPROVEMENT (ASCI)

GOALS:

Intended Outcomes: The Office of Aviation System Capacity Improvements (ASC) is working to provide an aerospace transportation system that meets the needs of users and efficiently governs the increasing level of air traffic by reducing systems delays, shortening operational criteria and procedures development time, and significantly reducing implementation risks for National Airspace System (NAS) Architecture.

The FAA is developing an overall strategy to enhance capacity. This includes both terminal and en route airport and airspace assessment of procedures, capacity-related technologies, and problem solving methodologies to support the Operational Evolution Plan (OEP) and the AIR-21 Cost Sharing Pilot Program. The strategy also includes developing an ATS performance measurement system to measure FAA progress against customer expectations and relate that performance to relevant costs. This strategy coordinates across budgetary lines allowing programs and projects to improve investment decision making and to achieve optimal strategic and operational results.

Initiatives are implemented in aviation system capacity planning to increase the number of aircraft operations per hour, reduce both en route and terminal airspace delays, reduce controller workload, and increase savings. As a result, the FAA, and the overall aviation community, will experience lower maintenance/operating costs. 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 Presidential Commission on Improved Airline Competitiveness recommendations.

Agency Outputs: The events of September 11, 2001 resulted in major shifts in the way the NAS is operated and maintained, as well as in a new emphasis for the planning and implementation of near-term and long-term needs. While safety and security have always been primary considerations, the problems of congestion and efficiency heretofore experienced, must now be considered in a new light. All venues of public transportation require increased resources to deal with the threat of terrorism. The National Aviation System is now a major area of concern. Reduced air travel has placed many airlines and airports in jeopardy of collapse, thus introducing the potential for the loss of thousands of jobs and revenues across many industries.

Economic recovery is more than ever a national priority. As now seen, the impact of temporary loss of the ability of the United States to maintain a safe, secure, and efficient national aviation system is felt worldwide. Improvements in safety and security must be supported by investments in returning the national aviation system to normal capacity. This means that each dollar invested in supporting the recovery from a capacity perspective must show how security and safety are also enabled. Ongoing and planned capacity initiatives and activities must be re-evaluated in terms of timing and implications to today's environments.

This program, for the first time, integrates 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 provides a responsive, ongoing problem solving research capability.

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 or near-term 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 System Capacity Improvement 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 program 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 request 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 parallels the congressional mandates concerning airport improvement plans and agency performance and results.

Accomplishments:

- Prepared and published Airport Capacity Benchmark Report 2001.
- Prepared and published the 2000 Ace Plan.
- Facilitated and consolidated ATS inputs for DOT Performance and Strategic Plan, FAA Performance and Strategic Plans, and the AFF Annual Report.
- Completed the Portland Capacity Design Study.
- Completed the Performance Data Analysis and Recording System (PDARS) installation within the FAA Western Pacific Region (AWP).

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 a number of projects, including:

- Further development and demonstration of the Small Aircraft Transportation System (SATS).
- 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 Tiltrotor 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 2002 ACCOMPLISHMENTS:

NAS Performance Measurement

- En Route Balance Scorecard – Completed scorecard development and implementation plans, identified/populated metrics, prototyped the tool at selected ARTCCs, developed scorecard reporting capability, and performed related communication and education outreach.
- AT System Metrics – Managed NAS performance measures for cost, efficiency and budget tie-in; developed/revised ATS customer performance metrics in support of GPRA; and developed facility-level metrics in support of system-level GPRA metrics.
- En Route Capacity Metric – Developed an en route capacity metric, in response to an OMB request, to complement airport benchmark activity.

Airport Development

- Benchmarking – Identified and measured efficiencies from new airfield procedural and technological improvements at SFO, PHL, and ATL.
- NLA – Analyzed (through modeling and simulation) NLA ground movements at MEM, JFK, LAX; facilitated NLA minimum operation procedure development.
- Regional Jets – Conducted modeling to confirm departure heading procedure created for DFW; facilitated departure heading and procedure change discussions with ATL and individual airports.
- Metrics for OEP 8 Pacing Airports – In support of ATP, developed metrics for the following OEP initiatives; reduced Vertical Separation, ER-4; reconfigured Airports Efficiently, AW-3; expanded Use of the three-mile separation standard, AD-5; and coordinated for Efficient Surface Movement, AD-6.
- 2001 ACE Plan – Completed and distributed.
- 2002 ACE Plan – Responded to the increased focus on airport efficiency and safety.

Capacity Improvement Opportunities

- Houston - Supported OEP Initiatives, Build New Runways, AD-1, and Maintain Runway Use in Reduced Visibility, AW-1; modeled the effect of airspace redesign on carriers in terms of economic impact and savings and the efficiencies gained; and included carriers that use IAH, DFW, MSY, and MEM.
- GPS Support – Developed GPS scientific data for flight standards certification of procedures development by creating a safety demonstration of GPS airways using PDARS data to analyze the fidelity of aircraft behavior when navigating through the airways; modeled the economic impact of a new runway on carriers and industry; developed and implemented a measure of the degree to which GPS-equipped aircraft conform to pre-established parameters by analyzing radar data to determine the level of fidelity of mode E&F-equipped aircraft in actual flight conditions.
- SFO Bay Area Analysis (OAK, SFO, SJC) – Investigated additional efficiencies and solutions, both individually and regionally (e.g. traffic flows and procedures) in response to an ATS request.

Architecture Deployment Support

- Simultaneous Offset Instrument Approaches (SOIA) – Conducted Analysis and simulation of arrivals to closely-spaced parallel runways in less than Visual Meterological Conditions (VMC) to determine how much the arrival rate

may be increased while maintaining a constant level of safety.

- Along Track Separation – Conducted Analysis and simulation of arrivals to closely spaced parallel runways in CAT I weather to determine how much the arrival rate may be increased while maintaining a constant level of safety.
- Wake Turbulence Separation Standards, AW - 1 - Analyzed the effect of wake turbulence on aircraft in various phases of flight to determine if separation standards may be reduced, thereby increasing operational efficiency.
- Required Navigation Performance (RNP) Operations – Established standards to improve terminal operations at ORD/MDW, SFO, OAK, SJC, DTW, ATC; assisted AAT and AFS in revising operational procedures; developed procedures to provide safe and efficient operations near security-restricted areas.

KEY FY 2003 PRODUCTS AND MILESTONES:

NAS Performance Measurement

- En Route Balance Scorecard – Complete measures development, causal analysis, and work on implementation and information systems.
- Terminal Balance Scorecard – Develop scorecard and causal analysis.

Airport Development

- Benchmarking – Complete at SFO, PHL, and ATL.
- NLA – Complete modeling and simulation NLA ground movements at MEM, JFK, LAX; complete NLA minimum operation procedure development.
- Regional Jets – Complete modeling of DFW departure heading procedure.
- Complete Metrics for OEP 8 Pacing Airports – for the following OEP initiatives; Reduce Vertical Separation, ER-4; Reconfigure Airports Efficiently, AW-3; Expand Use of 3 mile separation standard, AD-5; Coordinate for Efficient Surface Movement, AD-6
- 2002 ACE Plan – Complete and distribute.
- 2003 ACE Plan – Begin data collection.

Capacity Improvement Opportunities

- Complete Houston - Support OEP Initiatives, Build New Runways, AD-1 and Maintain Runway Use in Reduced Visibility, AW-1; model effect of airspace redesign on carriers in

terms of economic impact and savings and the efficiencies gained; include carriers that use IAH, DFW, MSY, MEM.

- GPS Support – Using PDARS data to analyze inflight fidelity of aircraft behavior, create a safety demonstration of GPS airways to provide data for flight standards certification of procedures development; complete the modeling of the economic impact of a new runway on carriers and industry; complete the implementation of a tool that measures the degree to which GPS-equipped aircraft conform to preestablished parameters in actual flight conditions.

Architecture Deployment Support

- Complete work on SOIA.
- Complete work on Along Track Separation.
- Complete Required Navigation Performance (RNP) Operations standards to improve terminal operations at ORD/MDW, SFO, OAK, SJC, DTW, ATC; complete procedures that provide safe and efficient operations near security-restricted areas.

NAS Plan Handoff

- Deliver maintenance, logistics and infrastructure (leased telecommunications, utilities) to support PDARS equipment installed in the Air Traffic Control System Command Center (FY 2000), AWP (FY 2000), ASW (FY 2001), and ASO (FY 2002) regions.

FY 2003 PROGRAM REQUEST:

In FY 2003, the program will continue to focus on capacity enhancement at all major airports as well as on terminal and en route airspace. Primary focus areas are: (1) airports where construction of suggested improvements can be completed within two to three years; and (2) air traffic radar facilities, where airspace redesign, reduce controller workload, increase safety, and provide the aviation industry with additional flexibility and predictability during flight.

In addition, the program will continue to fine tune air traffic system performance measures. These efforts will concentrate on reducing the cost of service delivery by targeting and coordinating investments across appropriations.

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2001)	$8,355
FY 2002 Enacted	5,300
FY 2003 Request	5,300
Out-Year Planning Levels (FY 2004-2007)	32,600
Total	$51,555

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

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
Basic	0	0	0	0	0
Applied	0	0	0	0	0
Development (includes prototypes)	1,855	1,200	5,300	5,300	5,300
Total	**1,855**	**1,200**	**5,300**	**5,300**	**5,300**

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

Aviation System Capacity Improvement Products and Activities	FY 2003 Request ($000)	Program Schedule					
		FY 2002	FY 2003	FY 2004	FY 2005	FY 2006	FY2007
NAS Performance Measurement	**$2,280**						
Develop & Implement En Route Balance Scorecard		◆	◇				
Develop AT Systems Metrics - PDARS		◆	◇				
Develop En Route Capacity Metric		◆	◇	◇	◇		
Airport Development	**$1,120**						
Conduct Benchmarking – SFO, PHL, ATL		◆	◇	◇	◇	◇	◇
Model & Simulate NLA Ground Movements at MEM, JFK, LAX		◆	◇	◇	◇		
Conduct Regional Jets Departure Procedure Modeling at DFW		◆	◇				
Develop Metrics for OEP 8 Pacing Airports		◆	◇				
Complete and Distribute 2001 ACE Plan		◆					
Begin Data Gathering for 2002 ACE Plan		◆	◇				
2003-2007 ACE Plans		◆	◇	◇	◇	◇	◇
Fund ACT-540 Requirements		◆	◇	◇	◇	◇	◇
Capacity Improvement Initiatives	**$1,100**						
Model Airspace Redesign at Houston		◆	◇				
Develop, Model and Implement GPS Support Initiatives		◆	◇				
Conduct SFO Bay Analysis		◆					
Architecture Deployment Support	**$800**						
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	**$5,300**	**$5,300**	**$5,300**	**$5,900**	**$7,100**	**$7,700**	**$7,900**

Notes:

- Out year numbers are for planning purposes only. Actual funding needs will be determined through the annual budget process.
- In the Facilities and Equipment appropriations, personnel and other costs are budgeted in Activity 5, not the program budget line item.

OPERATIONS CONCEPT VALIDATION

GOALS:

Agency Outputs: The agency provides:

- A well-defined and 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 more efficiently accommodate traffic demand).
- 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, essential for validating the concept for a modern NAS based on a shared, integrated infrastructure, ensures that the concept fully reflects user community requirements.

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 of a validation plan with the human factors activity:

Operational concept development

- 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 midterm concept capabilities.
- Developed detailed concepts for individual service enhancement and domains to support the development of system-level requirements for modernization (in particular, to support development of a concept of use for integrated Decision Support Tools for the 2003-2005 timeframe).

Concept validation

- Conducted a comparison of U.S. Eastern Triangle operations to European core airspace.
- Developed the capability for fast-time analysis of new concepts such as multi-sector planning and dynamic resectorization.
- Conducted joint FAA/NASA/user concept validation activities, including human-in-the-loop simulations.

Concept system design

- 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 analysis of en route sectorization strategies to support the mid-term design for the Eastern Triangle.

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, which would impose an undue burden on U.S. carriers, manufacturers, and other participants in the global airspace system.

MAJOR ACTIVITIES AND ANTICIPATED FY 2002 ACCOMPLISHMENTS:

Operational concept development

- Developed detailed concepts for Flight Intent.
- Developed detailed concepts for Information Management of airspace resources to facilitate improved flight planning and impact assessment.
- Developed en route evolution concept including flight data management (FDM) across NAS.

Concept validation

- Developed testbed for modernization.
- Assessed FAA high altitude concept.
- Developed information flow model to translate concepts into interface requirements.

Concept system design

- Conducted closed-loop modeling of changes in airspace/airports and user demand.

KEY FY 2003 PRODUCTS AND MILESTONES:

Operational concept development

- Develop terminal airspace evolution concept.
- 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 detailed concept of operations for the evolution of Traffic Flow Management.
- Develop performance framework for concepts including Required ATM System Performance and Real-Time Streaming Protocol (RTSP).

Concept validation

- Establish the Validation Data Repository to capture all activities and results associated with concept and concept-of-use validation activities in the FAA. Establish metrics to allow comparability of results across program validation efforts in the U.S. and in Europe.
- Validate the information management concept contained in the RTCA concept of operations.
- Validate the flight intent concept of use to assure completeness and harmonization of the definition for integration into ground and airborne decision support systems in the US and Europe.

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 the work in the human factors research and the human factors and the operational validations experimentation to define the information type, update rate, and display requirements needed to support the agreed to operational improvements of the NAS concept of operations through 2010.

FY 2003 PROGRAM REQUEST:

The FY 2003 request extends the high level concept of operations and the early validation efforts into detailed concepts of operation for the evolution of Airspace Management 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. The request also extends the development of performance measures to validate the operational improvements of future concepts as well as dynamic models of the interactions of schedule and control decisions on the performance of the NAS.

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 1982-2001)	$10,418
FY 2002 Enacted	2,500
FY 2003 Request	2,500
Out-Year Planning Levels (FY 2004-2007)	19,500
Total	$34,918

Budget Authority ($000)	FY 1999 Enacted	FY 2000 Enacted	FY 2001 Enacted	FY 2002 Enacted	FY 2003 Request
Contracts:					
Operations Concept Validation	3,412	2,200	1,400	2,500	2,500
Personnel Costs	3,406	0	0	0	0
Other In-house Costs	0	0	0	0	0
Total	**6,818**	**2,200**	**1,400**	**2,500**	**2,500**

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
Basic	0	0	0	0	0
Applied	0	0	0	0	0
Development (includes prototypes)	6,818	2,200	1,400	2,500	2,500
Total	**6,818**	**2,200**	**1,400**	**2,500**	**2,500**

Operations Concept Validation Products and Activities	FY 2003 Request ($000)	Program Schedule					
		FY 2002	FY 2003	FY 2004	FY 2005	FY 2006	FY2007
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	$1,000						
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	$2,500	$2,500	$2,500	$2,700	$5,000	$5,600	$6,200

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

SOFTWARE ENGINEERING

GOALS:

Intended Outcomes: The FAA intends to improve NAS and avionics safety and reduce NAS and avionics acquisition, development, and maintenance costs by developing and implementing 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 Software Engineering Resource Center (SERC), established in June 1998, is a focal point for 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 the agency's in-house software and systems engineering competencies. The primary SERC facilities are located at the William J. Hughes Technical Center.

Agency Outputs: The principal products of the SERC include a series of standards, guidelines, models, research papers, and "evolvable" prototypes. They demonstrate, validate, and verify the safety properties, performance, and other critical attributes of anticipated new NAS technologies. The SERC also evaluates and validates improved software processes, methods, and engineering tools that enhance architecture and systems, as well as engineering, testing, and certification functions for the life cycle of NAS systems software. The SERC brings together recognized industry experts and FAA personnel to solve problems related to acquisitions containing Commercial Off-The-Shelf/Non-developmental Item (COTS/NDI) products and the next generation architecture. These activities transfer skills to, and increase the technical competency of, the FAA workforce.

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

- COTS/NDI Software Assurance Research: This research directly supports the Flight Controls and Digital Avionics Systems by investigating conditions that allow COTS software products to be certified to a currently defined level of safety. It helps to establish selection criteria and evaluation guidelines for ongoing work in information security product evaluations and a number of other related areas, such as NAS Infrastructure. The research also identifies and evaluates techniques for reducing cost and schedule to ensure that COTS/NDI software systems are safe and function as required.
- Evaluation and Prototyping of Systems and Software Engineering Processes and Methods for Use in 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/NDI software. It 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: Research is seeking to identify and develop better ways of estimating and predicting the life-cycle costs of COTS-intensive systems. This study 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: Evaluates new technology and developing prototype tools to create a common NAS-wide adaptation work environment. This environment will facilitate the standardization of data, tools, services, and information exchange to improve the way adaptation is performed across the NAS.
- Evaluation and Prototyping of High-Integrity, Safety-Critical Architectures: Finds 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: Investigates unified approaches to formal architecture definition and description for cost-effective evaluation and comparison of competing candidate architectures for acquisition.
- Analytical and Simulation Architecture Models for the NAS: Investigates the operational effects of optimized constraints, including cost and performance, before committing resources to NAS systems implementation and deployment.

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 goal of streamlining the software aspects of certification is to assess cost and schedule drivers for certifying both avionics and ground systems software, and to prototype solutions that may reduce cost and schedules. These cost reduction measures support objectives of the Office of the Associate Administrator for Research and Acquisitions (ARA) and the Office of the Associate Administrator for Regulation and Certification (AVR).

Recommendation R-14 of the "Report of the Challenge 2000 Subcommittee of the FAA RE&D Advisory Committee for the Administrator" reads, in part:

> *The FAA should conduct an in-depth analysis of processes within the FAA which are affected by COTS/NDI technologies….[5] Identify new methods to test and validate safety-critical systems that are not dependent on source code analysis….[6/7] Investigate ways to reduce cost and time to (re)establish high confidence in a system….[18] Promote software technology and process improvement techniques.*

The SERC's COTS/NDI software assurance research work is directed toward answering the recommendations of this Subcommittee and also addresses concerns and recommendations contained in the COTS/NDI in Safety-Critical System report. This research also supports Action Plan 5: Validation and Certification Methodology of the FAA / EUROCONTROL R&D Committee agreements.

The Subcommittee Report of the NAS ATM R&D Panel to RE&D Advisory Committee addresses the entire contents of its section 4.0 to Software Engineering Research and Development. It concludes with a number of recommendations concerning the need to initiate research in (1) certification of ground as well as air systems involving critical software; (2) systems/software complexity; (3) various software architectural issues such as reuse and reliability; and (4) software/computer security. This is all captured within several sections, beginning with the Major Recommendation 4.2.1.a 2, "The FAA should establish a Software Engineering Laboratory under the direction of the Chief Scientist for Software Engineering that performs as a center of excellence." A major purpose of this research initiative is to address the concerns and identified weaknesses noted by the Subcommittee.

Accomplishments:

Research on Applying COTS/NDI Within NAS Ground Systems and Avionics

- Completed first phase of the development of a Constructive COTS Cost Estimation Model (COCOTS); collected maintenance data on 20 projects (13 FAA); conducted research on life-cycle cost criteria, and finishing development of a full life-cycle cost model; began collecting life-cycle data, piloting model on three projects; and conducted information seminars on the beta version.

NAS Architecture Research

- Developed a prototype NAS As-Adapted Data Repository utilizing web technologies in support of Center TRACON Automation System (CTAS) and Enhanced Traffic Management System (ETMS) adaptation work.
- Developed a prototype STARS Data Retrieval Tool to support STARS adaptation mainte-

nance personnel, as well as to demonstrate the efficiency of program specific data delivery tools and services.

- Conducted research and prototyping towards the development of an adaptation services computing platform that would increase the efficiency of doing adaptation and decrease the costs associated with adaptation.
- Developed a business case for consolidating projects requiring computing resources in order to reduce acquisition, operations and maintenance costs –"enterprise view" as opposed to "stovepipe/project specific" approach.

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.
- Adaptation Improvement Process – Boston University, MITRE.

Partnership agreements are being initiated with EUROCONTROL, DOD, National Institute of Standards and Technology (NIST), and others.

MAJOR ACTIVITIES AND ANTICIPATED FY 2002 ACCOMPLISHMENTS:

Research on Applying COTS/NDI Within the NAS Ground Systems and Avionics

- Completed Constructive COTS Cost Estimation Model, conduct workshops on use of model, pilot the tool on three 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.
- Conducted studies and develop prototype applications to improve efficiency of accomplishing NAS adaptation services within a common NAS-wide adaptation work environment.

KEY FY 2002 PRODUCTS AND MILESTONES:

The SERC will coordinate the completion of several software engineering research products. During FY 2002, the COCOTS life-cycle model will be available for use within the FAA's Acquisition Management System. Training, workshops, and briefings will be provided on the use of COTS/NDI products in acquisitions. A prototype NAS-wide adaptation services environment (NASE) will be established to provide electronic access to aeronautical information, adaptation tools and services. These prototype products will be made available for field use. Technology transfer liaisons will be established with remote researchers and research sites.

FY 2003 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 1982-2001)	$2,200
FY 2002 Enacted	1,000
FY 2003 Request	1,000
Out-Year Planning Levels (FY 2004-2007)	7,300
Total	$11,500

Budget Authority ($000)	FY 1999 Enacted	FY 2000 Enacted	FY 2001 Enacted	FY 2002 Enacted	FY 2003 Request
Contracts:					
Software Engineering R&D	462	300	900	1,000	1,000
Personnel Costs	538	0	0	0	0
Other In-house Costs	0	0	0	0	0
Total	**1,000**	**300**	**900**	**1,000**	**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
Basic	0	0	0	0	0
Applied	0	0	0	0	0
Development (includes prototypes)	1,000	300	900	1,000	1,000
Total	**1,000**	**300**	**900**	**1,000**	**1,000**

Software Engineering R&D Products and Activities	FY 2003 Request ($000)	Program Schedule					
		FY 2002	FY 2003	FY 2004	FY 2005	FY 2006	FY2007
F&E 1F01 Software Engineering R&D							
Perform Research on Application of COTS / NDI to NAS ground Systems and Avionics	$200	◆	◇	◇	◇		
Perform Research on NAS Architecture	$800	◆	◇	◇	◇	◇	◇
Total Budget Authority	$1,000	$1,000	$1,000	$1,000	$1,100	$2,100	$3,100

Notes:

- Out year numbers are for planning purposes only. Actual funding needs will be determined through the annual budget process.
- In the Facilities and Equipment appropriations, personnel and other costs are budgeted in Activity 5, not the program budget line item.

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 agency'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 Consolidated Operations and Delay Analysis System and the Daily Measurement of Air Traffic Service.

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:

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), Air Traffic Planning and Procedures (ATP), and Air Traffic Management.

MAJOR ACTIVITIES AND ANTICIPATED FY 2002 ACCOMPLISHMENTS:

- Deployed 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.
- Deployed 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.
- Developed concept papers on a range of topics, including:
  - Airspace data services and data management.
  - Multidivisional services to support development of advanced navigation (GPS).

KEY FY 2003 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
- 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 2003 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 1982-2001)	$7,000
FY 2002 Enacted	4,500
FY 2003 Request	4,500
Out-Year Planning Levels (FY 2004-2007)	36,800
Total	$52,800

Budget Authority ($000)	FY 1999 Enacted	FY 2000 Enacted	FY 2001 Enacted	FY 2002 Enacted	FY 2003 Request
Contracts:					
Airspace Management Lab	0	3,000	4,000	4,500	4,500
Personnel Costs	0	0	0	0	0
Other In-house Costs	0	0	0	0	0
Total	**0**	**3,000**	**4,000**	**4,500**	**4,500**

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
Basic	0	0	0	0	0
Applied	0	0	0	0	0
Development (includes prototypes)	0	3,000	4,000	4,500	4,500
Total	**0**	**3,000**	**4,000**	**4,500**	**4,500**

Airspace Management Lab Products and Activities	FY 2003 Request ($000)	Program Schedule					
		FY 2002	FY 2003	FY 2004	FY 2005	FY 2006	FY2007
Analyze, Deploy, and Enhance Traffic Data and Metrics Products and Projects.	$2,000	◆	◇	◇	◇	◇	◇
Analyze, Enhance and Support Environmental Tools.	$500	◆	◇	◇	◇	◇	◇
Provide Full-Scale Deployment and Integration Services for Obstruction Evaluation Workflow System	$2,000	◆	◇	◇	◇	◇	◇
Total Budget Authority	$4,500	$4,500	$4,500	$8,000	$9,000	$9,600	$10,200

Notes:
- Out year numbers are for planning purposes only. Actual funding needs will be determined through the annual budget process.
- In the Facilities and Equipment appropriations, personnel and other costs are budgeted in Activity 5, not the program budget line item.

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 assessments of the value the change brings to Air Traffic Control (ATC) system providers and users.
- A benefit-cost analyses 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 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:

- 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.
- 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) group.

The program also provides FAA representation on ICAO's Separation and Airspace Safety Panel (SASP) — the focal point for development of the technical justification for new separation minima as well as the 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 2001, 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 and 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).
- Agreement by the FAA to support 2002 introduction of the RVSM into the Western Pacific/South China Sea portion of the Asia Pacific Region.
- Development and acceptance by ICAO of requirements for 30-nm lateral separation standard based on automatic dependent surveillance in oceanic and remote airspace (May 2001).

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) 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 sponsorship of grants and cooperative work 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 2002 ACCOMPLISHMENTS:

Emphasis will have been in five major areas:

- Implemented (November 2001) the RVSM in the West Atlantic Route System.
- Implemented (February 2002) the RVSM in the Western Pacific/South China Sea portion of the Asia Pacific Region.
- Introduced a pair of parallel routes with a reduced lateral separation standard in the Gulf of Mexico.
- Began work to introduce NICE simulation methodology into northern Pacific system planning and analysis.
- Developed a comprehensive airspace safety oversight function in the Asia Pacific Region.

KEY FY 2003 PRODUCTS AND MILESTONES:

- Develop ATC operational concept for application of 30-nm lateral and longitudinal separation standards in FAA-administered oceanic airspace based on deployed FAA oceanic automation system (June 2003).
- Complete work within SASP to formalize implementation requirements for 30-nm lateral and 30-nm longitudinal separation standards.
- Complete plan to introduce reduced separation minima in Gulf of Mexico and ICAO Caribbean and South American Regions.
- Develop worldwide standardization of RVSM regional monitoring agency standards and long-term aircraft height-keeping performance requirements within ICAO SASP.
- Continue to provide RVSM safety oversight function in Pacific and North Atlantic.

- Transfer responsibility for safety oversight function in Asia portion of Asia Pacific Region to another State or international entity.
- Finalize transfer of NICE methodology to northern Pacific airspace.

FY 2003 PROGRAM REQUEST:

The FY 2003 program request provides for:

- Completion of work necessary to finalize development of operational concept and implementation requirements 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.
- Development of a plan to introduce reduced separation-standard values into Gulf of Mexico and ICAO Caribbean and South American Regions.
- Completion of recommendations for northern Pacific airspace improvement options.
- Standardization of RVSM monitoring requirements and regional monitoring agencies.
- Continued provision of RVSM safety oversight function in North Atlantic and Pacific airspace.
- Expansion of safety oversight assistance, including augmentation of the GPS Monitoring System, to support Gulf of Mexico, Caribbean/ South American, and Domestic RVSM implementation.

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2001)	$4,745
FY 2002 Enacted	2,200
FY 2003 Request	2,200
Out-Year Planning Levels (FY 2004-2007)	11,800
Total	$20,945

Budget Authority ($000)	FY 1999 Enacted	FY 2000 Enacted	FY 2001 Enacted	FY 2002 Enacted	FY 2003 Request
Contracts:					
Separation Standards	0	1,400	2,200	2,200	2,200
Personnel Costs	* 1,145	0	0	0	0
Other In-house Costs	0	0	0	0	0
Total	**1,145**	**1,400**	**2,200**	**2,200**	**2,200**

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
Basic	0	0	0	0	0
Applied	1,145	0	0	0	0
Development (includes prototypes)	0	1,400	2,200	2,200	2,200
Total	**1,145**	**1,400**	**2,200**	**2,200**	**2,200**

*** 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 2003 Request ($000)	Program Schedule					
		FY 2002	FY 2003	FY 2004	FY 2005	FY 2006	FY2007
Separation Standards							
West Atlantic Route System Reduced Vertical Separation Minima (RVSM)	$100						
Implemented		◆					
Conduct Safety Oversight		◆	◇	◇	◇	◇	◇
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					◇	◇	◇
Pacific and Western Pacific/South China Sea RVSM	$100						
Conducted Readiness and Safety Assessments		◆					
Implemented		◆					
Conduct Safety Oversight – Pacific		◆	◇	◇	◇	◇	◇
Global Standardization of RVSM Safety Oversight Function	$500						
Develop Common Principles and Practices		◆	◇				
Develop Long-Term Monitoring Requirements		◆	◇				
Reduced Separation Standards in Gulf of Mexico and ICAO Caribbean and South American Region	$600						
Develop Plan		◆	◇				
Conduct Data Collection and Analysis		◆	◇	◇	◇		
Implement		◆		◇	◇		
Investigation of Northern Pacific Airspace Improvement Options Using North Atlantic Cost Effectiveness Methodology	$200						
Formed Government-Industry Working Group		◆					
Formulate Possible Options; Conduct Simulation and Analysis; Identify Best Options		◆	◇				
Total Budget Authority	**$2,200**	**$2,200**	**$2,200**	**$2,500**	**$2,500**	**$3,100**	**$3,700**

Notes:
– Out year numbers are for planning purposes only. Actual funding needs will be determined through the annual budget process.
– In the Facilities and Equipment appropriations, personnel and other costs are budgeted in Activity 5, not the program budget line item.

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 2002 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 2003 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 2003 PROGRAM REQUEST:

The FY 2003 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 phased 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 1982-2001)	$0
FY 2002 Enacted	2,100
FY 2003 Request	2,100
Out-Year Planning Levels (FY 2004-2007)	*
Total	$4,200

Budget Authority ($000)	FY 1999 Enacted	FY 2000 Enacted	FY 2001 Enacted	FY 2002 Enacted	FY 2003 Request
Contracts:					
Domestic Reduced Vertical Separation Minima Program	0	0	0	2,100	2,100
Personnel Costs	0	0	0	0	0
Other In-house Costs	0	0	0	0	0
Total	**0**	**0**	**0**	**2,100**	**2,100**

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
Basic	0	0	0	0	0
Applied	0	0	0	0	0
Development (includes prototypes)	0	0	0	2,100	2,100
Total	**0**	**0**	**0**	**2,100**	**2,100**

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 2003 Request ($000)	Program Schedule					
		FY 2002	FY 2003	FY 2004	FY 2005	FY 2006	FY2007
Domestic Reduced Vertical Separation Minima							
DRVSM	$2,100						
Conduct Rule Making		◆	◇				
Conduct Safety Assessment		◆	◇	◇	◇		
Develop Database		◆	◇	◇	◇	◇	
Develop Monitoring Procedure		◆	◇				
Conduct Modeling and Simulations		◆	◇				
Conduct Analysis of Data		◆	◇	◇			
Develop Procedures		◆	◇	◇			
Total Budget Authority	$2,100	$2,100	$2,100	*	*	*	*

Notes:

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

– In the Facilities and Equipment appropriations, personnel and other costs are budgeted in Activity 5, not the program budget line item.

* Out Year Funding Request Under Review. FY 2002 is the First Year of Funding under Facilities and Equipment Advanced Technology Development and Prototyping.

DEVELOPMENT SYSTEMS ASSURANCE

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 large, heterogeneous networks, like the National Airspace System (NAS).

Definition and allocation of specific requirements is a key step in the NAS system security engineering process, and results from this effort will improve that requirement process. Results will be fed back to the security architecture and analysis for the NAS, and a more cost-effective enterprise security architecture will be produced and implemented. 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: The ARA Development System Assurance (ADSA) budget line item 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 ADSA 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 ADSA program builds upon work already underway within ARA, and provides ongoing planning, guidance, and support for data integrity and assurance within ARA-developed/owned systems. The ADSA begins in FY03, requiring $2.7 million to start addressing major security functions across FAA networks and operating platforms. The project will lead to a more balanced, optimized and layered implementation of ISS services that can be delivered in a more centrally directed, cost effective manner. ADSA can lead to measurable improvement in enterprise security services for the FAA.

The ADSA project provides security engineering and system analyses for research and planning to ensure successful enterprise security architecture. The ADSA 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 major security functions:

- Incident Prevention
- Incident Detection
- Incident Response

Customer/Stakeholder Involvement:

Benefits of ADSA project research and analyses flow directly to the Integrated Product Teams and suppliers that are developing automation, navigation, surveillance and communications systems for the NAS. The products of ADSA research and development will lead to more secure networks and operating environments for FAA information technology systems, including a more balanced set of specifications and standards for ISS requirements within the NAS.

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 ADSA project.

Benefits ultimately accrue to the aviation transportation system and the flying public through more secure, more reliable information systems that are resistant to cyber-threats and attacks but still adapt current commercial technologies to the unique environment of the FAA and NAS.

Accomplishments: The ADSA project has not previously been funded through budget item 1C01; however, the FAA has accomplished ISS goals that establish the need and a foundation for beginning a focused development effort to optimize security services across enterprise networks.

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 plays an integral role in the optimization of enterprise security services, including the introduction of public key infrastructure (PKI) and encryption technologies into the NAS environment.
- FAA Safeguard can be used to assist the FAA Technical Center with enterprise vulnerability assessment and technology applications for PKI.
- Other support partnerships will be developed to balance major security functions among NAS security domains and information sharing enclaves.

MAJOR ACTIVITIES AND ANTICIPATED FY 2002 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 2003 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 2003 Program Request:

The $2.7 million FY03 request initiates advanced technology development and prototyping that supports enterprise information systems security within the FAA. 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 1982-2001)	$0
FY 2002 Enacted	0
FY 2003 Request	2,700
Out-Year Planning Levels (FY 2004-2007)	0
Total	$2,700

Budget Authority ($000)	FY 1999 Enacted	FY 2000 Enacted	FY 2001 Enacted	FY 2002 Enacted	FY 2003 Request
Contracts:					
Development System Assurance	0	0	0	0	2,700
Personnel Costs	0	0	0	0	0
Other In-house Costs	0	0	0	0	0
Total	**0**	**0**	**0**	**0**	**2,700**

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
Basic	0	0	0	0	0
Applied	0	0	0	0	0
Development (includes prototypes)	0	0	0	0	2,700
Total	**0**	**0**	**0**	**0**	**2,700**

Note: Out year funding is under review.

Development System Assurance Products and Activities	FY 2003 Request ($000)	Program Schedule					
		FY 2002	FY 2003	FY 2004	FY 2005	FY 2006	FY2007
Development System Assurance							
FAA Technical Center Evaluation/Model	$500						
Develop and Implement FAA Technical Center Evaluation and Model				◇	◇	◇	◇
FAA Safeguard Gap Analysis and ISS Domain Requirement Process	$1,300						
Perform Gap Analysis and Establish Requirements				◇	◇	◇	◇
Other Research and Development to Validate Enterprise ISS Performance Within the NAS	$900						
Perform R&D as Required				◇	◇	◇	◇
Total Budget Authority	**$2,700**	**0**	**$2,700**	**$2,700**	**$2,000**	**$2,000**	**$3,000**

Notes:

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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 and other efforts to prepare and validate strategies and proposals designed to increase overall NAS efficiency. Also, it will support 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

MAJOR ACTIVITIES AND ANTICIPATED FY 2002 ACCOMPLISHMENTS:

- Researched navigation aids and National Transportation Safety Board (NTSB) high-risk airports.
- Researched the impact of Automatic Dependent Surveillance – Broadcast (ADS-B) information on controller techniques and decision making.
- 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 and capabilities supporting the Commercial Aviation Safety Team (CAST).
- Researched requirements for service-based planning in the NAS tool.
- Provided aviation weather issue management, coordination, and support.
- Provided AMS acquisition management and requirements development support.
- Initiated Portfolio Management process for FAA weather programs.
- Evaluated Human Factors and developed requirements.
- Provided Operations and Maintenance rough order magnitude estimates for budget formulation.

KEY FY 2003 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 2003 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 1982-2001)	$2,900
FY 2002 Enacted	3,000
FY 2003 Request	3,000
Out-Year Planning Levels (FY 2004-2007)	12,700
Total	$21,600

Budget Authority ($000)	FY 1999 Enacted	FY 2000 Enacted	FY 2001 Enacted	FY 2002 Enacted	FY 2003 Request
Contracts:					
NAS Requirements	0	0	2,900	3,000	3,000
Personnel Costs	0	0	0	0	0
Other In-house Costs	0	0	0	0	0
Total	**0**	**0**	**2,900**	**3,000**	**3,000**

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
Basic	0	0	0	0	0
Applied	0	0	0	0	0
Development (includes prototypes)	0	0	2,900	3,000	3,000
Total	**0**	**0**	**2,900**	**3,000**	**3,000**

NAS Requirements Development Products and Activities	FY 2003 Request ($000)	Program Schedule					
		FY 2002	FY 2003	FY 2004	FY 2005	FY 2006	FY2007
Fund Studies and Other Efforts, and Validate Strategies and Proposals Designed to Increase Overall NAS Efficiency	$3,000	◆	◇	◇	◇	◇	◇
Total Budget Authority	$3,000	$2,900	$3,000	$3,000	$3,000	$3,600	$3,100

Notes:

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

– In the Facilities and Equipment appropriations, personnel and other costs are budgeted in Activity 5, not the program budget line item.

SAFE FLIGHT 21 – OHIO RIVER VALLEY

GOALS:

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:

- 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., 1090MHz, 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 (NOTAMs), and Pilot Reports (PIREPs).
  - 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.

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 2002 ACCOMPLISHMENTS:

In FY 2002, 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.
- Developed TIS-B and FIS-B requirements and specifications.
- Began installation of a TIS-B and FIS-B broadcast capability at Memphis.
- Developed and approved concepts of operation for Terminal and Surface applications.
- Installed multilateration system capability at Louisville.
- Completed development of call sign procedure for 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 2003 PRODUCTS AND MILESTONES:

Key FY 2003 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.

Engineering and operational evaluation

- Begin measuring system benefits at Memphis and Louisville against an established baseline.
- Start Investment Analysis for NAS-wide ADS-B implementation.

FY 2003 PROGRAM REQUEST:

FY 2003 funding completes procurement of avionics and ground systems necessary to conduct operational testing, demonstration, and evaluation activities. The funding also provides for operational evaluation itself, procedures development, certification tasks, and simulation activities.

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2001)	$37,700
FY 2002 Enacted	14,000
FY 2003 Request	11,400
Out-Year Planning Levels (FY 2004-2007)	28,300
Total	$91,400

Budget Authority ($000)	FY 1999 Enacted	FY 2000 Enacted	FY 2001 Enacted	FY 2002 Enacted	FY 2003 Request
Contracts:					
Safe Flight 21 - Ohio Valley	5,000	10,000	22,700	14,000	11,400
Personnel Costs	0	0	0	0	0
Other In-house Costs	0	0	0	0	0
Total	**5,000**	**10,000**	**22,700**	**14,000**	**11,400**

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
Basic	0	0	0	0	0
Applied	0	0	0	0	0
Development (includes prototypes)	5,000	10,000	22,700	14,400	11,400
Total	**5,000**	**10,000**	**22,700**	**14,400**	**11,400**

Safe Flight 21 - Ohio River Valley Products and Activities	FY 2003 Request ($000)	Program Schedule					
		FY 2002	FY 2003	FY 2004	FY 2005	FY 2006	FY2007
Safe Flight 21 - Ohio River Valley							
Operational Enhancements	$11,400						
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		◆	◇	◇	◇	◇	◇
Provide Improved Separation Standards		◆					
Data Link Evaluation		◆					
Program Management and Support		◆	◇	◇	◇	◇	◇
Safety Assessment		◆	◇	◇			
Total Budget Authority	$11,400	$14,000	$11,400	$6,900	$10,000	$6,000	$5,400

Notes:

– Out year numbers are for planning purposes only. Actual funding needs will be determined through the annual budget process.
– In the Facilities and Equipment appropriations, personnel and other costs are budgeted in Activity 5, not the program budget line item.
– The FY 1999 Facilities and Equipment appropriation allocated $11M for the Alaska Capstone project and $5 for the Ohio Valley project.
– In FY 2000 Safe Flight 21 was Funded in F&E Budget Activity 1.

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 aerospace.*"

Figure 2.3-1 indicates the percentage of the total FY 2003 R&D that will be devoted to the support of Aviation Environmental research.

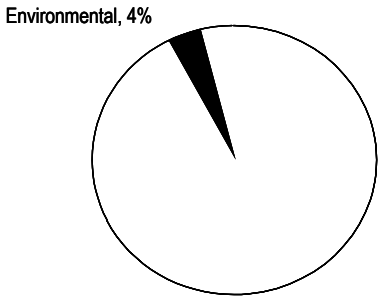

Figure 2.3-1: Percentage of Total FY 03 R&D Funding Supporting FAA Aviation Environmental Goal

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 and emissions upon the environment.

For FY 2003, the primary Environmental R&D performance goal is to*:* "*Reduce the impact of aviation-generated noise and emissions pollution.*" All research and development within the Environmental R&D Program Area will be directed toward satisfying one of the following Derived Environmental Performance Goals:

1. Increase understanding of current and potential environmental consequences of aviation-system operation and alternative countermeasures.
2. Control and reduce environmental impacts of aircraft and airport operations.

Environmental research efforts reflect the following strategies:

- Lead a cooperative development effort that balances noise reduction with adequate airport capacity.
- Manage FAA activities to understand and minimize adverse environmental consequences and comply with all federal statutes.
- Stimulate private industry and government sponsored research to reduce noise and emissions by the aviation sector.
- Harmonize international aircraft noise and engine emissions certification standards.

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 2003 budget submission and immediately follows this general program area description.

Through an optimal mix of aircraft noise and engine 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.

Program Area Outputs

Detailed program outputs of FAA Environmental R&D can be found in the description, drawn from the FY 2003 budget submission, that 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 type 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.

Program Area Structure

The environmental research program is a single budget line item, Environment and Energy, composed of the following major elements:

- Aircraft noise control
- Engine exhaust emissions control
- Aviation noise analysis
- Aviation emissions analysis

These topics form a cohesive system of research projects that support federal actions to identify, control, and mitigate the environmental consequences of aviation activity.

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 aircraft engine exhaust 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 2003 budget submission, that immediately follows this program area description.

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 will need to continue to determine where best to target its research to achieve noise 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 2003 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:

- Optimize the mix new aircraft certification standards, operational procedures, compatible land use, and abatement technology in order to prevent any increase in the impact of aircraft noise upon the population 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 give 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 uses a unified regulatory R&D approach — working closely with other federal agencies, industry, and foreign governments — 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 to be considered 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.

The FAA represents the United States on the International Civil Aviation Organization's (ICAO) Committee on Aviation Environmental Protection (CAEP) along with representatives of other civil aviation authorities and observers from the aviation industry. 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.

The Aviation Environmental Research Program directly supports the General Aviation (GA) action plan in demonstrating noise abatement technologies for light propeller-driven airplanes.

Accomplishments:

- Produced reports to Congress —
  - Report on quiet aircraft technology for light propeller driven airplanes and helicopters. The finding of this report has led to a joint FAA/NASA research project on general aviation noise.
  - Report on the effects of aircraft noise.
  - Five reports on the annual progress of the FAA/NASA subsonic jet noise research program.
- Developed advanced computer models — Used for airport and heliport noise analysis. Have resulted in over 1000 copies sold 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.

- Public forums on aviation noise research:
  - Atlanta
  - Minneapolis
  - San Diego
  - Seattle
  - Washington, DC
- Special reports and findings:
  - Four FICAN annual reports
  - One report on federal aviation noise research projects
  - One federal finding on the relationship between aircraft noise and sleep awakenings

Funding has also led to enhancements to the computer model used for airport air quality analysis and formal acceptance by the Environmental Protection Agency (EPA) as a preferred guideline model, 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 environmental assessments that are reviewed by the Federal Government.

R&D Partnerships: The FAA works closely with NASA through a series of Memorandums of Understanding 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 also 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 and resulted in more efficient use of federal funds.

MAJOR ACTIVITIES AND ANTICIPATED FY 2002 ACCOMPLISHMENTS:

Aircraft noise reduction and control

- Submitted final report to Congress on the joint FAA/NASA subsonic jet noise reduction technology program.
- Harmonized FAA helicopter noise certification regulations with those of the European Joint Aviation Authorities that govern the procedures used by airframe manufacturers.

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. Conducted a training/workshop with industry and government participants to identify potential procedures for analysis.
- Published the FAA Advisory Circular (AC) 34-1A, including field practices and technical guidance related to engine emissions certification.

Aviation environmental analysis

- Released Integrated Noise Model (INM) Version 6 for use in airport noise assessments.
- Completed the first phase of the validation of the Grand Canyon National Park aircraft overflight noise model.
- Continued to examine and validate methodologies used to assess aircraft noise exposure and impact.
- Finalized the release of Emissions And Dispersion Modeling System (EDMS) version 4.1, including enhanced modeling of aicraft plume and ground support equipment (GSE).
- Completed validation of individual modules and inter-module testing for the modeling System For Assessing Aviation Global Emissions (SAGE), version 1.
- Delivered the first version of the Screening Model for Airport Air Quality (SMAAQ) to FAA field personnel.

KEY FY 2003 PRODUCTS AND MILESTONES:

Aircraft noise control

- Publish an update of the noise certification handbook (replacement for AC 36-4).

Engine emissions control

- Develop harmonized, simplified engine exhaust emissions certification test procedures and technical guidance materials that will increase efficiency and reduce costs of the tests.

Aviation noise analysis

- Continue to examine and validate methodologies used to assess aircraft noise exposure and impact.

Aviation emissions analysis

- Continue to examine and validate methodologies used to assess aviation emissions and their impact on air quality.
- Complete development of the SAGE model for assessing aviation's global emissions.
- Publish an update to the handbook on procedures for airport air quality analyses.
- Publish guidance document for reducing emissions from ground support equipment and auxiliary power units.

FY 2003 PROGRAM REQUEST:

The FAA will continue to work with NASA in the Quiet Aircraft Technology (QAT) research program which should identify noise reduction technologies that will enter the marketplace within 10-15 years 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 FAA's role in the ICAO CAEP working groups to assess the international standards and recommended practices 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 assess the global exposure to noise from transport airplanes
- Enhancement and validation of the Emissions and Dispersion Modeling System (EDMS) and the Screening Model for Airport Air Quality (SMAAQ), and related input databases.
- Development and testing of the System for assessing Aviation's Global Emissions (SAGE).
- Maintain currency of the regulation and technical guidance materials concerning aircraft noise and engine exhaust emissions certification requirements.

New Initiatives

- Enhanced aircraft noise modeling for airspace management analysis
- New Helicopter Modeling Methodology and Expanded Helicopter Database
- Initiate the systematic forecasting of aircraft engine exhaust emissions (local air quality, national burden, global burden).

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2001)	$ 57,727
FY 2002 Enacted	22,081
FY 2003 Request	7,698
Out-Year Planning Levels (FY 2004-2007)	31,794
Total	$ 119,300

Budget Authority ($000)	FY 1999 Enacted	FY 2000 Enacted	FY 2001 Enacted	FY 2002 Enacted	FY 2003 Request
Contracts:					
Aircraft Noise Control	1,307	1,329	678	16,041	1,259
Engine Exhaust Emissions Control	400	900	55	400	698
Aviation Environmental Analysis	532	627	2,060	0	0
Aviation Noise Analysis	0	0	0	2,920	2,765
Aviation Emissions Analysis	0	0	0	1,450	1,348
Personnel Costs	607	589	653	1,086	1,531
Other In-house Costs	45	36	27	184	97
Total	**2,891**	**3,481**	**3,473**	**22,081**	**7,698**

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
Basic	0	0	0	0	0
Applied	2,891	3,481	3,473	22,081	7,698
Development (includes prototypes)	0	0	0	0	0
Total	**2,891**	**3,481**	**3,473**	**22,081**	**7,698**

A13a – Aviation Noise Analysis Products and Activities	FY 2003 Request ($000)	Program Schedule					
		FY 2002	FY 2003	FY 2004	FY 2005	FY 2006	FY2007
091-110 Aircraft Noise Control							
Reduction Technology, Certification Standards & Procedures	$1,259						
Harmonized FAA/European Noise Certification Regulations		◆					
Report to Congress on FAA/NASA Subsonic Jet Noise Reduction Research		◆					
Final Assessment of FAA/NASA Light Propeller-Driven Airplane Noise Reduction Technology Research		◆		◇		◇	
Publish Advisory Circular 36-4			◇				
New Noise Standard for Large Subsonic Airplanes				◇			
Rulemaking Completed t Amend Helicopter Certification Requirements in 14 CFR Part 36							
091-111 Engine Exhaust Emission Control	$698						
Reduction Technology, Standards & Procedures, and Assessments		◆		◇		◇	
Updated the FAA Engine Exhaust Emissions Database to be Consistent with the ICAO Databank					◇		
Assessment of ICAO Standards Taking into Account the Required Technological and Scientific Bases		◆		◇		◇	
Development of a Harmonized, Simplified Engine Exhaust Emissions Certification Test Procedure			◇				
Complete Development of Advisory Circular 34-1A, Including Harmonization of Regulatory and Guidance Material Differences with the European Joint Aviation Authorities (JAA)						◇	
Update Certification Regulation and Guidance Document, AC 34-1, for Consideration of Climb/Cruise Conditions							
091-114 Aviation Noise Analysis	$2,765						
Develop Noise Assessment Methodologies							
Released Integrated Noise Model (INM) Version 6		◆					
Completed the First Phase of the Validation of the Grand Canyon National Park Aircraft Over Flight Noise Model		◆					
Validation of the Methodologies Used t Assess Aircraft Noise Exposure and Impact		◆		◇		◇	
Release INM Version 7					◇		
Enhanced Aircraft Noise Modeling for Airspace Management Analysis				◇			
New Helicopter Modeling Methodology and Expanded Helicopter Database				◇			
091-115 Aviation Emissions Analysis							
Initiate the Systematic Forecasting of Aircraft Engine Exhaust Emissions (Local Air Quality, National Burden, Global Burden)				◇			
Develop Air Quality Assessment Methodologies	$700						
New Emissions and Dispersion Modeling System		◆		◇	◇		
Publish Revised Handbook on Procedures for Airport Air Quality Analyses			◇			◇	
Draft Guidance Document for reducing Emissions from Ground Support Equipment and Auxiliary Power		◆	◇				
Develop Global Emissions Assessment Methodologies	$648						
Complete Prototype Model-System for Assessing Aviation's Global Emissions (SAGE)		◆	◇				
Forecast of National Global Emissions Burden					◇	◇	◇
Personnel and Other In-House Costs	$1,628						
Total Budget Authority	**$7,698**	**$22,081**	**$7,698**	**$7,700**	**$7,860**	**$8,030**	**$8,204**

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 FY 2003 R&D that will be devoted to Mission Support activities.

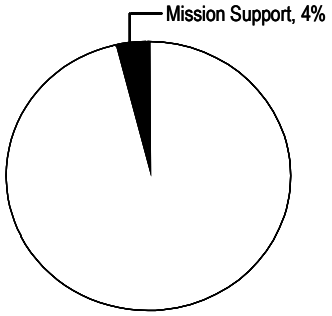

Figure 2.4-1: Percentage of Total FY 03 R&D Funding Supporting FAA Aviation Mission Support

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.

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.

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 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.

Program Area Structure

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

The *NARP* Program Management effort is divided into the following areas:

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

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, 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.

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.

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.

SYSTEMS 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.

Agency Outputs: The FAA prepares the annual R,E&D budget submission to Congress and publishes the annual *National Aviation Research Plan (NARP)*. The agency hosts 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. The Agency intends to start developing and publishing a research and development strategic plan.

Customer/Stakeholder Involvement: REDAC reviews FAA research commitments annually and provides guidance for future R,E&D investments. The Advisory Committee is limited to a maximum of 30 members. These members 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 agency provides R,E&D program status information through the *NARP* and submits the R,E&D budget requests to the Office of Management and Budget (OMB) and Congress. REDAC has provided the FAA with an independent strategic view on the agency's research commitments. In a recent report, the committee has reviewed the FAA's planned FY 2003 R,E&D Investments (April 2001). The Committee has also participated in a joint meeting with NASA's Aero-Space Technology Advisory Committee (Oct 2001) and has joined with NASA in supporting a subcommittee examining the Small Aircraft Transportation System (SATS) initiative.

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

MAJOR ACTIVITIES AND ANTICIPATED FY 2002 ACCOMPLISHMENTS:

R,E&D plans and programs

- Published the *National Aviation Research Plan*.

R,E&D advisory committee

- Submitted Committee review of and recommendations for FY 2003 R,E&D Program.
- Submitted Committee guidance for FY 2004 R,E&D Program.
- Participated in joint meetings with NASA's Aero-Space Technology Advisory Committee.

KEY FY 2003 PRODUCTS AND MILESTONES:

R,E&D plans and programs

- Publish the *National Aviation Research Plan*.

R,E&D advisory committee

- Prepare recommendations on planned R,E&D investments for FY 2004.
- Prepare other reports as requested by the Administrator.
- Participate in joint meetings with NASA's Aero-Space Technology Advisory Committee.

FY 2003 PROGRAM REQUEST:

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

Specifically, the agency will update the Research and Development Strategic Plan to ensure that is remains closely linked to the agency's and the department's corporate strategic goals. Specific tasks will be to update the performance measurements framework and R&D strategies. The agency will engage the service of the REDAC in the preparation of this plan.

The agency will continue to support the work of the REDAC in its task to advise the Administrator on the FAA R&D Program. In particular, the agency will seek the counsel and guidance of the committee for the FY 2004 program, review the proposed FY 2004 program prior to submission of the budget requirements to the Department of Transportation, and seek the committee's guidance during the execution of our R&D program.

The agency will continue to publish, as required by Congress, the *National Aviation Research Plan* and submit it annually to Congress as part of the President's Budget Request.

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

The agency will continue to provide the following core, essential services across all the service areas to produce the following:

- Financial management of the R,E&D program.
- Financial support for REDAC, a body of customers and aviation experts drawn from outside the FAA who provide guidance to the Administrator on R,E&D program planning and execution.
- Negotiation and execution of bilateral and multilateral agreements with international civil aviation authorities. These agreements establish cooperative R,E&D programs, system standards, and air traffic system procedures.

Ongoing Activities

Ongoing activities include:

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

New Initiatives

No new intiatives are planned in FY 2003.

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2001)	$ 33,581
FY 2002 Enacted	1,200
FY 2003 Request	1,459
Out-Year Planning Levels (FY 2004-2007)	6,062
Total	$ 42,302

Budget Authority ($000)	FY 1999 Enacted	FY 2000 Enacted	FY 2001 Enacted	FY 2002 Enacted	FY 2003 Request
Contracts:					
R,E&D Plans and Programs	385	1,164	886	1,130	1,408
Personnel Costs	685	0	246	49	47
Other In-house Costs	94	0	30	21	4
Total	**1,164**	**1,164**	**1,162**	**1,200**	**1,459**

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
Basic	0	0	0	0	0
Applied	1,164	1,164	1,162	1,200	1,459
Development (includes prototypes)	0	0	0	0	0
Total	**1,164**	**1,164**	**1,162**	**1,200**	**1,459**

A14a – System Planning and Resource Products and Activities	FY 2003 Request ($000)	Program Schedule					
		FY 2002	FY 2003	FY 2004	FY 2005	FY 2006	FY2007
011-130 R,E&D Plans and Programs							
R,E&D Plans and Programs	$1,189						
Publish Annual Plan for R&D		◆	◇	◇	◇	◇	◇
R, E&D Financial Management		◆	◇	◇	◇	◇	◇
Prepare Annual Budget Submissions		◆	◇	◇	◇	◇	◇
R<E&D Advisory Committee	$219						
Recommendations on FAA, R,E&D Investments		◆	◇	◇	◇	◇	◇
Joint Meetings with NASA's Aero-Space Technology Advisory Committee		◆	◇	◇	◇	◇	◇
Personnel and Other In-House Costs	$51						
Total Budget Authority	$1,459	$1,200	$1,459	$1,479	$1,502	$1,528	$1,553

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 Agency research facilities located at the William J. Hughes Technical Center (WJHTC) in support of R,E&D program goals to:

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

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

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 agency 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
- 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 2002 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 2003 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 2003 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
- Stars Integration
- Satellite Com. and Navigation Programs
- Separation Standards
- GPS WAAS/LAAS
- TERPS
- Runway Incursion
- Aircraft Safety
- ATC/AF Human Factors

New Initiatives

- OEP Concept Validation

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2001)	$ 71,672
FY 2002 Enacted	12,250
FY 2003 Request	6,455
Out-Year Planning Levels (FY 2004-2007)	26,445
Total	$ 116,822

Budget Authority ($000)	FY 1999 Enacted	FY 2000 Enacted	FY 2001 Enacted	FY 2002 Enacted	FY 2003 Request
Contracts:					
WJHTC Laboratory Facility	3,268	3,300	2,710	3,540	3,889
Personnel Costs	6,462	6,988	8,044	8,046	2,533
Other In-house Costs	0	787	1,469	664	33
Total	**9,730**	**11,075**	**12,223**	**12,250**	**6,455**

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
Basic	0	0	0	0	0
Applied	9,730	11,075	12,223	12,250	6,455
Development (includes prototypes)	0	0	0	0	0
Total	**9,730**	**11,075**	**12,223**	**12,250**	**6,455**

A14b – WJHTC Laboratory Facility Products and Activities	FY 2003 Request ($000)	Program Schedule					
		FY 2002	FY 2003	FY 2004	FY 2005	FY 2006	FY2007
011-140 WJHTC Laboratory Facility							
Systems Support laboratory (En Route, Terminal, Automated Flight Station, Communications, and Scan Radars)	$400						
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)	$450						
Approach Procedures (SOIA)		◆	◇	◇	◇	◇	
Free Flight Phase 2		◆	◇	◇	◇	◇	◇
Airspace Design		◆	◇	◇	◇	◇	◇
Operational Evolution Plan Concept Validation		◆	◇	◇	◇	◇	◇
Data Link		◆	◇	◇	◇	◇	◇
Stars Integration		◆	◇	◇	◇		
Aviation Support Laboratory (Aircraft)	$2,589						
Satellite Communications and Navigation Programs		◆	◇	◇	◇	◇	◇
Separation Standards		◆	◇	◇	◇		
GPS WAAS/LAAS		◆	◇	◇	◇	◇	◇
TERPS		◆	◇	◇	◇	◇	◇
Data Link		◆	◇	◇	◇	◇	◇
Runway Incursion		◆	◇	◇	◇	◇	◇
ADS-B		◆	◇	◇	◇	◇	◇
Aircraft Safety		◆	◇	◇	◇	◇	◇
Human Factors Laboratory	$450						
Air Traffic Control Human Factors		◆	◇	◇	◇	◇	◇
Airway Facilities Human factors		◆	◇	◇	◇	◇	◇
Operational Evolution Plan Concept Validation		◆	◇	◇	◇		
Personnel and Other In-House Costs	$2,566						
Total Budget Authority	$6,455	$12,250	$6,455	$6,356	$6,520	$6,695	$6,874

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

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, 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 R,E&D 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 R,E&D 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:

- Field evaluations of prototypes of key Free Flight capabilities to define requirements and estimate potential system benefits.
- Analysis to review the state of wake vortex detection technology to help the FAA and NASA define programs that will achieve meaningful enhancements to the NAS.
- Development of procedure changes to improve runway safety and efficiency in the en route, terminal and oceanic domains.
- Conduct of Safe Flight 21 demonstrations in the Ohio Valley and Alaska that show how Communication, Navigation and Surveillance (CNS) technologies can be integrated with procedural changes to enhance service to airspace users.
- 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.
- Conducted 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 Advisior (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 has 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 2002 ACCOMPLISHMENTS:

- Conducted evaluations of Free Flight Phase 2 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 Phase 1 capabilities to gather information on their utilization and on the system benefits derived from their use.
- Prototype development and assessment of key en route system architecture enhancements.

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2001)	$24,425
FY 2002 Enacted	5,143
FY 2003 Request	5,227
Out-Year Planning Levels (FY 2004-2007)	21,578
Total	$56,373

Budget Authority ($000)	FY 1999 Enacted	FY 2000 Enacted	FY 2001 Enacted	FY 2002 Enacted	FY 2003 Request
Contracts:					
Center for Advanced Aviation System Development (CAASD)	4,890	4,900	3,991	4,895	4,964
Personnel Costs	0	0	0	173	188
Other In-house Costs	0	0	0	75	75
Total	**4,890**	**4,900**	**3,991**	**5,143**	**5,227**

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
Basic	0	0	0	0	0
Applied	4,890	4,900	3,991	5,143	5,227
Development (includes prototypes)	0	0	0	0	0
Total	**4,890**	**4,900**	**3,991**	**5,143**	**5,227**

Notes:

- Out year funding is under review.

- By OMB direction, starting FY 03 CAASD is a part of the F&E line item of the same name. The numbers above represent the research portion only.

Center for Advanced Aviation System Development (CAASD) Products and Activities	FY 2003 Request ($000)	Program Schedule					
		FY 2002	FY 2003	FY 2004	FY 2005	FY 2006	FY2007
011-160 Center for Advanced Aviation System Development (CAASD)							
Research, Engineering and Development	$2,045						
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		◆	◇	◇	◇	◇	◇
Trustworthy Systems From Untrustworthy Components	$1,057						
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	$1,862						
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		◆	◇	◇	◇	◇	◇
Personnel and Other In-House Costs	$263						
Total Budget Authority	$5,227	$5,143	$5,227	$5,284	$5,373	$5,421	$5,500

Notes:
- Out year numbers are for planning purposes only. Actual funding needs will be determined through the annual budget process.
- By OMB direction, starting FY 2003 CAASD is a part of the F&E line item of the same name. The numbers above represent the research portion only.

STRATEGIC PARTNERSHIPS

GOALS:

Intended Outcomes: FAA will improve the effectiveness of our R&D programs in an austere funding environment by leveraging our resources with those resources abailable in other government agencies, academia, and industry through mutuallly beneficial partnerships. The Strategic Partnerships Program provides the mechanism for maintaining an open dialogue with potential partners absent specific project needs, and identifying partnership opportunities for the agency. Additionally, it provides for a continuing source of expertise in executing partnership agreements that individual programs can use in meting their mission-critical needs.

Agency Outputs:

NASA STRATEGIC PARTNERSHIPS

FAA Field Offices at NASA Research Centers

- Foster and facilitate coordination, collaboration and technology transitions between NASA researchers and FAA personnel who ultimately will use the products of the joint research and development activities.

UNIVERSITY RESEARCH PROGRAMS

Joint University Program

Through quarterly technical review meetings, the universities present their research results in such diverse areas as:

- Design methods for robust and failure-tolerant flight control systems.
- High-accuracy global positioning system (GPS) navigation and altitude determination, e.g., Local Area Augumentation System (LAAS).
- Aircraft crew situational awareness.
- Pilot and controller situational awareness through common weather and traffic information.
- Guidance and control for wake vortex encounters.

INDUSTRY RESEARCH PROGRAMS

Technology Transfer Awards

- Award agency personnel for exceptional contributions to technology transfer projects.

Customer/Stakeholder Involvement: Customer/ stakeholder feedback is solicited via continuing interface with the FAA R,E&D Advisory Committee. The committee has recently formed a subcommittee to advise the FAA on cooperative research ventures such as those supported by the R&D Partnership Program.

Accomplishments:

NASA STRATEGIC PARTNERSHIPS

- Produced and distributed 55,000 copies of the "Gate to Gate" CD-ROM about air traffic control throughout the FAA education community and to various aviation organizations. Received a 2001 Silver Axiem award for the production.
- Supported a simulation addressing runway incursion problem at LAX using the NASA Future Flight Central facility in support of the FAA Runway Safety Program.
- Distributed an enhanced Wake Turbulence training package incorporating National Transportation Safety Board (NTSB) recommendations and NASA research data to pilot organizations using the NAS.
- Processed cooperative agreements between NASA and the FAA in the areas of:
  - Aviation Environmental Compatibility (MOU)
  - Impact of Aviation Air Emissions on Climate & Global Atmospheric Composition (MOA)
  - Accident and Incident Mitigation Research (MOA)
  - Commercial Spaceport Infrastructure Development (MOA)
  - Synthetic / Enhanced Vision Systems (MOA)
- Completed evaluation of SOCRATES sensor technology through joint tests with NASA

UNIVERSITY RESEARCH PROGRAMS

Joint University program

- Received the 1999 RTCA William E. Jackson award.
- Received two Aerospace Industries Association of America major field awards (aviation meteorology).
- Received one Institute of Electrical and Electronics Engineers major field award (control systems).
- Negotiated a Memorandum of Agreement with NASA Ames for jointly funded research in a portfolio of civil aeronautics technologies.

INDUSTRY RESEARCH PROGRAMS

Technology Transfer Awards

- Made Technical Transfer Awards of approximately $43K in FY 2000.

R&D Partnerships: The collective vision of this chapter is to provide safe and secure air transportation through partnerships that maximize the FAA R,E&D program investment. In effect, the programs of this chapter function as a clearinghouse for the major share of all partnerships occurring in the FAA R,E&D community.

MAJOR ACTIVITIES AND ANTICIPATED FY 2002 ACCOMPLISHMENTS:

NASA STRATEGIC PARTNERSHIPS

- Developed two new MOAs supporting the use of Future Flight Central Facility by the FAA and the development of Carbon Nanotube based Nanosensors for Detection of Trace Amount of Explosives.
- Continued support of the Technology Transition Program for transitioning NASA developed technologies into the NAS.
- Hired three new participants into the Technology Transition Program.
- Developed and coordinated joint FAA / NASA wake turbulence research plan and activities
- Managed and coordinated joint FAA / NASA / university research on low cost gyroscopes for GA aircraft.
- Supported FAA / NASA research on a Small Aircraft Transportation System (SATS).

UNIVERSITY RESEARCH PROGRAMS

Joint University program

- Held quarterly reviews and published annual report.
- Transitioned FAA/NASA Joint University Program to FAA/NASA Ames program sponsorship.
- Initiated long-term research projects to complement FAA R,E&D.

INDUSTRY RESEARCH PROGRAMS

Technology transfer/cooperative activities

- Presented technology transfer awards.

KEY FY 2003 PRODUCTS AND MILESTONES:

NASA Strategic Partnerships

- Continue FAA/NASA Coordination at the Langley and Ames Research Centers.
- Continued the development and implementation of Free Flight Phase 1 and 2 Tools.
- Continued the development and implementation of Aircraft structural safety programs.
- Continued the development and implementation of Terminal Airspace Productivity tools.
- Continued to study the feasibility of the Small Aircraft Transportation System.

UNIVERSITY RESEARCH PROGRAMS

Joint University program

- Publish research results reported on at quarterly reviews.

INDUSTRY RESEARCH PROGRAMS

Technology transfer

- Continue annual technology transfer awards.

FY 2003 PROGRAM REQUEST:

NASA STRATEGIC PARTNERSHIPS

- Maintain the FAA Field Offices at the NASA Langley and Ames Research Centers.

UNIVERSITY RESEARCH PROGRAMS

- Sustain FAA's partnership with NASA in maintaining the research provided by the Joint University Program.

INDUSTRY RESEARCH PROGRAMS

- Fund the Technology Transfer Awards program directed by the Congress.

New Initiaves: No new initiaves

Ongoing Activities : Sustainment of:

- FAA field offices at the NASA Langley and Ames Research Centers
- The Joint University Program
- The Technology Transfer Awards Program

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2001)	$ 43,418
FY 2002 Enacted	400
FY 2003 Request	610
Out-Year Planning Levels (FY 2004-2007)	2,531
Total	$ 46,959

Budget Authority ($000)	FY 1999 Enacted	FY 2000 Enacted	FY 2001 Enacted	FY 2002 Enacted	FY 2003 Request
Contracts:					
Strategic Partnerships	0	0	0	0	214
NASA Field Offices	0	0	0	370	374
Personnel Costs	973	0	0	21	20
Other In-house Costs	27	0	0	9	2
Total	**1,000**	**0**	**0**	**400**	**610**

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
Basic	0	0	0	0	0
Applied	1,000	0	0	400	610
Development (includes prototypes)	0	0	0	0	0
Total	**1,000**	**0**	**0**	**400**	**610**

A14c – Strategic Partnerships Products and Activities	FY 2003 Request ($000)	Program Schedule					
		FY 2002	FY 2003	FY 2004	FY 2005	FY 2006	FY2007
101-210 Strategic Partnerships	$218						
Industry Research Programs							
Technology Transfer Awards			◆	◇	◇	◇	◇
University Research Programs							
Joint University Program			◆	◇	◇	◇	◇
Hold Quarterly Reviews			◆	◇	◇	◇	◇
Y101-220 NASA Field Offices	$370						
Conduct Annual Reviews in Support of R,E&D Efforts Between FAA & NASA for Multiple Programs							
Provide Continuous Technical Liaison Support Between FAA & NASA Centers Cooperative R,E&D							
Administer FAA's Portfolio of More Than 60 Memoranda of Agreement with NASA, R,E&D Program							
Personnel and Other In-House Costs	$22						
Total Budget Authority	$610	$400	$610	$617	$627	$638	$649

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

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APPENDIX A

RESEARCH, ENGINEERING AND DEVELOPMENT ADVISORY COMMITTEE

The FAA values the ongoing involvement of the R,E&D Advisory Committee in reviewing its current and planned R,E&D programs. A formal process has been established whereby the agency replies to the Committee's reports. This document summarizes recent Committee recommendations and FAA responses.

FAA's R,E&D Advisory Committee and NASA's Aero-Space 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 2001 *FAA National Aviation Research Plan*, the Committee submitted the following reports.

- *Committee's Recommendations on Fiscal Year 2002-2006 Investment Portfolio,* dated July 13, 2000 (FAA Interim response, April 17, 2001)
- *Committee Recommendations on Planned Research and Development Investments for Fiscal Year 2003,* dated July 10, 2001 (FAA Interim response, October 30, 2001)

In 2002, the FAA expects to receive the Committee's recommendations on FAA's planned research and development investments for fiscal year 2004, including detailed recommendations from the standing subcommittees.

As a result of the tragic events of September 11, 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 is 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. The Administrator received an interim report from the Security Subcommittee dated November 20, 2001. The Research, Engineering and Development Advisory Committee will provide the final report to the Administrator in January 2002.

Also in 2002, the Committee will be receiving recommendations from two ad hoc Subcommittees: the Small Aircraft Transportation Systems (SATS) and the Aviation Communications Research and Technology (ACRT).

Committee's Recommendations on Fiscal Year 2002-2006 R,E&D Investment Portfolio (dated July 13, 2000)

At the April 11-12, 2000, Committee meeting, the Committee reviewed FAA's planned FY 2002-2006 R,E&D Investment Portfolio and provided recommendations to FAA in a letter dated July 13, 2000 from Committee Chairman Mr. Robert Doll to Administrator Jane Garvey. The Committee received an interim response at the April 17, 2001 meeting.

Committee Recommendations:

The majority of the REDAC supports the requirements shown in the table below. Some members of the committee feel that the sub committees are not given enough detail to make such a decision. We are working on procedural changes to assure that all of the sub committees feel comfortable with the depth of information they receive. We believe these funding levels accurately reflect the appropriations required by each line of business to advance its programs and achieve important goals. These include the strategic plan goals of safety, security, and efficiency as well as the enabling environmental goals.

We note the disparity between the requirements and the Office of Management and Budget (OMB) target level funding. The OMB target falls significantly below the required funding level. Therefore, we strongly support an effort by FAA to develop Flagship Initiatives to supplement the OMB target level funding in order to bring it closer inline with the required funding level. We believe a strong R&D program is essential to our future aviation system, and the required funding level is a step

toward strengthening the R&D program that will contribute to achieving the goals of your strategic plan.

Program Area	FY 2002 Requirement ($M)	FY 2002 OMB Target ($M)	Delta ($M)
Aircraft Safety	78.6	66.0	12.6
Aviation Security	92.8	50.2	42.6
Environment & Energy	7.7	7.7	--
R&D Management	2.5	2.5	--
Information Security	10.5	5.5	5.0
Air Traffic Systems	164.8	128.6	36.2
Safe Flight 21	45.0	25.0	20.0
Airport Technology	10.0	7.5	2.5
TOTAL:	411.9	293.0	118.9

The majority of the committee endorses the "Aviation System After Next" effort to develop a longer-term vision for the aviation system beyond the year 2020. The FAA and the National Aeronautics and Space Administration (NASA) propose it as a unified effort including government and private-sector stakeholders led by a joint working group of our Committee and the NASA Aero Space Transportation Advisory Committee (ATAC). Currently, we are participating with the NASA ATAC to develop a plan for accomplishing this effort. We feel that it is our responsibility to ensure that future generations of Americans will have the quality of life and economic prosperity that the current national aviation system affords our generation today. A minority of the committee felt that this effort was too far reaching and could not produce meaningful results. They felt the industry would be better served with an effort to better define what comes after Free Flight I/II before efforts are spent going beyond 2020.

We support the congressional direction under the Wendell H. Ford Aviation Investment and Reform Act for the 21st Century (AIR-21) to create a Chief Operating Officer (COO) for the air traffic control system, appointed by the Administrator and reporting directly to the Administrator. We believe that this action is long overdue and have been recommending it for some time now. In April 1997, we presented our National Airspace System (NAS) Air Traffic Management R&D report to Acting Administrator Barry Valentine. One of our primary recommendations in this report was to establish a Deputy Administrator position responsible for the air traffic control system – including the creation, operation, and maintenance of the NAS but not the regulatory obligations. As we said in our 1997 report, the new COO will help breakdown the walls between the engineering and operational organizations and, thereby, focus the necessary actions to achieve a successful NAS. Therefore, we support this important initiative.

We recommend separating the aviation security R&D program from the balance of the R&D program, because its requirements are so demanding that it is draining funds from the remaining R&D program. In the next decade, the aviation security program will require several billion dollars to achieve the zero-tolerance goals established by both Congress and the White House. This puts a tremendous financial burden on FAA as the sole agency responsible for fighting terrorism in our aviation system, because significant increases to the R&D budget to accomplish this mission have not been forthcoming. As the security portion of the R&D budget has increased, the total R&D budget has declined. This has exhausted the balance of FAA's R&D program including air traffic systems, airports, aircraft safety, human factors, and environment and energy. Furthermore, the trend threatens to continue over the next decade unless something is done to correct it. We do not believe the security program goals are unimportant. Our citizens should expect to travel safely in our aviation system. They also should expect to travel in a timely fashion, but the security program alone does not provide these services. There are other efforts within the R&D program that contribute to safety and efficiency.

Therefore, we recommend segregating the aviation security R&D program from the balance of your R&D program to protect the continued existence of these programs.

Although we support the goals of the environment and energy program, we believe the program is grossly under funded and may not meet its goals at current funding levels. I have asked Mr. James DeLong, Chairman of our Subcommittee on Environment and Energy, to investigate and report on this issue in more detail. In the meantime, I would like to share some of the subcommittee's preliminary findings. FAA invests $7.7 million per year in its environment and energy program. This is grossly out of proportion to what the rest of the community spends each year. For example, Louisville spent an average of $75 million per year for 10 years to expand its airport. A large part of that expenditure was related directly to environmental concerns, primarily noise. Compare FAA's $7.7 million to Louisville's $75 million: that is one airport and one investment. It seems out of proportion. Denver built a new airport for no other reason than environmental concerns, specifically noise and emissions. The price tag was $4.5 billion. In the first year, Denver violated noise restrictions with fines of $35 million for that year alone. These were levied as landing fees, which resulted in higher airfares. We all pay when airfares increase. Studies show that a 10 percent increase in airfares results in a reduction in air travel by as much as 27 percent. That is quite an elastic demand curve compared to automobile travel, which reduces only 2-3 percent for a 10 percent increase in gasoline prices. When airfares increase, the economy suffers and so does our quality of life.

Another example is Seattle Tacoma, which plans to build a new runway to access the Far East. It should cost $60 million, but it probably will cost $300 million after addressing environmental concerns. These concerns include relocating 10 acres of wetlands and 700 homes and businesses; sound proofing historic sites, schools, and 170 homes; and using staged construction due to environmental restrictions, which will delay completion of the project, thereby, increasing cost.

Historically, the FAA has set aside about 12% of its annual airport budget for noise abatement or mitigation. This will amount to $300 million in FY 2002. This type of expenditure will continue for the foreseeable future for sound proofing and acquiring homes. As stated above, the $7.7 million allocated to environmental and energy research programs pales in comparison. The Subcommittee on Environment and Energy will consider a detailed recommendation at their next meeting for the FAA to fund a feasibility study for the development of a "green" engine focusing on how some of the abatement funds might be better directed toward a potential solution to the noise problem rather than building ever larger buffer zones.

Environmental impacts extend beyond our national borders. They threaten our global competitiveness. Europe is attempting to eliminate acoustically treated aircraft from operating in Europe. This action would restrict our aircraft from that market. The FAA's environmental R&D provides the regulation, certification, and policies that the industry needs both in the U.S. and worldwide. We recommend more funding for environment and energy, because we see it as perhaps the greatest inhibitor to the growth of our industry.

We want to direct your attention to the fuel problem facing general aviation. There is a worldwide trend to phase out leaded general aviation fuel. The European Union plans to ban leaded fuel after 2005. We believe that the effort to find a replacement for leaded fuel will require R&D funds of $4 million in FY 2002. Current general aviation fuel supplies are drying up and represent such a small percentage of the petroleum industry that the industry may stop producing it. These factors drive the need for alternative fuels for general aviation.

However, new fuels require new engine technology, and this requires retrofitting the fleet with new engines, which could take 30 years or more. There is compelling need for an alternative fuel that is transportable, adaptable to the existing fleet, and available in large quantities. Without it, we risk losing general aviation. Without it, we risk losing the primary training-arena that feeds pilots to the regional and commercial fleet. Without it, we fear fatalities as aviators attempt to use unapproved alternative fuels. Therefore, we recommend $4 million in R&D to upgrade the FAA research lab that certifies general aviation fuels. One of our members describes the current facility as shockingly archaic.

FAA Interim Response, April 17, 2001

1. Recommendation: Majority support FY02 budget request.

FAA Response: FY02 status provided today.

2. Recommendation: Strongly supports Flagship Initiatives to increase budget.

FAA Response: No FY02 Flagship Initiatives allowed by OMB.

3. Recommendation: Majority endorses "Aviation System After Next" effort – minority prefers near term focus.

FAA Response: Status briefing provided today.

4. Recommendation: Support AIR-21 Chief Operating Officer requirement.

FAA Response: Status briefing provided today. **5. Recommendation: Separate Aviation Security for other R&D**

FAA Response: REB addressed in FY03 process but found no solution.

6. Recommendation: More funding for Environment and Energy R&D.

FAA Response: - FY02 request represents a 120% increase.

FAA relies on NASA partnership for technology and supports a strong program.

7. Recommendation: Add $4M to upgrade FAA General Aviation fuels Lab.

FAA Response: $1.5M increase in FY01.

Committee's Recommendations on FY 2003 Budget (dated, July 10, 2001)

At the April 17-18, 2001 meeting, the Committee reviewed FAA's planned Research and Development Investments for Fiscal Year 2003 and provided recommendations in a letter dated July 10, 2001 from Committee Chair Dr. Deborah Boehm-Davis to Administrator Jane Garvey. The Committee received an interim response to the recommendations at the October 30, 2001 meeting.

Committee Recommendations:

First, it has been difficult to brief subcommittees at the appropriate level of detail and in a timely fashion. Thus, committees often feel that their input is not based on as much information as they would like and that they cannot provide the appropriate feedback on important, strategic level issues regarding research and development. Second, as we discussed, it is difficult for the Committee to deliberate in an open setting. Having some time available for a closed session is important to a full and open discussion of recommendations. Finally, the low attendance by associate administrators and other senior FAA officials at our meetings gives the impression that the FAA does not appear to be interested in receiving our advice and that research is not a very high priority for the FAA. I would like to explore with you ways of raising the level of presentation and discussion of the FAA's R,E,&D program (and budget) so that we can provide you with better and more useful recommendations.

The Committee supports continued work on the Operational Evolution Plan (OEP) and Operational Concepts Plan (OCP), which covers the next 10 to possibly 15 years. They provide a common framework for the entire aviation community and will guide investments for government, operators and manufacturers. However, we are concerned that no research plan has been developed to complement the OEP and to provide the technology base for the future. Since this research is likely to be done largely by NASA, it is imperative that NASA's program planning become tightly integrated with FAA planning.

We also are concerned that although the activities defined in the OEP and OCP are important first steps in alleviating the capacity crisis, they will not meet the demand for 2010 and beyond. We believe the incremental evolutionary steps outlined in these plans will not overcome gridlock by the years 2010 to 2015. With demand projected to increase at 8 percent per year, and capacity improvements expected at only 3 percent per year, demand will soon overcome capacity. The nation must invest more heavily in aviation research to meet future needs, and we would like to help you work with NASA to achieve this outcome.

We believe that a major paradigm shift, supported by a substantial research effort, is required to move us beyond the 2010 to 2015 timeframe. Year after year, we express our concern over the lack of investment in aviation related research, but we have been ineffective in achieving any results. At the same time, the committee recognizes a number of obstacles to ensuring a viable, healthy air transportation system beyond 2010, including:

- The lack of a national transportation policy and national objectives to be achieved
- The lack of a sense of "urgency" on the part of Congress to address aviation issues, perhaps due in part to the fact that aviation is the safest mode of transportation in the world
- The increasing reliance on NASA to help support the FAA RE&D mission, without a mechanism for ensuring closure of the technology readiness gap
- The lack of OMB and Congressional support for an increased budget

- The lack of compelling stories to make an argument for the need for increased funding

The Committee would hate to have a serious accident, incident, or system interruption as the driver for an increased RE&D budget. Rather, we would hope to work with you to secure increased funding to prevent future accidents. We feel that one possible approach to making this case might be to put forward specific goals to be achieved by a specific deadline. Recognizing that FAA and NASA both have the same Senate authorization committee, and that the NASA and FAA R,E&D budgets are both authorized by the same House committee, we would hope to go with you to ask for support so that FAA and NASA can work together to achieve these goals.

For example, the Committee feels that there are two achievable goals that would increase capacity if the research issues could be resolved -- reduced wake turbulence separation in appropriate weather conditions and implementation of low noise arrival and departure procedures. By specifying, for example, that separation could be reduced by some specified percentage by the year 2005, FAA could argue for increased funding while providing benchmarks to ensure that predicted outcomes are being achieved.

Another concern arises from the development of the PBO within FAA. Because the R,E&D Advisory Committee currently is aligned along the lines of business, we believe there may be a need to rethink its function and structure as a result of the PBO. We would like to provide recommendations to you on this as the PBO unfolds.

The Committee developed specific recommendations that could be acted on without changes in the RE&D budget. First, the Committee recommends that all FAA R,E&D programs be reviewed after they have been in place for a certain amount of time (e.g., 3 years) and/or after a certain amount of funds has been spent (e.g., $1million). Further, the Committee recommends that an internal process be developed for carrying out those reviews.

The Committee expressed concern about some items in the RE&D portfolio that the Committee strongly feels belongs in the Operations portfolio. For example, the Human Factors Subcommittee feels that the bulk of the aeromedical work being conducted at CAMI (particularly in the areas of medical/toxicological factors) is directed towards the support of actual accident investigations, not at research that could improve safety by improving the accident investigation process. Similarly, the Air Traffic Services Subcommittee feels that the work being done on system capacity, planning, and improvements is not a focal point for FAA's more general work on capacity R&D.

Individual subcommittees recommended moving forward on specific research programs, which were supported by the full Committee. These include:

- Research examining wake vortex and aviation weather
- Research examining whether new large aircraft (group 6) can operate at group 5 airports
- Research to find a replacement for aqueous film forming foam (AFFF). This foam is the primary fire-fighting agent currently in use. However, this foam is now considered toxic and will no longer be manufactured. Thus, research is urgently needed (and is planned in conjunction with DOD) in this area
- Research on wildlife control and mitigation
- Research into visual guidance that can be used to prevent runway incursions
- Research on high payoff solutions (e.g., trace technologies and other passive devices) rather than active devices for aviation security

FAA Interim response to Recommendation/Comments, October 30, 2001:

Recommendation: REDAC wants to explore ways to raise level of presentation and discussion of programs and budget.

FAA Response: FAA would welcome REDAC suggestions.

Recommendation: Have a closed session to allow full and open discussions.

FAA Response: Legal restrictions on closed session on full committee.

Requires DOT Secretary's approval – case by case.

Suggest REDAC explore alternatives.

Recommendation: Low attendance by Associates and other senior officials gives impression that FAA not interested in our advice.

FAA Response: Operational issues dominate Associate's attention.

Need to explore ways to encourage senior officials involvement, e.g., REDAC Chair and/or Subcommittee Chairs meeting the key Associates.

Recommendation: REDAC supports OEP, however is concerned that no research to complement OEP or for the future. Imperative that NASA's R&T become tightly integrated with FAA planning.

FAAResponse: OEP support research is identified in the long-term NAS Architecture. Agree that NASA's R&T needs to be tightly integrated with FAA planning.

NASA's research addressing NAS level requirements are identified in the NAS Architecture.

FAA and NASA working to improve integration.

Recommendation: OEP important first step, but concerned that incremental evolutionary steps will not meet demand beyond 2010. National must invest more heavily in aviation research. Offer to work with FAA and NASA to secure R&D funding.

FAA Response: FAA recognizes that new ways to improve the capacity/demand imbalance after 2010 will bee needed.

Increased FAA, NASA and industry research could identify and develop new concepts to increase system capacity.

FAA welcomes REDAC offer to assist.

Recommendation: Two achievable goals to increase capacity:

- Reduced wake turbulence separation
- Low noise arrival and departure procedures

FAA could argue for increased funding and provide benchmark for outcomes achieved.

FAA Response:

FAA has been working with NASA on wake turbulence separation research – FAA funding proposed in FY 03 – Implementation past 2005.

Low noise procedures are considered longer-term options.

Some research at NASA and in Europe.

Recommendation: Need to rethink function and structure of REDAC under PBO – REDAC wants to provide recommendations.

FAA Response: FAA's restructuring as a PBO not finalized.

FAA would welcome REDAC's recommendations with respect to REDAC function and structure – suggest waiting until restructuring complete.

Recommendation: All FAA R&D programs be reviewed at specified longevity (e.g., 3 years) and/or funding (e.g., $1M) expenditure.

FAA Response: FAA supports the recommendation and will work with the REDAC to define the criteria, scope and perform the reviews.

Recommendation: Concerned that some RE&D items belong to Operations, e.g.,

- Some CAMI Aeromendical Work
- System Capacity, planning, and improvement work

FAA Response: There are conflicting views within FAA as to what constitutes R&D or which budget to fund what.

- *CAMI's support of operational functions provide access to otherwise unavailable biological samples for research..*
- *System capacity program focuses on airports and surrounding airspace not general system capacity research..*

Recommendation: Move forward on specific research, including:

- Wake turbulence and aviation weather
- New large aircraft operations at group 5 airports
- Replacement for aqueous film forming foam for fire-fighting
- Wildlife control and mitigation
- Visual guidance to prevent runway incursions
- High pay-off passive security screening technologies rather than active devices

FAA Response:

- *FAA's FY03 RE&D request includes $1M to start a FAA wake turbulence R&D program.*
- *The President's FY 2003 budget includes $1,650,000 for research in Airport Technology to address airport operating issues for new large aircraft.*
- *FAA is working with DOD and EPA on performance standards and environmental limitations.*
- *FAA proposed to double funding in FY 03 for wildlife and mitigation.*

- *Some FAA visual guidance technology could be transitioned – research funding has been limited.*
- *Agree that passive screening technology offers potential high pay-off.*
- *Near-term operational needs for implementation and improving active devices has delayed long-term research.*

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APPENDIX B

ALPHABETICAL LISTING OF NATIONAL AVIATION RESEARCH PLAN BUDGET LINE ITEMS

Budget Program	Item Number	Page
Advanced Materials/Structural Safety	A11c	
Aeromedical Research	A11j	
Aging Aircraft	A11e	
Air Traffic Control/Airway Facilities Human Factors	A11i	
Aircraft Catastrophic Failure Prevention Research	A11f	
Airports Technology – Safety	AIP	
Airports Technology – Efficiency	AIP	
Airspace Management Laboratory	F&E-1C01	
Aviation Safety Risk Analysis	A11h	
Aviation System Capacity Improvement (ASCI)	F&E-1C01	
Aviation Weather – Efficiency	A12a	
Aviation Weather – Safety	A11k	
Center for Advanced Aviation System Development (CAASD)	5A32	
Commercial Space Transportation Safety	Ops	
Development Systems Assurance	F&E-1C01	
Domestic Reduced Vertical Separation Minima (DRVSM)	F&E-1C01	
Environment and Energy	A13a	
Fire Research and Safety	A11a	
Flight Deck/Maintenance/System Integration Human Factors	A11g	
Flight Safety/Atmospheric Hazards Research	A11d	
General Aviation and Vertical Flight Technology (GA&VF)	F&E-1C01	
Information Systems Security and Technology	5A17	
NAS Requirements Development	F&E-1C01	
Navigation – Local Area Augmentation System (LAAS)	F&E-1C01	
Navigation – Wide Area Augmentation System (WAAS)	F&E-1C01	
Operations Concept Validation	F&E-1C01	
Propulsion and Fuel Systems	A11b	

Budget Program	Item Number	Page
Runway Incursion Reduction	F&E-1C01	
Safe Flight 21 – Alaska Capstone	F&E-1B01	
Safe Flight 21 – Ohio River Valley	F&E-1B01	
Separation Standards	F&E-1C01	
Software Engineering	F&E-1C01	
Strategic Partnerships	A14c	
Surveillance	F&E-1C01	
System Planning and Resource Management	A14a	
William J. Hughes Technical Center Laboratory Facility	A14b	

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-1C01
98770101--	Information Systems Security and Technology	5A17
98750855--	Software Engineering	F&E-1C01
98610855--	Operations Concept Validation	F&E-1C01
97200855--	Airspace Management Laboratory	F&E-1C01
67100903--	Safe Flight 21 – Ohio River Valley	F&E-1B01
67100855--	Surveillance	F&E-1C01
45540855--	Runway Incursion Reduction	F&E-1C01
40160289--	NAS Requirements Development	F&E-1C01
31270855--	Navigation – Local Area Augmentation System (LAAS)	F&E-1C01
26620866--	Domestic Reduced Vertical Separation Minima (DRVSM)	F&E-1C01
26610855--	Separation Standards	F&E-1C01
26600855--	Aviation System Capacity Improvement (ASCI)	F&E-1C01
11280101--	Safe Flight 21 – Alaska Capstone	F&E-1B01
11270855--	Navigation – Wide Area Augmentation System (WAAS)	F&E-1C01
101-210/220	Strategic Partnerships	A14c
091-110/111/114	Environment and Energy	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
041-110	Aviation Weather – Efficiency	A12a
041-110	Aviation Weather – Safety	A11k

Project Number	Budget Program	Budget Item
011-160	Center for Advanced Aviation System Development	5A29
011-140	William J. Hughes Technical Center Laboratory Facility	A14b
011-130	System Planning and Resource Management	A14a
TBD	Development Systems Assurance	F&E-1C01
TBD	Airports Technology – Efficiency	AIP
TBD	Airports Technology – Safety	AIP
TBD	Commercial Space Transportation Safety	Ops

Note: The final two digits of project numbers for the F&E –1C01 line item correspond to the Fiscal Year.

APPENDIX D

ACRONYMS AND ABBREVIATIONS

The Following high-frequency or generally well-known acronyms often 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
AAT	FAA Air Traffic
AAWG	Airworthiness Assurance Working Group
AC	Advisory Circular
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	FAA Aircraft Certification
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 System Measuring
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
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
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
ATCS	Air Traffic Control Specialist
ATIDS	Airport Target Identification System
ATM	Air Traffic Management
ATP	FAA Air Traffic Planning and Procedures
ATS	FAA Air Traffic Service
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 Authorities
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
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 Agreements
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	
DOD	Department of Defense
DOE	Department of Energy
DOT	Department of Transportation
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
EPA	Environmental Protection Agency
ETC	Engine Titanium Consortium
ETMS	Enhanced Traffic Management System
EUROCAE	European Organization for Civil Aviation Equipment

F	
F&E	Facilities and Equipment
FAA	Federal Aviation Administration
FAR	Federal Air Regulation
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
FMECA	Failure Modes, Effects, and Criticality Analysis
FOQA	Flight Operations Quality Assurance
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
GAO	General Accounting Office
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 Satellite
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
HIRF	High Intensity Radiated Fields
HQ	NASA Headquarters
HSI	Human-System Interface
HUMS	Health, Usage and Monitoring Systems
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
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
ILS	Instrument Landing System
IMT	Integrity Monitoring Test Bed
INM	Integrated Noise Model
IPHWG	ARAC Ice Protection Harmonization Working Group
IPT	Integrated Product Team
IRS	Internal Revenue Service
ISS	Information Systems Security
ISSA	Information Systems Security Architecture
ITWS	Integrated Terminal Weather System
IWG	Technical Interoperability Working Group
J	
JAA	Joint Aviation Authorities
JRC	Joint Resource Council
JSATS	Joint Safety Analysis 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
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 System
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
NAS	National Airspace System 1-1
NASA	National Aeronautics and Space Administration
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
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 Program
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	Notices 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
NTSB	National Transportation Safety Board
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
OMB	Office of Management and Budget
OOT	Object Oriented Technology
OSA	Operational Safety Assessments
P	
PAD	Program Area Description
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
Q	
QAT	Quiet Aircraft Technology
R	
R&D	Research and Development
R&T	Research and Technology
REDAC	Research, Engineering and Development Advisory Committee
RFID	Radio Frequency Identification System
RIRP	Runway Incursion Reduction Program
RITA	Rotorcraft Industry Technology Association
RLV	Reusable Launch Vehicle
RNP	Required Navigation Performance
ROC	Radar Operations Center
RTSP	Required ATM System Performance and Real-Time Streamlining Protocol

RTVS	Real Time Verification System
RUC	Rapid Update Cycle
RV	Reentry Vehicles
RWSL	Runway Safety Lights
S	
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
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
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
STARS	Standard Terminal Automation Replacement System
STATS	Safety Through Accurate Technical Statistics
SVM	Service Model Volume

T

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
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

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