Federal Aviation Administration

2008
National Aviation Research Plan (NARP)

Appendices

A - Program Descriptions
B - R&D Annual Accomplishments
C - Partnership Activities
D - Advisory Committee
E - Mapping JPDO R&D Requirements
F - Acronyms and Abbreviations

February 4, 2008

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

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APPENDIX A: Program Descriptions

Listed by FAA Appropriation and Budget Item

* Budget line item numbers are not used for these programs within the S&O and AIP appropriations.

APPENDIX A: Program Descriptions

Listed Alphabetically

R&D Program Title	FAA Budget Appropriation	Budget Item	Page
Advanced Materials/Structural Safety	R,E&D	A11.c.	A-13
Aeromedical Research	R,E&D	A11.j.	A-78
Aging Aircraft/Continued Airworthiness	R,E&D	A11.e.	A-26
Air Traffic Control/Technical Operations Human Factors	R,E&D	A11.i.	A-70
Aircraft Catastrophic Failure Prevention Research	R,E&D	A11.f.	A-32
Airport Cooperative Research – Capacity, Environment, Safety	AIP	*	A-38
Airports Technology Research – Capacity	AIP	*	A-45
Airports Technology Research – Safety	AIP	*	A-50
Airspace Management Laboratory	ATO Capital	1A01E	A-171
Airspace Redesign	ATO Capital	1A01F	A-176
Atmospheric Hazards/Digital System Safety	R,E&D	A11.d.	A-19
Aviation Safety Risk Analysis/System Safety Management	R,E&D	A11.h.	A-63
Center for Advanced Aviation Systems Development (CAASD)	ATO Capital	4A09A	A-227
Commercial Space Transportation Safety	S&O	*	A-234
Environment and Energy	R,E&D	A13.a.	A-125
Fire Research and Safety	R,E&D	A11.a.	A-1
Flightdeck/Maintenance/System Integration Human Factors	R,E&D	A11.g.	A-54
Joint Planning and Development Office (JPDO)	R,E&D	A12.a.	A-97
NAS Weather Requirements	ATO Capital	1A01D	A-166
NextGen – Air Ground Integration	R,E&D	A12.c.	A-109
NextGen – ATC/Technical Ops Human Factors – Air/Ground Integration	ATO Capital	1A09B	A-196
NextGen – ATC/Technical Ops Human Factors – Controller Efficiency	ATO Capital	1A09A	A-190
NextGen Demonstrations and Infrastructure Development	ATO Capital	1A08	A-185
NextGen - Environment and Energy – Advanced Noise and Emissions Reduction	ATO Capital	1A09C	A-201
NextGen - Environment and Energy – Validation Modeling	ATO Capital	1A09D	A-201
NextGen Environmental Research – Aircraft Technologies, Fuels, and Metrics	R,E&D	A13.b.	A-137
NextGen – New Air Traffic Management Requirement	ATO Capital	1A09E	A-207
NextGen – Operations Concept Validation – Validation Modeling	ATO Capital	1A09F	A-212
NextGen – Self Separation	R,E&D	A12.d.	A-114
NextGen – System Safety Management Transformation	ATO Capital	1A09G	A-217
NextGen – Wake Turbulence – Re-categorization	ATO Capital	1A09H	A-222
NextGen – Weather Technology in the Cockpit	R,E&D	A12.e.	A-120
Operations Concept Validation	ATO Capital	1A01C	A-161
Propulsion and Fuel Systems	R,E&D	A11.b.	A-7
Runway Incursion Reduction	ATO Capital	1A01A	A-152
System Capacity, Planning and Improvement	ATO Capital	1A01B	A-156
System Planning and Resource Management	R,E&D	A14.a.	A-144
Unmanned Aircraft Systems Research	R,E&D	A11.l.	A-93
Wake Turbulence	R,E&D	A12.b.	A-103
Weather Program	R,E&D	A11.k.	A-87
William J. Hughes Technical Center Laboratory Facility	R,E&D	A14.b.	A-148
Wind Profiling and Weather Research - Juneau	ATO Capital	1A01I	A-181

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

FAA Budget Appropriation	Budget Item	Program Title	Budget Request
R,E&D	A11.a.	Fire Research and Safety	$6,650,000

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

Intended Outcomes: The Fire Research and Safety Program helps achieve FAA's strategic goal of increasing aviation safety by reducing the number of accidents associated with aircraft fires and by mitigating the effects of a post-crash ground fire. The program supports FAA's aviation safety goal by developing technologies, procedures, test methods, and fire performance criteria that can prevent accidents caused by hidden in-flight fires and fuel tank explosions and improve survivability during a post-crash fire. Fire safety research focuses on near-term improvements in fire test methods and materials performance criteria, fire detection and suppression systems, aircraft fuel tank explosion protection, and long-range development of ultra-fire resistant cabin materials.

Agency Outputs: The FAA issues aircraft fire safety rules that govern material selection, design criteria, and operational procedures. The new test methods, reports, and journal publications produced by the Fire Research and Safety Program describe the technical basis for these regulations and offer guidance for regulatory compliance. Through this research, which is also producing new materials and government-owned patents, FAA provides industry with state-of-the-art safety products and information.

Research Goals: The FAA will work to reduce the number of accidents and incidents caused by in-flight fire, to prevent fuel tank explosions, and to improve survivability during a post-crash fire. Near term research will focus on improved fire test standards for interior and structural materials, improved fuel tank inerting systems and extended inerting applications, and new or improved fire detection and extinguishment systems. Additional long-range research will be conducted to develop the enabling technology for a fireproof aircraft cabin constructed of ultra-fire resistant materials. The following milestones directly support the ultimate strategic goals of in-flight fire prevention, fuel tank explosion prevention and improved post-crash fire survivability:

- By FY 2010, develop and validate a methodology for predicting the flammability of wing fuel tanks of aluminum or composite construction.
- By FY 2011, provide comprehensive guidance on the fire safety of high energy density lithium batteries in passenger carry-on items and aircraft power systems.
- By FY 2012, demonstrate the improvements in post-crash fire survivability, provided by ultra-fire resistant materials under full-scale test conditions.

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

- Aircraft Safety Subcommittee of the FAA Research, Engineering and Development Advisory Committee – These representatives from industry, academia, and other government agencies annually review the program's research activities.
- Technical Community Representative Groups – The FAA representatives apply formal guidelines to ensure that the program's research projects support new rule making and development of alternate means of compliance for existing rules.

- Aircraft manufacturers (U.S. and foreign), airlines, foreign airworthiness authorities, chemical companies, material suppliers, and aircraft fire safety equipment manufacturers meet regularly to share information on interior material fire tests and improvement of fire detection and suppression systems.
- National Transportation Safety Board (NTSB) – The FAA works with and supports NTSB on in-flight fire incidents, on-site accident investigations, and related testing.
- Pipeline and Hazardous Materials Safety Administration (PHMSA) – PHMSA cooperatively develop with FAA requirements/guidelines for the safe transport of hazardous materials.

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

- FAA-sponsored International Systems Fire Protection Working Group – R&D involves fuel tank protection, hidden fire safety, fire/smoke detectors, halon replacement, and lithium battery fire hazards.
- FAA-sponsored International Aircraft Materials Fire Test Working Group – R&D involves development and standardization of improved material fire tests.
- Interagency working group on fire and materials – promotes technology exchange among U.S. Government agencies and prevents unwarranted duplication of work.
- Interagency agreement with the National Institute of Standards and Technology – develops fire retardant mechanisms and rapid screening tools for flammability.
- Memorandum of cooperation with the British Civil Aviation Administration – R&D involves a variety of fire safety research efforts.
- Cabin safety research technical group – cooperates in and coordinates cabin safety research conducted and/or sponsored by the international regulatory authorities.
- Arrangements with Fortune 100 companies to share development costs for new fire resistant materials.

Accomplishments: The FAA operates the world's most extensive aircraft fire test facilities. The FAA certification engineers receive training in these facilities each year and, at the request of the NTSB, program personnel participate in major fire accident and incident investigations. The Fire Research and Safety Program annually publishes over two-dozen reports and papers (available to the public on-line at http://www.fire.tc.faa.gov/reports.asp) highlighting research results that have led to major improvements in aircraft safety.

Outstanding program accomplishments include:

FY 2007:

- Developed a cabin crew training video for fighting in-flight fires.
- Characterized the flammability of epoxy-graphite structural composites.
- Developed and standardized a next generation burner for insulation burn-through resistance.
- Evaluated the flammability of non-halogen, ultra-fire resistant plastics.

FY 2006:

- Evaluated the cabin hazards caused by outgassing from a composite fuselage material subjected to a simulated post-crash fuel fire.
- Determined the fire hazards of lithium ion batteries shipped as air cargo.
- Conducted engine nacelle fire extinguishment tests to determine the suitability of a promising new environmentally friendly agent, NOVEC 1230, as a replacement for the currently used halon.

FY 2005:

- Issued the first Department of Transportation licenses to manufacture the FAA-patented microscale combustion calorimeter for evaluating the heat release rate of extremely small research samples of advanced ultra-fire resistant material.
- Developed technology to support the use of low false alarm cargo fire/smoke detectors.
- Determined the vulnerability of AN-26 insulation to ignition by a small arc, resulting in the issuance of a proposed Airworthiness Directive requiring its removal from affected aircraft.
- Characterized the fire performance of ultra-fire resistant chlorobisphenol polymers for aircraft interior applications.

FY 2004:

- Conducted flight tests in National Aeronautics and Space Administration 747 shuttle carrying aircraft to measure performance of FAA fuel tank inerting system and measure fuel tank vapor concentration (first time ever done).
- Determined the limiting concentration of oxygen to prevent fuel tank explosions.
- Evaluated the effectiveness of halon hand-held extinguishers against hidden fires in standard and wide body aircraft.
- Developed technology and requirements for the protection of shipped oxygen cylinders during a cargo compartment fire, resulting in the issuance of a Notice of Proposed Rulemaking.

Previous Years:

- Developed and demonstrated a simple and cost effective fuel tank inerting system.
- Developed improved and new flammability tests for thermal acoustic insulation, measuring in-flight fire resistance and post-crash burn-through resistance, respectively.
- Developed minimum performance test standards for halon replacement agents.
- Developed and demonstrated an onboard cabin water spray system for significantly improving post-crash fire survivability.

FY 2008 MAJOR ACTIVITIES AND ANTICIPATED ACCOMPLISHMENTS:

Fire Safety Improvements

- Develop and evaluate an onboard detection and extinguishment system to protect against hidden in-flight fires (under full-scale test conditions).
- Complete development of updated Advisory Circular on hand held extinguishers prescribing safe agent exposure levels.
- Examine lithium battery technology in passenger carry-on items and aircraft power systems for potential fire safety risks.
- Measure the flammability of wing fuel tank vapors under simulated operational conditions.
- Evaluate the effectiveness of intumscent paint for fuselage burn-through protection under full-scale fire test conditions.

Fire Resistant Materials

- Fabricate small-scale ultra-fire resistant cabin panels (sidewalls, ceiling) using fire smart polymer technology and measure fire and mechanical performance; down-select to optimal panel design.

FY 2009 PROGRAM REQUEST:

Ongoing Activities

Research on the prevention of hidden in-flight fires will continue to address the fire resistance of interior materials and the growing problem with lithium battery fire hazards. This research responds to FAA concerns with the high frequency of in-flight smoke/fume incidents, averaging more than two per day, and the diversions/returns that often occur.

Research related to the fire behavior of structural composites is driven by the new Boeing 787, the first large transport aircraft with a composite fuselage and wings. A number of fire safety concerns will be studied, associated with the replacement of aluminum with a combustible composite material that can burn and is a poor conductor of heat.

Research will also continue on the improvement of existing required flammability tests and the development of new tests for novel applications of materials that may impact future aircraft fire safety.

Fuel tank explosion protection research will focus on supporting the introduction of fuel tank inerting systems in the U.S. fleet, and understanding and predicting the flammability of wing fuel tanks, which is an immediate concern for aluminum and composite (e.g., B-787) constructions.

Long term, applied research will continue to develop the enabling technology for ultra-fire resistant interior materials, and facilitate the transfer of that technology to the private sector through patents, reports, publications, and international standards.

New Initiatives

No new initiatives are planned in FY 2009.

KEY FY 2009 MAJOR ACTIVITIES AND ANTICIPATED ACCOMPLISHMENTS:

Fire Safety Improvements

- Develop improved fire test criteria for materials in hidden areas not previously addressed.
- Develop fire safety guidance for new high energy density lithium batteries in passenger carry-on items
- Develop fire test criteria to limit the emission of hazardous gases during post-crash fire exposure of a burn-through resistant fuselage, including composite construction.
- Develop small-scale fire test criteria to measure the effectiveness of intumescent paint used to impart burn-through resistance to an aluminum fuselage, if warranted.
- Demonstrate the application of non-intrusive oxygen measurement technology in aircraft fuel tanks.
- Develop an analytical model to predict the flammability in wing fuel tanks.

Fire Resistant Materials

- Fabricate small-scale ultra-fire resistant thermoplastic components (e.g., seat tray, passenger service units) and measure fire and mechanical performance; down select optimal thermoplastic design.

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2007)	$140,998
FY 2008 Appropriated	7,350
FY 2009 Request	6,650
Out-Year Planning Levels (FY 2010-2013)	27,996
Total	$182,994

Budget Authority ($000)	**FY 2005 Enacted**	**FY 2006 Enacted**	**FY 2007 Enacted**	**FY 2008 Enacted**	**FY 2009 Request**
Contracts:					
Fire Research and Safety	3,263	2,570	2,816	3,355	2,961
Personnel Costs	2,890	3,379	3,588	3,650	3,443
Other In-house Costs	372	233	234	345	246
Total	**6,525**	**6,182**	**6,638**	**7,350**	**6,650**

OMB Circular A-11, Conduct of Research and Development ($000)	**FY 2005 Enacted**	**FY 2006 Enacted**	**FY 2007 Enacted**	**FY 2008 Enacted**	**FY 2009 Request**
Basic	0	0	0	0	0
Applied	6,525	6,182	6,638	7,350	6,650
Development (includes prototypes)	0	0	0	0	0
Total	**6,525**	**6,182**	**6,638**	**7,350**	**6,650**

A11a - Fire Research and Safety Product and Activities	FY 2009 Request ($000)	Program Schedule					
		FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013
061-110 Fire Research & Safety							
Fire Resistant Materials	**$0**						
Fabricate/test small-scale cabin panels		◆					
Fabricate/test small-scale cabin plastics			◊				
Fabricate/test small-scale cabin fabrics and foams				◊			
Evaluate improvement in post-crash fire survivability provided by ultra-fire resistant materials during full-scale fire tests						◊	
Fire Safety Improvement	**$2,961**						
Assess need/develop improved fire test criteria for hidden materials not previously addressed			◊				
Develop detection/extinguishing system to suppress hidden in-flight fires		◆					
Develop Advisory Circular on hand-held extinguishers for safe agent exposure levels		◆					
Examine lithium battery technology for fire safety risks		◆					
Develop safety guidelines for lithium battery passenger carry on items			◊				
Develop fire test criteria gas emissions during burn-through resistant fuselage post-crash fire exposure			◊				
Develop test criteria for intumescent paint			◊				
Evaluate intumescent paint for fuselage burn-through protection (full-scale tests)		◆					
Validate wing fuel tank prediction method (aluminum and composite)				◊			
Provide comprehensive guidance on lithium battery fire safety					◊		
Measure wing fuel tank flammability under simulated operational conditions		◆					
Demonstrate oxygen measurement technology for fuel tanks			◊				
Develop analytical model wing fuel tank flammability			◊				
Examine fuel cell technology for fire safety risks							◊
Personnel and Other In-House Costs	**$3,689**						
Total Budget Authority	**$6,650**	**$7,350**	**$6,650**	**$6,819**	**$6,935**	**$7,057**	**$7,185**

◆ - Activities Accomplished ◊ - Activities Planned

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

FAA Budget Appropriation	Budget Item	Program Title	Budget Request
R,E&D	**A11.b.**	**Propulsion and Fuel Systems**	**$3,669,000**

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

Intended Outcomes: The Propulsion and Fuel Systems Program helps achieve FAA's strategic goal of increasing aviation safety by reducing the number of accidents associated with the failure of aircraft engines, components, and fuel systems. The program supports FAA's aviation safety goal by developing technologies, procedures, test methods, and criteria to enhance the airworthiness, reliability, and performance of civil turbine and piston engines, propellers, fuels, and fuel management systems. In addition, the program is working with fuel, airframe, and engine manufacturers to test new unleaded fuels as they become available to seek a safe alternative to current leaded aviation gasoline (avgas). To improve safety, the program will conduct the research needed to develop tools, guidelines, and data to support improvements in turbine engine certification requirements.

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

Research Goals: To enhance the safety and reduce the risk associated with the failure of engine systems, the propulsion program is developing criteria, guidelines, and data to support improvements of turbine engine certification standards. The current focus is to ensure the structural integrity and durability of critical rotating engine parts throughout their service life. This research is providing analytical tools to meet the requirements of Advisory Circular (AC) 33.14-1, "Damage Tolerance for High Energy Turbine Engine Rotors", allowing aircraft turbine engine manufacturers to assess the risk of fracture and manage the life of rotor disks. Research is also being conducted to establish an improved understanding of other material factors and manufacturing anomalies that can shorten the fatigue life of rotor disks. In the general aviation piston engine arena, the goal is to find a replacement for current leaded avgas (100LL). The replacement fuel should perform as well as 100LL in general aviation (GA) piston engines. This unleaded high octane replacement fuel must not cause any accidents and should be a seamless, transparent change to a GA pilot. Extensive laboratory and test cell dynamometer engine testing will evaluate and characterize all new fuel formulations provided by industry for consideration.

- By FY 2010, evaluate the feasibility of using ethanol and ethanol blends as a general aviation fuel.
- By FY 2012, evaluate the feasibility of modifying general aviation piston engine controls to accommodate alternative fuels for 100LL.
- By FY 2012, develop a design methodology for use by industry to prevent cold dwell fatigue in turbine engine rotor disks and define a technique to assess the risk of the current aircraft fleet for cold dwell fatigue.
- By FY 2012 evaluate and characterize all candidate replacement formulations for 100LL.
- By FY 2012, develop advanced damage tolerance methods to reduce the risk of failure of turbine engine rotor disks.

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

- Subcommittee on Aircraft Safety of the FAA Research, Engineering and Development Advisory Committee – representatives from industry, academia, and other government agencies annually review the program's activities.
- Technical Community Representative Groups – FAA representatives apply formal guidelines to ensure that the program's research projects support new rule making and development of alternate means of compliance with existing rules.
- The Coordinating Research Council (CRC) Unleaded Aviation Gasoline Development Group – representatives from Texaco, Exxon Mobil, Phillips Petroleum, Chevron, British Petroleum, Cessna, Raytheon (Beech), Teledyne Continental, and Textron Lycoming facilitate two-way transfer of technology between government and industry to benefit all participants.
- The CRC Molecular Marker Ad Hoc Committee – representatives from turbine engine manufacturers, major oil companies and FAA provide oversight to ensure the safe implementation when adding molecular markers to jet fuel.
- The Aerospace Industries Association (AIA) – working subcommittees on rotor integrity and rotor manufacturing.
- The National Transportation Safety Board – Recommendations A-90-89 and A-90-90 recommend that a damage tolerance philosophy be implemented in the design and maintenance of failure critical engine parts and A-98-28 recommends that FAA in cooperation with industry address the uncontained engine failures caused by cold dwell fatigue.

R&D Partnerships: Propulsion and Fuel Systems Program R&D partners include:

- Turbine Rotor Material Design Program - Southwest Research Institute (SwRI) has teamed with Pratt and Whitney, General Electric, Honeywell, and Rolls Royce to provide DARWIN™, a probabilistic-based rotor life and risk management certification tool.
- The AIA working subcommittees on rotor integrity and rotor manufacturing.
- The Ohio State University, a member of the FAA Airworthiness Assurance Center of Excellence (COE), is conducting research on a failure mode of titanium rotor disks known as cold dwell fatigue.
- SwRI is conducting research to determine the acceptable level of fuel dye contamination allowable for the safe, continuous operation of turbine engines in partnership with the Defense Energy Support Center, Internal Revenue Service, Air Transport Association, American Petroleum Institute, General Electric Aircraft Engines, Pratt and Whitney, Rolls Royce, Honeywell and Boeing.
- CRC Unleaded Aviation Gasoline Development Group – includes Texaco, Exxon-Mobil, Phillips Petroleum, Chevron, British Petroleum, Cessna, Raytheon (Beech), Teledyne Continental, and Textron Lycoming; this group facilitates two-way transfer of technology between government and industry to benefit all participants.
- The FAA General Aviation Center of Excellence in conjunction with direct grants with the University of North Dakota, South Dakota State University and Baylor University – these relationships produce feasibility studies for the use of ethanol fuel blends as a possible unleaded piston fuel replacement for 100LL avgas.

Accomplishments: Outstanding program accomplishments include:

FY 2007:

- Completed an enhanced version of the DARWIN™ code with the following new features: new analysis mode for titanium hard alpha anomalies, probabilistic treatment of multiple anomalies, and a crack formation module.
- Completed full scale engine tests of 45 fuel formulations provided by the CRC.

FY 2006:

- Continued the enhancement of the DARWIN™ probabilistic rotor design code.
- Completed research on an experimental GA fuel provided by Exxon-Mobil under a cooperative research and development agreement; results demonstrated that amine-based additives show some promise as a replacement for 100LL.
- Completed research investigating the feasibility of using ETBE, an ethanol fuel blend, as a GA fuel; results showed there are significant range penalties associated with this fuel that make it an undesirable replacement for 100LL.

FY 2005:

- Completed an enhanced version of the DARWIN™ code that addresses multiple subsurface defects in turbine engine rotor disks.

FY 2004:

- Populated a rotor manufacturing induced anomaly database for use by the engine industry in sharing lessons learned in the manufacture of critical rotating engine parts to prevent future accidents caused by manufacturing defects.
- Completed an industrial demonstration of the pool power controller for the vacuum arc remelting process that will aid in producing defect-free titanium material for the manufacturer of turbine engine rotor disks.
- Completed research on the performance in a GA piston engine of 30 unleaded fuel formulations specified by the CRC Unleaded Aviation Gasoline Development Group. The research showed that none of the candidate formulations match the detonation suppression capability of 100LL.

Previous Years:

- Demonstrated, verified, and industrialized the probabilistic rotor design and life management code known as DARWIN™ for titanium alloys that provides turbine engine manufacturers a tool to augment their safe life approach.
- Demonstrated and verified the DEFORM™ defect deformation code for analysis of titanium alloy defects during the rotor disk forging process.
- Proved that the fleet octane requirement is the single most critical parameter for development of high octane unleaded aviation gasoline and that the motor octane rating of any potential candidate must be 100 or greater.
- Defined detonation detection procedures that were adopted by the American Society for Testing and Materials as a test standard (ASTM D6424) for use on candidate unleaded replacement fuels.

FY 2008 MAJOR ACTIVITIES AND ANTICIPATED ACCOMPLISHMENTS:

Turbine Engine Research

- Release an enhanced version of the DARWIN™ probabilistic rotor design code with capabilities for surface damage of turned surfaces and blade slots.

Unleaded Fuels and Fuel System Safety Research

- Continue laboratory characterization and engine ground testing of candidate unleaded fuels to replace 100LL avgas including ethanol and ethanol blends.
- Complete research on the effects of molecular markers in Jet A fuel.
- Continue research and engine tests on blended fuels containing ethanol for piston engines.

FY 2009 PROGRAM REQUEST:

Ongoing Activities

- Continue to advance DARWIN™, the probabilistically based turbine engine rotor design and life management code to enhance its predictive capability. This code is an FAA approved means to support a damage tolerant based certification enhancement to the current safe life design approach.
- Continue to develop advanced damage tolerance methods for turbine rotor disks through experimentation and modeling to address the effects of complex time-temperature stress histories, small crack sizes, anomalies in nickel alloys, crack geometries, and surface residual stress on fatigue crack growth life.
- Continue to develop a design methodology for use by industry to prevent cold dwell fatigue in turbine engine rotor disks and define a technique to assess the risk of the current aircraft fleet for cold dwell fatigue.
- Continue to assess industry-provided lead free fuel formulation candidates, including petrochemical and ethanol based fuels to replace 100LL avgas.

New Initiatives

No new initiatives are planned in FY 2009

KEY FY 2009 MAJOR ACTIVITIES AND ANTICIPATED ACCOMPLISHMENTS:

Turbine Engine Research

- Release an enhanced version of the DARWIN™ probabilistic rotor design code with capabilities for automatic rotor modeling.
- Complete experiments to calibrate and verify analytical methods for time-dependent crack growth and thermo-mechanical fatigue crack growth.

Unleaded Fuels and Fuel System Safety Research

- Continue laboratory characterization and engine ground testing of candidate unleaded fuels to replace 100LL avgas including ethanol and ethanol blends.

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2007)	$93,830
FY 2008 Appropriated	4,086
FY 2009 Request	3,669
Out-Year Planning Levels (FY 2010-2013)	14,906
Total	$116,491

Budget Authority ($000)	**FY 2005 Enacted**	**FY 2006 Enacted**	**FY 2007 Enacted**	**FY 2008 Enacted**	**FY 2009 Request**
Contracts:					
Propulsion And Fuel Systems	6,089	4,508	2,592	2,463	2,415
Personnel Costs	922	1,155	1,366	1,476	1,168
Other In-house Costs	104	78	90	147	86
Total	**7,115**	**5,741**	**4,048**	**4,086**	**3,669**

OMB Circular A-11, Conduct of Research and Development ($000)	**FY 2005 Enacted**	**FY 2006 Enacted**	**FY 2007 Enacted**	**FY 2008 Enacted**	**FY 2009 Request**
Basic	0	0	0	0	0
Applied	7,115	5,741	4,048	4,086	3,669
Development (includes prototypes)	0	0	0	0	0
Total	**7,115**	**5,741**	**4,048**	**4,086**	**3,669**

A11b - Propulsion and Fuel Systems Product and Activities	FY 2009 Request ($000)	Program Schedule					
		FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013
063-110 Propulsion and Fuel Systems							
Turbine Engine Research	$2,415						
Continue to advance the Probabilistic Rotor Design and Life Management code (DARWIN™) to enhance its predictive capability.		◆	◊	◊	◊	◊	◊
Release an enhanced version of the DARWIN™ probabilistic rotor design code with capabilities for surface damage of turned surfaces and blade slots.		◆					
Release an enhanced version of the DARWIN™ probabilistic rotor design code with capabilities for automatic rotor modeling.			◊				
Continue to develop advanced damage tolerance methods for turbine rotor disks.		◆	◊	◊	◊	◊	◊
Complete experiments to calibrate and verify analytical methods for time-dependent crack growth and thermo-mechanical fatigue crack growth.			◊				
Continue to develop a design methodology for use by industry to prevent cold dwell fatigue and for assessing the fleet risk.		◆	◊	◊	◊	◊	◊
Unleaded Fuels and Fuel System Safety Research	$0						
Complete research on the effects of molecular markers in Jet A fuel		◆					
Continue laboratory characterization and engine ground testing of candidate unleaded fuels to replace 100 octane low-lead gasoline, including ethanol and ethanol blends		◆	◊	◊	◊	◊	◊
Continue the evaluation of the feasibility of using ethanol and ethanol blends as a general aviation fuel		◆	◊	◊			
Evaluate the feasibility of modifying general aviation piston engine controls to accommodate alternative fuels for 100LL				◊	◊	◊	◊
Personnel and Other In-House Costs	$1,254						
Total Budget Authority	$3,669	$4,086	$3,669	$3,720	$3,724	$3,729	$3,733

◆ - Activities Accomplished ◊ - Activities Planned

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

FAA Budget Appropriation	Budget Item	Program Title	Budget Request
R,E&D	**A11.c.**	**Advanced Materials/Structural Safety**	**$2,920,000**

Supports FAA Strategic Goal: Increased Safety

Intended Outcomes: The Advanced Materials/Structural Safety Program helps FAA achieve its strategic goal of increasing aviation safety by preventing accidents that would occur as a result of structural failure. The Advanced Materials/Structural Safety Program assesses the safety implications of new and present day composites, alloys, and other materials, and associated structures and fabrication techniques that can help to reduce aviation fatalities. The program is also enhancing aircraft crashworthiness.

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

Advanced Materials

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

Structural Safety

The FAA revises or updates crashworthiness-related Federal Aviation Regulations to accommodate new information for overhead stowage bins, auxiliary fuel tanks and fuel systems, aircraft configurations, seat and restraint systems, and human tolerance injury criteria. The FAA is developing alternative methods to streamline the certification process (i.e. certification by analysis and component tests in lieu of full-scale tests).

Research Goals: To prevent accidents associated with the airframe and to improve the crashworthiness of airframes in the event of accidents, the Advanced Materials/Structural research focuses on developing analytical and testing methods for standardization; understanding how design, loading, and damage can affect the remaining life and strength of composite aircraft structures; developing maintenance and repair methods that are standardized and correlated with training and repair station capabilities; enhancing occupant survivability and reducing personal injury from accidents; improving crash characteristics of aircraft structures, cabin interiors, auxiliary fuel tanks, fuel systems, and occupant seat and restraint systems; and improving the efficiency of aircraft certification through the use of better analytical modeling of crash events.

- By FY 2009, generate composite material dynamic properties.
- By FY 2009, develop analytical modeling techniques of aircraft structures.
- By FY 2010, generate data using full-scale structure with a goal of uniform, accepted certification methodology for damage tolerance and fatigue of composite airframe.
- By FY 2010, develop test and analysis protocols for repeated loads and damage threats.
- By FY 2011, identify required data and test methods for high temperature materials to assure safety of new constructions.

- By FY 2012, initiate study of ceramics as they are used in engine components.
- By FY 2013, develop criteria for damage tolerance assessments of laminate composite structures.
- By FY 2013, generate methodology for demonstrating aircraft structure crashworthiness certification by analysis.

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

- Public Law 100-591, the Aviation Safety Research Act of 1988, and House of Representatives Report 100-894 – sets priorities to develop technologies, conduct data analysis for current aircraft, and anticipate problems related to future aircraft.
- The Aviation Rulemaking Advisory Committee (ARAC) – this FAA committee and its subcommittees help to ensure the effectiveness of the agency’s rule making by identifying R&D requirements and priorities, providing guidance for the update of documents, such as AC20-107A, and encouraging industry’s full participation in implementing new rules.
- Aircraft Safety Subcommittee of the FAA Research, Engineering and Development Advisory Committee – representatives from industry, academia, and other government agencies annually review the program’s activities.
- Technical Community Representative Groups – FAA representatives apply formal guidelines to ensure that the program’s research projects support new rule making and development of alternate means of compliance for existing rules.

R&D Partnerships: The Advanced Materials/Structural Safety Program benefits from a close working relationship with the FAA Center of Excellence lead by Wichita State University’s National Institute of Aviation Research and the University of Washington. The research performed under this program is leveraged by the monetary and intellectual contributions of its core universities.

Advanced Materials

With the cooperation of other government agencies, FAA sponsors a primary, authoritative handbook (Composite Materials Handbook 17) facilitating the statistical characterization data of current and emerging composite materials. The best available data and technology source for testing and analysis, this international reference tool also includes guidance on data development and usage. On recommendations by the ARAC, material data contained in this handbook are acceptable for use in the certification process.

Structural Safety

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

Memoranda of cooperation and exchange of personnel have been established between the program and the French, Italian, and Japanese governments in the crash testing area. The program has worked closely with Drexel University to develop dynamic crash computer modeling codes for transport airplane structures.

Accomplishments: The Advanced Materials/Structural Safety Program provides technical reports (available on-line at http//actlibrary.tc.faa.gov), handbooks, ACs, and certification guidance to aircraft manufacturers, maintainers, and operators. Outstanding program accomplishments include:

FY 2007:

- Completed the validation of analytical methodology to predict residual strength of a composite sandwich structures following an impact event.
- Established feasibility of embedded sensors to track damage in composite structures.
- Evaluated aging composite aircraft by a destructive evaluation and testing.
- Developed an updated ATR 42-300 model to analyze critical fuselage frame failure observed in the vertical drop test.
- Developed occupant protection criteria for side facing seats commonly used in business jets. Currently, no criteria exist.
- Evaluated the use of reticulated foam to mitigate post-crash fires using full-scale sled tests.

FY 2006:

- Developed software for analyzing bonded joints that can be used by the general aviation industry.
- Developed a web-based course on maintenance of composite airframe structures.
- Developed analytical models that predict durability of braided materials.
- Generated data on human neck injury criteria for side-facing aircraft seats that may be used to develop safety criteria for business jet with side-facing seats. Currently, no criteria exist for these seats.

FY 2005:

- Developed an aircraft seat cushion replacement methodology that may have the potential to replace future requirement for full-scale sled test currently required when replacing aircraft seat cushions.
- Established common practices for bonded joints in composites structures that served as a basis for an AC.

Previous years:

- Developed data on the procurement and processing of composites that resulted in a published AC.
- Analyzed data from ATR42-300 drop test to help establish crashworthiness criteria for commuter aircraft.
- Developed an economical data reduction method, characterizing statistically composite materials through shared databases, that is now used worldwide by the general aviation industry.

FY 2008 MAJOR ACTIVITIES AND ANTICIPATED ACCOMPLISHMENTS:

Advanced Materials

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

Structural Safety

- Develop analytical models of aircraft crash events to reduce the number of full-scale tests and thus reduce the cost of certification.

FY 2009 PROGRAM REQUEST:

Ongoing Activities

The program will continue to focus on damage tolerance and fatigue issues of composite airframes. In addition it will focus on the aging of composite materials. Composite control surfaces degradation on transport airplanes will be explored and linked to aircraft safety issues. Bonded joints will be studied for damage tolerance and durability. Researchers will also explore savings in maintenance costs, of using embedded sensors to monitor in-service damage and will investigate the long-term safety friction stir-welded parts and fiber/metal laminates proposed for use in new aircraft. In addition, they will collect data for new materials and applications, such as ceramics and high temperatures.

Research will continue to develop analytical models of aircraft crash events. This will focus on the development of criteria and methodologies to validate analysis techniques and assess the effectiveness of the analysis to properly describe the crash event.

New Initiatives

No new initiatives are planned in FY 2009.

KEY FY 2009 MAJOR ACTIVITIES AND ANTICIPATED ACCOMPLISHMENTS:

Advanced Materials

- Generate composite material dynamic properties.

Structural Safety

- Develop analytical modeling techniques of aircraft crash conditions.

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2007)	$90,998
FY 2008 Appropriated	7,083
FY 2009 Request	2,920
Out-Year Planning Levels (FY 2010-2013)	11,923
Total	$112,924

Budget Authority ($000)	FY 2005 Enacted	FY 2006 Enacted	FY 2007 Enacted	FY 2008 Enacted	FY 2009 Request
Contracts:					
Advanced Materials	5,087	4,383	1,211	6,054	1,838
Structural Safety	96	174	165	0	0
Personnel Costs	1,345	1,247	1,394	945	1,022
Other In-house Costs	115	77	73	84	60
Total	**6,643**	**5,881**	**2,843**	**7,083**	**2,920**

OMB Circular A-11, Conduct of Research and Development ($000)	FY 2005 Enacted	FY 2006 Enacted	FY 2007 Enacted	FY 2008 Enacted	FY 2009 Request
Basic	0	0	0	0	0
Applied	6,643	5,881	2,843	7,083	2,920
Development (includes prototypes)	0	0	0	0	0
Total	**6,643**	**5,881**	**2,843**	**7,083**	**2,920**

A11c – Advanced Materials/Structural Safety Product and Activities	FY 2009 Request ($000)	Program Schedule					
		FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013
062-111 Advanced Materials Structures							
Advanced Materials	**$1,838**						
Ascertain the effect of stiffness loss due to damage for dynamic characteristics		◆					
Develop safety criteria as they concern damage tolerance of fiber/metal laminates and friction stir welded joints		◆					
Develop chemical characterization tests to assure adequate surface preparation for bonded joints		◆					
Generate composite materials dynamic properties			◊				
Verify accepted certification methodology for damage tolerance and fatigue using full-scale test data.				◊			
Develop test and analysis protocols for repeated loads and damage threats				◊			
Identify data and test for materials at elevated temperatures					◊		
Initiate research in ceramic composites						◊	
develop criteria for damage tolerance assessments of laminate composite structures							◊
062-110 Structural Safety	**$0**						
Structural Safety							
Develop analytical models of aircraft crash events		◆					
Develop analytical modeling techniques of aircraft structures crash conditions			◊				
Develop analytical model protocols and detailed requirements for crashworthiness certification analysis							◊
Personnel and Other In-House Costs	**$1,082**						
Total Budget Authority	**$2,920**	**$7,083**	**$2,920**	**$2,965**	**$2,975**	**$2,986**	**$2,997**

◆ - Activities Accomplished ◊ - Activities Planned

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

FAA Budget Appropriation	Budget Item	Program Title	Budget Request
R,E&D	A11.d.	Atmospheric Hazards/Digital System Safety	$4,838,000

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

Intended Outcomes: The Atmospheric Hazards/Digital System Safety (DSS) Research Program supports FAA's strategic goal of increased safety by reducing the number of accidents or potential accidents associated with aircraft icing and failures to software-based digital flight controls and avionics systems. The program supports FAA's aviation safety goal by developing and testing technologies that detect frozen contamination, predict anti-icing fluid failure, and ensure safe operations both during and after flight in atmospheric icing conditions. To improve digital system safety, researchers are working to ensure the safe operation of emerging, highly complex software-based digital flight controls and avionics systems.

A major goal of the program is to reduce aviation's vulnerability to all in-flight icing hazards through the application of its research to improve certification criteria. Commercial airplanes are not yet certified to fly in icing conditions to an icing envelope that includes supercooled large droplet (SLD) icing conditions. The program's researchers have contributed to the development of technical data and advisory materials to correct this omission. A study by the Engine Harmonization Working Group indicates that over 100 in-service engine events, many resulting in power loss and at least six in multiple engine flameouts, occurred in high ice water content environments over the period 1988 to 2003. A future collaborative research effort will focus on this issue.

The program will develop new guidelines for testing, evaluating, and qualifying digital flight controls and avionics systems for the certification of aircraft platforms. Additionally, the program supports development of policy, guidance, technology, and training needs of the Aircraft Certification Service and Flight Standards Service that will assist and educate FAA and industry specialists in understanding digital systems safety and assessing how it may be safely employed in systems such as fly-by-wire, augmented manual flight controls, navigation and communication equipment, and autopilots.

Agency Outputs: The FAA establishes rules for the certification and operation of aircraft that encounter icing conditions as well as rules for the use of software, digital flight controls, and onboard avionics systems. The agency uses the research results to generate Advisory Circulars (ACs), and various other forms of technical information detailing acceptable means for meeting requirements, to guide government and industrial certification and airworthiness specialists and inspectors.

Research Goals: To reduce the number and severity of accidents, or potential accidents, associated with icing and failures to software-based digital flight controls and avionics systems, the program develops and assesses ways to ensure that airframes and engines can safely operate in atmospheric icing conditions, and ensure the proper operation of software, complex electronic hardware, and digital systems.

Atmospheric Hazards

- By FY 2010, complete characterization of high ice water content atmospheric environments potentially hazardous to engines.
- By FY 2011, complete experimental work on the physics of engine icing in high ice water content environments.

- By FY 2012, develop methods for the airworthiness testing of engines in simulated high ice water content environments.
- By FY 2013, develop data and methods supporting the evaluation of aircraft engines for operation in high ice water content environments.

Digital System Safety

- By FY 2010, evaluate complex hardware techniques and tools for qualification, verification, and assurance to develop additional evaluation methods that may improve the certification process for complex hardware.
- By FY 2010, determine potential safety, security, and certification issues of connecting aircraft systems to external systems, per onboard network security and integrity.
- By FY 2010, determine software development assurance levels.
- By FY 2011, evaluate the obsolescence and life cycle maintenance of aviation electronics to determine the availability and affordability of digital avionics repair parts.
- By FY 2011, evaluate model-based development criteria to promote faster development and shorter certification times for aircraft systems with safety-critical software and complex electronic hardware.
- By FY 2012, evaluate alternatives to existing verification and validation techniques; improved techniques will provide a way to identify system requirement errors early in the development process before implementation into the system.
- By FY 2013, determine applicability of safety engineering and reliability engineering to software development assurance standards (i.e., DO-178B).

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

- Aircraft Safety Subcommittee of the FAA Research, Engineering, and Development Advisory Committee – representatives from industry, academia, and other government agencies annually review the activities of the Atmospheric Hazards/Digital System Safety Research Program.
- Technical Community Representatives Groups – FAA representatives apply formal guidelines to ensure that the program's R&D projects support new rule making and the development of alternate means of compliance with existing rules.
- Ice Protection Harmonization Working Group and Engine Harmonization Working Group of the FAA Aviation Rulemaking Advisory Committee – groups that ensure the effectiveness of the agency's rule making. Members of the working group and full committee identify research requirements and priorities.
- G-12 Aircraft Ground Deicing Committee of the Society of Automotive Engineers (SAE) – this subcommittee assists in updating holdover time guidelines and establishing standards for de/anti-icing methodologies, deicing fluids, and ground ice detection.
- SAE AC-9C Aircraft Icing (In-flight) Subcommittee – this subcommittee assists in updating the Aircraft Icing Handbook, including the Icing Bibliography, and in establishing standards for icing simulation methods.
- RTCA (formerly known as Radio Technical Commission for Aeronautics) – members of this U.S. Federal Advisory Committee and its special committees help to ensure the effectiveness of the agency's rulemaking by identifying research requirements and priorities and providing guidance for Aircraft Certification Office engineers and the update of documents, such as avionics software, and electromagnetic hazards.

- Certification Authorities Software Team (CAST) – a group of international certification software and complex electronic hardware (CEH) specialists who collaborate and make recommendations to regulatory authorities on the resolution of software and CEH aspects of safety.

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

- National Aeronautics and Space Administration (NASA) Glenn Research Center – includes various cooperative efforts on aircraft icing activities.
- Transport Canada – based on an international agreement on research on aircraft ground deicing issues.
- Environment Canada – based on an international memorandum of cooperation for research on in-flight icing conditions.
- NASA Langley Research Center – assesses software-based digital flight controls and avionics systems and electromagnetic hazards research.
- Aerospace Vehicle Systems Institute (AVSI) – cooperative industry, government, and academia venture for investigation and standardization of aerospace vehicle systems to reduce life-cycle cost and accelerate development of systems, architectures, tools, and processes.

Accomplishments: Significant program accomplishments include:

Aircraft Icing

FY 2007:

- Conducted propeller icing test in McKinley Climatic Chamber and processed and published data.
- Conducted testing at flight Reynolds numbers on full-scale airfoil model of simulated runback ice for a thermal ice protection system.
- Developed technical data for the use of ground ice detectors.

FY 2006:

- Developed snow generation system to test the time of effectiveness of modern de/anti-icing fluids in a controlled laboratory environment.
- Completed development of facility simulation capability for SLD icing testing to show safe operation in SLD environments in accordance with new proposed rules.
- Completed documentation and analysis of residual and inter-cycle ice for pneumatic boots at low airspeeds to provide data for guidance to ensure safe operation of pneumatic boots on low speed aircraft in icing conditions.

FY 2005:

- Investigated and documented characteristic features of runback ice for thermal ice protection systems to provide data for guidance to ensure safe operation of thermally protected aircraft in icing conditions.
- Enhanced in-flight icing simulation capability at the McKinley Climatic Laboratory suitable for testing of full scale engines and rotor blades for substantiation of safe operation of engines and helicopters in icing conditions.

FY 2004:

- Investigated and analyzed atmospheric icing environment - supercooled water and mixed-phase conditions – to provide data for formulation of expanded atmospheric icing envelopes for new proposed rules.

Digital System Safety

FY 2007:

- Completed analysis of aspects of commercial off-the-shelf (COTS) component integration related to the verification of the integration of components into a generic aviation platform that includes a handbook that will be useful for FAA and industry practitioners of integrating IMA systems on aircraft. Results published in a technical report.
- Developed evaluation criteria for airworthiness of newly proposed databases that will define a suitable approach to develop and evaluate data networks for safety-critical avionics; results will provide guidance to FAA certification engineers. Results published in a technical report.
- Defined a safe, secure process for implementing LANs onboard aircraft; results will provide a network assurance process for FAA certification engineers. Results published in a technical report.

FY 2006:

- Completed research on object-oriented technology (OOT) in aviation that will provide input for policy and guidance on the use of OOT systems and support harmonization with international certification authorities on the use of OOT.
- Completed research on component integration and verification considerations in integrated modular avionics (IMA) systems; results will lead to more effective systems development and enhance the certification of digital flight controls and avionics systems.
- Evaluated the criteria and use of microprocessors in aviation and the identification of safety concerns for microprocessors; results will be used to develop test methods for modern, complex microprocessors that will improve the process of certifying aircraft avionics.

FY 2005:

- Studied deterministic operations of Ethernet equipment and provided evaluation criteria for the certification of Ethernet databases; results were incorporated into a handbook that provides network designers with guidelines for developing Ethernet databases that will be deployable in certifiable avionics systems.
- Completed research on software development tools that led to a handbook for developers and certifying authorities to use to evaluate the tools from the system and software safety perspective and provided a basis for future software development tool qualification guidelines.
- Completed research on software verification tools that identified specific evaluation criteria that could be used to determine whether the performance of the tool was acceptable and thereby improve the ability of the certification engineer to qualify software using these tools.

Previous Years:

- Investigated issues concerning the structural coverage of object-oriented software that clearly showed that there is a desire and emerging trend by suppliers of commercial airborne safety-critical systems toward the use of object-oriented technology (OOT), and thereby an increasing need by certifiers for the proper application of structural coverage analysis to OOT.

- Investigated three forms of the modified condition decision coverage (MCDC) criterion that assists with the assessment of the requirements-based testing process for Level A software and provided data to support the right choice for the type of structural coverage to use.

FY 2008 MAJOR ACTIVITIES AND ANTICIPATED ACCOMPLISHMENTS:

Aircraft Icing

- Complete analysis of data from propeller icing test at McKinley Climatic Laboratory to provide data for guidance to ensure safe flight of propeller aircraft in icing conditions.
- Continue research to characterize high ice water content environments for engines to ensure their safe operation in such conditions.
- Continue experimental work on the physics of engine icing in high ice water content environments
- Develop improved methods for simulation of ice pellet, mixed, and other conditions for determination of fluid failure and holdover times.
- Continue study of aerodynamic effects of runback ice for thermal ice protection for simulated flight conditions.

Digital System Safety

- Complete and document methods to improve software velocity in production certification timeframes.
- Determine additional microprocessor evaluation issues pertaining to risk and safety.
- Evaluate onboard network security and integrity issues.
- Evaluate complex electronic hardware techniques and tools for qualification, verification, and assurance.
- Evaluate COTS technology in complex and safety-critical systems for obsolescence and life cycle maintenance of aviation electronics.

FY 2009 PROGRAM REQUEST:

Ongoing Activities

Researchers will continue to refine laboratory methods to determine de-icing fluid holdover times in a variety of environmental conditions. Study of the enhancement and validation of icing simulation methods, with an emphasis on engine testing in high ice water content conditions will continue. Researchers will also continue to evaluate complex electronic hardware techniques and tools for qualification, verification, and assurance.

New Initiatives

No new initiatives are planned for FY 2009.

KEY FY 2009 MAJOR ACTIVITIES AND ANTICIPATED ACCOMPLISHMENTS:

Aircraft Icing

- Continue collaborative flight research to acquire atmospheric data for high ice water content environments. Initiate processing and analysis of data.
- Continue experimental work on the physics of engine icing in high ice water content environments.
- Complete the development of methods for simulation of ice pellet and mixed conditions for determination of fluid failure and holdover times.
- Develop methods to test engines in simulated high ice water content environments.

- Complete investigation of runback ice formation and size and velocity effects on aerodynamic impact of runback ice for thermal ice protection for simulated flight conditions.

Digital System Safety

- Complete an additional microprocessor evaluation pertaining to risk and safety.
- Evaluate onboard network security and integrity issues.
- Evaluate complex electronic hardware techniques and tools for qualification, verification, and assurance.
- Evaluate COTS technology in complex and safety-critical systems for obsolescence and life cycle maintenance of aviation electronics.
- Determine software development assurance level.
- Evaluate verification and validation techniques.

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2007)	$86,819
FY 2008 Appropriated	3,574
FY 2009 Request	4,838
Out-Year Planning Levels (FY 2010-2013)	19,859
Total	$115,090

Budget Authority ($000)	FY 2005 Enacted	FY 2006 Enacted	FY 2007 Enacted	FY 2008 Enacted	FY 2009 Request
Contracts:					
Digital System Safety	440	232	842	737	1,080
Atmospheric Hazards	1,864	1,287	1,316	1,052	1,811
Personnel Costs	1,621	1,786	1,614	1,653	1,832
Other In-house Costs	161	102	76	132	115
Total	**4,086**	**3,407**	**3,848**	**3,574**	**4,838**

OMB Circular A-11, Conduct of Research and Development ($000)	FY 2005 Enacted	FY 2006 Enacted	FY 2007 Enacted	FY 2008 Enacted	FY 2009 Request
Basic	0	0	0	0	0
Applied	4,086	3,407	3,848	3,574	4,838
Development (includes prototypes)	0	0	0	0	0
Total	**4,086**	**3,407**	**3,848**	**3,574**	**4,838**

A11d – Atmospheric Hazards/Digital System Safety Product and Activities	FY 2009 Request ($000)	Program Schedule					
		FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013
064-110 Digital System Safety							
Digital System Safety	**$1,080**						
Determine software velocity in production		◆					
Determine additional microprocessor evaluation issues		◆	◇				
Evaluate onboard network security and integrity		◆	◇	◇			
Evaluate complex electronic hardware techniques and tools		◆	◇	◇			
Evaluate obsolescence and environmental qualification of electronic components		◆	◇	◇	◇		
Determine software development assurance level			◇	◇			
Evaluate model-based development criteria				◇	◇		
Evaluate verification and validation techniques			◇	◇	◇		
Determine applicability of safety engineering and reliability engineering					◇	◇	◇
064-111 Atmospheric Hazards							
Aircraft Icing	**$1,811**						
Complete analysis of propeller icing test data from McKinley Climatic Laboratory		◆					
Characterize high ice water content atmospheric environments for engines		◆	◇	◇			
Conduct experimental work on the physics of engine icing in high ice water content environments.		◆	◇	◇	◇		
Develop improved methods for simulation of ice pellet, mixed, and other conditions for determination of fluid failure and holdover times		◆	◇				
Develop methods to test engines in simulated high ice water content environments			◇	◇	◇	◇	
Investigate scaling of formation and aerodynamic effects of runback ice for thermal ice protection for simulated flight conditions.		◆	◇				
Develop data and methods supporting the evaluation of aircraft engines for operation in high ice water content environments					◇	◇	◇
Personnel and Other In-House Costs	**$1,947**						
Total Budget Authority	**$4,838**	**$3,574**	**$4,838**	**$4.921**	**$4,949**	**$4,979**	**$5,010**

◆ - Activities Accomplished ◇ - Activities Planned

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

FAA Budget Appropriation	Budget Item	Program Title	Budget Request
R,E&D	**A11.e.**	**Aging Aircraft / Continued Airworthiness**	**$14,589,000**

Supports FAA Strategic Goal: Increased Safety.

Intended Outcomes: The Aging Aircraft/Continued Airworthiness Program (formerly known as the Aging Aircraft Program) contributes to FAA's strategic goal of increasing aviation safety by reducing the number of accidents associated with failure of aircraft structure, engines, and systems. The program supports FAA's aviation safety goal by developing technologies, procedures, technical data, and performance models to prevent accidents and mitigate accident severity related to civil aircraft failures as a function of their continued operation and usage. The program is focused on the structural integrity of fixed wing aircraft and rotorcraft, continued safety of aircraft engines, development of inspection technologies, and safety of electrical wiring interconnect systems (EWIS), mechanical systems, and flight controls.

Agency Outputs: The FAA issues rules and advisory materials for regulating aircraft design, construction, operation, modification, inspection, maintenance, repair, and safety. Technologies, procedures, technical data, and analytical models produced by the Aging Aircraft/Continued Airworthiness Program provide a major source of technical information used in developing these regulations and related advisories. Through this research, FAA also provides the aviation community with critical new safety technologies and data.

Research Goals: The goal of the Aging Aircraft/Continued Airworthiness Program is to understand and develop methods to counter the effects of age and usage on the airworthiness of an aircraft over its lifetime, including potential effects of modifications and repairs. The program conducts research, develops technologies and processes, and assesses current practices in order to eliminate or mitigate the potential failures related to aircraft aging processes, thereby reducing the number and severity of accidents.

To satisfy these goals the program conducts research to assess causes and consequences of airplane structural fatigue, corrosion, and other structural failures, and develop effective analytical tools to predict the behavior of these conditions. This includes development of nondestructive inspection technologies to detect these conditions. Similar research is conducted on aircraft engines and rotorcraft. Aircraft systems research to understand the causes and consequences of EWIS and mechanical systems failures, and the relationship of these failures to other aircraft systems and safety completes the program.

- By FY 2010, develop EWIS separation and segregation advisory guidance. This research supports development of guidelines for the design and modification of aircraft EWIS and improves safety by ensuring that adequate clearances for EWIS separation and segregation are provided in EWIS installation.
- By FY 2010, develop and validate a model-assisted probability of detection methodology to determine quantitative inspection reliability data, eliminating the need to conduct expensive and time consuming tests currently required to establish inspection reliability. Accurate probability of detection data is critical to determining the life of safety critical components.
- BY FY 2011, complete a study of risk-based fleet management for small-airplane continued operational safety.
- BY FY 2011, assess performance of in-situ damage detection technologies for inspection of remote and inaccessible areas in aircraft. In-situ monitoring provides the means to monitor structural behavior and identify damage not normally found between major maintenance checks.

- By FY 2011, complete study to assess need for new rudder design standards in transport category aircraft and need for new pilot training standards with regard to rudder usage.
- BY FY 2012, develop damage tolerance methodologies and standards for rotorcraft to establish guidance for certification.
- BY FY 2012, assess performance of traditional and advanced inspection systems necessary for evaluating the strength of bonded aircraft structures. The continued airworthiness of bonded aircraft structures, whose use is increasing, will require technologies to find hidden damage in these joints.
- By FY 2013, develop standards for rotorcraft that provide guidance for certification of Health and Usage Monitoring Systems (HUMS) for usage credits.
- By FY 2013, develop a predictive methodology for damage tolerance risk assessment and risk management for continued operational safety of small airplanes.

Customer/Stakeholder Involvement: The Continued Airworthiness Program coordinates with an extensive network of government and industry groups, including:

- Subcommittee on Aircraft Safety of the FAA Research, Engineering and Development Advisory Committee – representatives from industry, academia, and other government agencies annually review program activity, progress, and plans.
- Technical Community Representative Groups – FAA representatives apply formal guidelines to ensure that the program's research projects support new rule making and the development of alternate means of compliance with existing rules.
- The Aviation Rulemaking Advisory Committee – Industry representatives propose cost-effective rulemaking and research to address aircraft safety issues.
- Aircraft manufacturers, operators, foreign airworthiness authorities, academia, and industry trade groups consult on a wide range of current and future aging aircraft and continued airworthiness issues.

R&D Partnerships: The Aging Aircraft/Continued Airworthiness Program activities are closely coordinated with industry, NASA, and DoD. The FAA maintains interagency agreements with NASA, the U.S. Navy, the U.S. Air Force, and the Department of Energy (DOE). The FAA, DoD, and NASA have co-sponsored 10 joint aging aircraft conferences.

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

- The Joint Council on Aging Aircraft – leverages resources and coordinates the efforts of all DoD service organizations for common aging aircraft issues.
- The National Rotorcraft Technology Center – comprised of the U.S. Army, U.S. Navy, FAA, and NASA.
- Metallic Materials Properties Development and Standardization (MMPDS) Government/Industry Steering Group – a joint government and industry working group that funds and develops the metallic materials properties handbook.

Accomplishments: The Aging Aircraft/Continuing Airworthiness Program conducts a broad array of projects to meet the goals described above. Technical reports documenting the accomplishments of most projects are available on-line at http://aar400.tc.faa.gov/Programs/AgingAircraft/index.htm.

Outstanding program accomplishments include:

FY 2007:

- Completed the airworthiness evaluation of an aged Raytheon Beech 1900D.

- Completed the destructive and extended fatigue testing of fuselage sections from a retired Boeing 727. Results support formulation of policy on use of teardown data for airworthiness certification.
- Conducted the field test of a magnetic carpet probe for rapid and wide-area inspection of aircraft engine critical rotating components.
- Completed assessment of ASTM and new fatigue crack growth test methods for use in addressing rotorcraft fatigue life.
- Developed methodology to evaluate mechanical systems on current transport category aircraft for safety and reliability.

FY 2006:

- Completed development of the MMPDS Handbook of FAA accepted material properties, which replaces MIL-HDBK-5 previously cancelled by the DoD. The MMPDS Handbook is an essential reference for aircraft manufacturer design engineers and is used by FAA for aircraft certification.
- Completed aircraft wire degradation research on common types of aircraft electrical wire as a function of laboratory controlled aging processes. Data generated are used to evaluate potential methods of monitoring wire performance in aircraft and wire reliability assessment methods.
- Completed research on the use of composite doublers as a safer, more cost-effective means for repair of damaged metallic aircraft structure.
- Completed development of a low cost, field prototype, generic scanning and imaging system that can be readily coupled to existing aircraft inspection devices, thereby improving flaw detection in metal and composite structure.
- Completed second-phase development of a magnetic carpet probe for rapid and wide-area inspection of aircraft engine critical rotating components. This technology is a potential replacement of fluorescent penetrant inspection.

FY 2005:

- Completed airworthiness evaluations of two aging Cessna airplanes, a 402A and 402C, and a teardown evaluation of a T-34A accident aircraft.
- Evaluated and verified methods to assess multiple site damage.
- Developed the fatigue crack growth database that is used in support of damage tolerance assessments of airframe structure.
- Developed and demonstrated a prototype micro-energy, high-voltage nondestructive test method for inspecting aircraft wiring.
- Completed research to determine the interrelationship of landing gear lateral loads on the body and wing gear during ground turns of FAA's multiple main gear B-747SP aircraft. Results of this research support development of landing gear certification standards.

Previous Years:

- Established the FAA Arc Fault Evaluation Laboratory and initiated the evaluation of advanced circuit protection technologies and experiments to quantify damage created by arc fault conditions.
- In cooperation with industry, developed, validated, and facilitated the adoption of improved inspection procedures for detecting cracks and corrosion in rotorcraft.

- Demonstrated phased array inspection technology for critical engine titanium forgings. Phased array technology reliably detects smaller material flaws in critical engine component forgings.
- Developed rotorcraft component damage part database that allows determination of the origin and causal factors of rotorcraft structure and component failures.
- Developed and flight tested aircraft arc-fault circuit breaker prototypes; they mitigate the hazardous effects of potentially catastrophic arc-faults.

FY 2008 MAJOR ACTIVITIES AND ANTICIPATED ACCOMPLISHMENTS:

- Develop a predictive methodology for the risk assessment and risk management of small airplane continued operational safety with regard to fatigue crack initiation.
- Complete loads characterization of B-737/700 (transports) and B-767 (cargo) airplanes in typical operations (altitude, airspeed, acceleration, ground-air-ground cycles, and kinematics of flight and ground operation). Data will be used to assess assumptions in design and certification.
- Complete assessment of reliability of various advanced inspection technologies in detecting second layer cracks in typical transport aircraft fuselage structure.
- Initiate research on damage tolerance and durability issues for emerging structural technologies entering service, to ensure safety, support maintenance, and establish future certification policies and guidance.
- Complete validation of HUMS flight regime recognition methods for rotorcraft using the HUMS advisory circular.
- Complete an advanced risk assessment tool for conducting hazard analysis of EWIS systems. The tool will use a probabilistic method to support compliance with FAR 25.1309 requirements.

FY 2009 PROGRAM REQUEST:

Ongoing Activities

The FY 2009 funding request will support Aging Aircraft/Continued Airworthiness research requirements that contribute to FAA's aviation safety goal. The program will continue its focus on developing technologies, technical information, procedures, and practices that help ensure the safety of aircraft structures and systems in the civil aircraft fleet. Research will continue on the development of damage tolerance methods and health and usage monitoring systems for rotorcraft. Research will continue on the development and evaluation of risk assessment and risk management methods for the continued operational safety of small airplanes. Research will continue on flight controls and mechanical systems, focusing on design, maintenance and pilot training to increase safety. Researchers will also continue efforts on engine airworthiness and propeller damage tolerance. Research in nondestructive inspection will continue its focus on the development of methods and technologies to assure the long term safety of metallic and composite structures.

New Initiatives

The program will begin research that investigates issues related to flight control safety for general aviation.

KEY FY 2009 MAJOR ACTIVITIES AND ANTICIPATED ACCOMPLISHMENTS:

- Develop a comprehensive analysis tool for the risk assessment and risk management of small airplane continued operational safety with regard to fatigue crack initiation.

- Develop a comprehensive analysis tool for the risk assessment and risk management of small airplane continued operational safety with regard to fatigue crack initiation.
- Complete studies to quantitatively determine the impact of process variables on the performance of fluorescent penetrant inspection (FPI) and integrate results into industry inspection standards.
- Develop a rotorcraft certification plan for the use of HUMS.
- Continue research on damage tolerance and durability issues for emerging structural technologies entering service, to ensure safety, support maintenance, and establish future certification policies and guidance.
- Complete the evaluation of thermal acoustic technology as a potential replacement for FPI in inspecting critical engine components.
- Complete the evaluation of nondestructive inspection (NDI) technologies for identifying small cracks and corrosion in propeller systems.
- Complete testing of single-element, dual-load-path flight control linkages from transport category aircraft for corrosion and other anomalies that could affect safety.
- Complete upgrade of Arc Fault Evaluation Laboratory to accommodate more sophisticated separation and segregation testing of aircraft wiring (EWIS research).

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2007)	$375,009
FY 2008 Appropriated	15,946
FY 2009 Request	14,589
Out-Year Planning Levels (FY 2010-2013)	59,114
Total	$464,658

Budget Authority ($000)	**FY 2005 Enacted**	**FY 2006 Enacted**	**FY 2007 Enacted**	**FY 2008 Enacted**	**FY 2009 Request**
Contracts:					
Aging Aircraft	13,852	14,881	14,211	11,680	9,839
Personnel Costs	4,609	4,631	4,159	3,946	4,447
Other In-house Costs	537	295	251	320	303
Total	**18,998**	**19,807**	**18,621**	**15,946**	**14,589**

OMB Circular A-11, Conduct of Research and Development ($000)	**FY 2005 Enacted**	**FY 2006 Enacted**	**FY 2007 Enacted**	**FY 2008 Enacted**	**FY 2009 Request**
Basic	0	0	0	0	0
Applied	18,998	19,807	18,621	15,946	14,589
Development (includes prototypes)	0	0	0	0	0
Total	**18,998**	**19,807**	**18,621**	**15,946**	**14,589**

A11e – Aging Aircraft/Continued Airworthiness Product and Activities	FY 2009 Request ($000)	Program Schedule					
		FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013
065-110 Continued Airworthiness							
Structural Integrity and Inspection Systems Research	**$4,904**						
Develop risk-based fleet management methods for small-airplane continued operational safety		◆	◊	◊	◊	◊	◊
Initiate research on application of damage tolerance methods to emerging structural technologies		◆	◊	◊	◊		
Complete operational loads characterization of Boeing 737/700 and 767 aircraft		◆					
Complete assessment of reliability of NDI techniques for second layer cracks in transports		◆					
Assess the effect of FPI process variables on inspection performance and reliability		◆	◊				
Develop and validate a model-assisted methodology to predict inspection reliability data		◆	◊	◊			
Assess performance of in-situ damage detection technologies for inspection of remote and inaccessible areas in aircraft		◆	◊	◊	◊		
Assess performance of advanced inspection systems to determine strength of bonded aircraft structures		◆	◊	◊	◊	◊	◊
Rotorcraft Structural Integrity and Safety	**$1,995**						
Develop rotorcraft damage tolerance methodologies and standards to establish guidance for certification		◆	◊	◊	◊	◊	◊
Establish guidance for certification of HUMS applications for usage credits		◆	◊	◊	◊	◊	◊
Continued Airworthiness of Aircraft Engines	**$0**						
Evaluate thermal acoustic technology as a potential replacement of FPI for critical engine components		◆	◊				
Evaluate advanced techniques to detect manufacturing-induced surface anomalies on critical engine components		◆	◊	◊			
Investigate suitability of NDI technologies for detection of small cracks and corrosion in propeller systems		◆	◊				
Develop standard propeller load spectrum for damage tolerant design methodologies		◆	◊	◊			
Continued Airworthiness of Aircraft Systems	**$2,940**						
Assess pilot rudder usage, design, and training		◆	◊	◊	◊		
Assess single element, dual-load path flight control linkages for corrosion		◆	◊				
Complete advanced risk assessment tool for aircraft electrical systems		◆					
Assess EWIS separation and segregation standards and develop advisory guidance		◆	◊	◊			
Personnel and Other In-House Costs	**$4,750**						
Total Budget Authority	**$14,589**	**$15,946**	**$14,589**	**$14,780**	**$14,779**	**$14,778**	**$14,777**

◆ - Activities Accomplished ◊ - Activities Planned

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

FAA Budget Appropriation	Budget Item	Program Title	Budget Request
R,E&D	**A11.f.**	**Aircraft Catastrophic Failure Prevention Research**	**$436,000**

Supports FAA Strategic Goal: Increased Safety

Intended Outcomes: The Aircraft Catastrophic Failure Prevention Program supports FAA's strategic goal of increasing aviation safety by reducing the number of fatal accidents from uncontained engine failures and engine malfunctions. The program supports FAA's safety goal by developing technologies and methods to assess risk and prevent occurrence of potentially catastrophic defects, failures, and malfunctions in aircraft, aircraft components, and aircraft systems. Its researchers assess the use of advanced materials to protect aircraft critical systems and passengers in the event of catastrophic engine failures. The program also uses historical accident data and National Transportation Safety Board recommendations to examine and investigate:

- Turbine engine uncontainment events, including the mitigation and modeling of aircraft vulnerability to uncontainment parameters stated in Advisory Circular (AC) 20-128, Phase II.
- Fan blade out analysis and other engine related impact events like bird strike and ice ingestion.
- Propulsion malfunction indications in response to Aerospace Industries Association (AIA) recommendations and proposed solutions.

Agency Outputs: With technical data from the Aircraft Catastrophic Failure Prevention Program, FAA establishes certification criteria for aircraft and revises regulations to certify new technologies. The agency also publishes ACs to outline acceptable means for meeting these rules. The program's objective is to ensure safe aircraft operation in the public domain.

Research Goals: To reduce the number of fatal accidents from uncontained engine failures, the program develops data and methods for evaluating aircraft vulnerability to uncontained engine failures and provides analytical tools for protecting identified critical systems that may need shielding from uncontained engine debris. Through the LSDYNA Aerospace Users Group, FAA is working with industry to establish standards for finite element analysis and guidance for use in support of certification.

- By 2010, develop a modular Uncontained Engine Debris Damage Assessment Model (UEDDAM) (version 4) to be compatible with Department of Defense code upgrades for supportability and incorporate industry recommended improvements.
- By 2012, develop revised guidance for fuselage protection from uncontained engine failure fragments that includes multiple fragment analysis.
- In the area of propulsion malfunctions, the program develops guidance on the symptoms that can be expected when malfunctions occur and evaluates the ability of available technologies to detect and annunciate the malfunctions to the flight crew. An important factor is to identify which engine is malfunctioning so that in the event of a commanded engine shutdown, the crew will not mistakenly shut down a good engine.
- By 2011, conduct a propulsion indication system demonstration bench test that will combine the sustained thrust anomaly recommendations with the engine damage recommendations into a complete indication system.
- By 2013, conduct propulsion indication system simulator flight evaluation to provide a visualization of the cockpit indication in the flight environment.

Customer/Stakeholder Involvement: The program collaborates with a broad cross section of the aviation community, including:

- Subcommittee on Aircraft Safety of the FAA Research, Engineering and Development Advisory Committee – representatives from industry, academia, and other government agencies annually review the program's activities.
- Technical Community Representative Groups – FAA representatives apply formal guidelines to ensure that the program's research projects support new rule making and development of alternate means of compliance with existing rules.
- The Aviation Rulemaking Advisory Committee (ARAC) – helps to ensure the effectiveness of the agency's rule making. Members of the subcommittee and full committee identify research requirements, priorities, and provide guidance for the update of documents such as AC20-128, and encourage industry's full participation in implementing new rules.

R,E&D Partnerships: The Aircraft Catastrophic Failure Prevention Program partners with industry and other government agencies including:

- The National Aeronautics and Space Administration (NASA) and industry in support of the development and validation of explicit finite element analysis. The industry participates in the LSDYNA Aerospace Users Group to support quality control reviews of the code and also critique research objectives in material testing, model development and verification. NASA and FAA are teamed to develop high quality test data and analytical models that support the Aerospace Users Group efforts. The end goal is to develop guidance for the use of LS-DYNA in the certification process.
- The AIA Transport Committee – with participation of FAA and industry, has examined propulsion system malfunctions, identified inappropriate crew response, and recommended development of specific regulations and advisory materials to correct safety hazards. AIA has completed some preliminary efforts on propulsion issues with implications for follow-on ARAC work on FAR 25.1305.

Accomplishments: Results of Aircraft Catastrophic Failure Prevention Program research provide the technical basis for FAA rule changes and new or modified ACs. Researcher results are also provided to airframe and engine manufacturers and designers.

Engine Uncontainment Research

FY 2007:

- Complete testing and modeling of fabrics used in gas turbine engine containment systems. Test results will be compared with analytical results from fabric model version 3.1
- Complete testing and material model development for aluminum using the Johnson-Cook formula.
- Develop an oversight process for generic aerospace problems run in LSDYNA that ensures consistent results as computers and programs continue to evolve.

FY 2006:

- Delivered the UEDDAM, version 3.0 for evaluation of uncontained engine debris hazards to aircraft. UEDDAM uses a Monte Carlo approach to perform the vulnerability analysis in design cases where the released multiple fragments are analyzed.
- Conducted a workshop for the Department of Defense and ARAC on UEDDAM in November 2005.

FY 2005:

- Developed fabric attachment data and designs for fuselage shielding. Fabric material models were used to design full scale shields to be tested in an aircraft fuselage.
- Completed full-scale fabric shielding demonstration test of various fabric attachment designs in a retired commercial airplane at Naval Air Warfare Center (NAWC), China Lake.

FY 2004:

- Developed test data using spherical projectiles on aluminum, Lexan and composites, then evaluated material model ability to accurately predict the results.
- Conducted a workshop for engine certification engineers on non-linear finite element modeling of turbine engine containment systems at the Los Angeles Aircraft Certification Office (ACO).

Previous Years:

- Completed a collaborative effort with NASA, the U.S. Navy, and the U.S. Air Force to perform the first full-scale engine disk crack detection demonstration.
- Developed test data and improved analytical modeling of fabric shielding with revision to the fabric material model.
- Conducted a workshop for engine certification engineers on non-linear finite element modeling of turbine engine containment systems at the Boston ACO.
- Developed a significant database of small and full-scale test data to understand the interaction of multiple ballistic fabric layers in engine fan blade out containment systems.
- Completed a mitigation test for debris damage to pressurized fuel lines inside the aircraft due to an uncontained engine failure; prototype power panels showed promise.

Propulsion Malfunction

FY 2007:

- Completed detailed study of propulsion malfunctions classified as mechanical damage. Research developed a set of indications that can be added to the flight deck as indications and annunciations to inform the crew that a malfunction exists on a specific engine. This effort recommended a focused follow-on effort to study an information based oil system display.

FY 2005:

- Completed detailed study of propulsion malfunctions classified as Sustained Thrust Anomalies. Research developed a set of indications that can be added to the flight deck as indications and annunciations to inform the crew that a malfunction exists on a specific engine.

FY 2003:

- Completed an in-depth analysis of 80 in-service propulsion system malfunctions and developed recommendations for potential propulsion indication improvement.

FY 2008 MAJOR ACTIVITIES AND ANTICIPATED ACCOMPLISHMENTS:

Engine Uncontained Research

- Continue FAA/NASA/industry sponsored quality control program for modeling aircraft problems in the manufacturer's supported finite element code (LSDYNA).
- Improve material models for incorporation into the LSDYNA model that are verified and accepted by the aerospace users group as standardized models.

Propulsion Malfunction

- Continue development of an information based oil system display that can replace the prescriptive engine oil system gauges and minimize pilot interpretation and troubleshooting.

FY 2009 PROGRAM REQUEST:

Ongoing Activities

Research will continue on the NASA/FAA/industry program for modeling aircraft engine failures in LSDYNA. The FAA/NASA/academia will continue to evaluate improved material models and incorporate them into LSDYNA upon acceptance by the Aerospace Users Group. User guidelines and training will continue to be developed and made available through George Washington University.

Propulsion malfunction research will complete a demonstration of the information-based display for the engine lubrication system. This demonstration is a key stepping stone to moving beyond the prescriptive instrument displays to an information based system intended to inform the pilot and connect the information with procedures which will minimize both pilot troubleshooting efforts and un-annunciated checklists.

New Initiatives

No new initiatives are planned in FY 2009.

KEY FY 2009 MAJOR ACTIVITIES AND ANTICIPATED ACCOMPLISHMENTS:

Engine Uncontained Research

- Continue FAA/NASA/industry sponsored quality control program for modeling aircraft problems in the manufacturer's supported finite element code (LSDYNA).

Propulsion Malfunction

- Complete demonstration of an information based cockpit display for the engine lubrication system.

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2007)	$33,872
FY 2008 Appropriated	2,202
FY 2009 Request	436
Out-Year Planning Levels (FY 2010-2013)	1,971
Total	$38,481

Budget Authority ($000)	**FY 2005 Enacted**	**FY 2006 Enacted**	**FY 2007 Enacted**	**FY 2008 Enacted**	**FY 2009 Request**
Contracts:					
Aircraft Catastrophic Failure Prevention Research	833	2,703	947	1,684	0
Personnel Costs	241	566	533	482	415
Other In-house Costs	33	37	32	36	21
Total	**1,107**	**3,306**	**1,512**	**2,202**	**436**

OMB Circular A-11, Conduct of Research and Development ($000)	**FY 2005 Enacted**	**FY 2006 Enacted**	**FY 2007 Enacted**	**FY 2008 Enacted**	**FY 2009 Request**
Basic	0	0	0	0	0
Applied	1,107	3,306	1,512	2,202	436
Development (includes prototypes)	0	0	0	0	0
Total	**1,107**	**3,306**	**1,512**	**2,202**	**436**

A11f - Aircraft Catastrophic Failure Prevention Research Product and Activities	FY 2009 Request ($000)	Program Schedule					
		FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013
066-110 Aircraft Catastrophic Failure Prevention Research							
Engine Uncontainment Research	**$0**						
Continue FAA/NASA/industry sponsored quality control program for modeling aircraft problems in the manufacturer's supported finite element code (LSDYNA)		◆	◊	◊	◊	◊	◊
Develop improved material models for use in LSDYNA model that are verified and accepted as standardized models		◆					
Develop modular UEDDAM Code (version 4)				◊			
Develop revised guidance for protection from uncontained engine failure with multiple fragment analysis						◊	
Propulsion Malfunction	**$0**						
Demonstrate an information based cockpit display for the engine lubrication system		◆	◊				
Develop propulsion indication system demonstration bench test					◊		
Conduct propulsion indication simulator flight evaluation							◊
Personnel and Other In-House Costs	**$436**						
Total Budget Authority	**$436**	**$2,202**	**$436**	**$458**	**$480**	**$504**	**$529**

◆ - Activities Accomplished ◊ - Activities Planned

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

FAA Budget Appropriation	Budget Item	Program Title	Budget Request
AIP	**N/A**	**Airport Cooperative Research Program – Capacity, Environment, Safety**	**$15,000,000**

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

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

The ACRP began operations on September 26, 2005, after a Memorandum of Agreement (MOA) was signed between the FAA, which funds the program, and the National Academy of Sciences, acting through its Transportation Research Board (TRB), which administers the program. The ACRP Oversight Committee (AOC), an independent governing board composed of airport managers and other aviation officials appointed by the Secretary of Transportation, selects all of the program's research projects. The ACRP undertakes research and other technical activities in a variety of significant airport issues involving operations, design, construction, engineering, maintenance, human resources, administration, policy, planning, environment, safety, and security. This research will lead to continual improvements in airport safety, capacity, efficiency, and environmental quality.

Agency Outputs: The nature of airport problems requires ACRP research to have products specifically tailored to obtain maximum effectiveness.

Standard research projects are relatively low cost studies lasting one to two years resulting in original research that can be published as a report, guidebook, multimedia disk (CDs and DVDs), computer software, informational pamphlet, and/or a presentation.

Special research projects are conducted in areas of specific interest to the airport community, of which there are currently three main areas: Legal aspects of airport programs; Quick response studies for special needs; and Synthesis of information related to airport problems. The products of this special research will generally be in the form of legal briefs or short reports (40-60 pages) intended to capture and consolidate information or practices currently in use by the airport industry.

All ACRP research products are published and distributed through the National Academies and TRB.

Customer/Stakeholder Involvement: The ACRP benefits from the cooperation and participation of airport professionals, air carriers, shippers, state and local government officials, equipment and service suppliers, airport users, educational institutions, and other research organizations. These groups are solicited annually by the TRB for research topics and industry concerns. Representatives from these organizations also serve on the AOC where they help select ACRP research projects. Federal representation on the AOC is comprised of the FAA, along with NASA and the Environmental Protection Agency (EPA). The aviation industry is further represented on the AOC through the participation of the following groups: the Airports Council International (ACI), the American Association of Airport Executives (AAAE), the National Association of State Aviation Officials (NASAO), and the Air Transport Association (ATA).

Accomplishments: Program outputs during the first two years have been focused on low-cost, rapid-response projects on urgent airport problems:

- The initiation of 91 research projects between September 2005 and October 2007.

- Conducting an energy-use study of Terminals B and D at Dallas-Fort Worth Airport. This effort will provide a model energy report and informational brochure for airport managers that focuses on pro-typical operations, building commissioning, and energy conservation retrofits opportunities. (ACRP 11-02/T1)
- Producing a report containing new and updated documentation of the characteristics of ground access markets to airports. This will provide airport managers with user-friendly, concise, and accurate documentation concerning changing trends in the area of airport ground access. (ACRP 11-02/T2)
- Developing an overview document regarding airport Safety Management Systems (SMS) that defines what such a system is, and provides a summary of existing practice in other countries and industries. (ACRP 11-02/T4)
- Conducting a workshop for airport, airline, and federal government representatives who are involved in responding to a potential pandemic events. This activity helps to clarify roles, discuss issues of mutual interest, and identify further coordination activities that are needed. (11-02/T6)
- Producing a report that explores alternative financing options and revenue sources currently available or that could be available in the future to airport operators, stakeholders, and policymakers. The report examines capital funding and revenue sources, as well as various finance mechanisms for airports. (ACRP Synthesis 1)
- Producing a report that examines the state of airport forecasting methods. Areas of discussion include: common aviation metrics, aviation data sources, issues in data collection and preparation, and special data issues at non-towered airports. In addition the report reviews forecast uncertainty, accuracy, issues of optimism bias, and options for resolving differences when multiple forecast are available. (ACRP Synthesis 2)
- Producing a report that examines safety and security practices at GA airports. Areas of focus include a discussion of: the resources used in the development of safety and security programs, the funding sources and issues that determine the amount of money spent on such programs, and the current practices that GA airports use to keep their facilities safe and secure. (ACRP Synthesis 3)
- Producing a report that explores the different methods used by states, airports, and metropolitan planning organizations (MPOs) for counting and estimating aircraft operations at non-towered airports. The report also examines the new technologies that enable those counts and estimates. (ACRP Synthesis 4)

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

FY 2008 MAJOR ACTIVITIES AND ANTICIPATED ACCOMPLISHMENTS:

- Publication of Project 01-02 Guidebook for Developing and Managing Airport Contracts
- Publication of Project 01-03 Recommended Practices to Collect and Integrate Airport Operational and Financial Data
- Publication of Project 01-05 Guidebook for Airport Capital Project Delivery Systems
- Publication of Project 2-02 Managing Runoff from Aircraft and Airfield Deicing and Anti-Icing Operations.
- Publication of Project 2-03 Airport-Related Hazardous Air Pollutants Analysis.
- Publication of Project 2-04 Research Needs Associated with Particulate Emissions at Airports.

- Publication of Project 02-04A Summarizing and Interpreting Aircraft Gaseous and Particulate Emissions Data
- Publication of Project 02-06 Guidebook on Preparing Airport Greenhouse Gas (GHG) Emissions Inventories
- Publication of Project 3-02 U.S. Airport Passenger-Related Processing Rates.
- Publication of Project 03-03 Enhancing Airport Land Use Compatibility
- Publication of Project 3-04 Guidebook for Airport-User Survey Methodology.
- Publication of Project 4-01 Aircraft Overrun and Undershoot Analysis for Runway Safety Areas.
- Publication of Project 5-01 Guidance for Developing Regionally Coordinated Airport Emergency Plans for CBRNE Events.
- Publication of Project 7-01 New Concepts for Airport Terminal Landside Facilities.
- Publication of Project 7-02 Airport Curbside and Terminal-Area Roadway Operations.
- Publication of Project 9-01 Guidelines for the Collection and Use of Geospatially Referenced Data for Airfield Pavement Management.
- Publication of Project 10-02 Planning Guide for Offsite Terminals.
- Publication of Project 11-01(T1) Compilation of Digest - Parts 13 and 16 Determinations and Related Documents.
- Publication of Project 11-01(T2) Theory and Law of Airport Revenue Diversion.
- Publication of Project 11-01(T3) Compilation of Airport Law Resources.
- Publication of Project 11-01(T4) Survey of Airport Laws and Regulation of Commercial Ground Transportation.
- Publication of Project 11-01(T5) Responsibilities for Implementation and Enforcement of Airport Land-Use Zoning Restrictions.
- Publication of Project 11-01(T6) Who is the owner or Operator for Purposes of the Right to Self-Fuel?
- Publication of Project 11-01(T7) The Impact of Airline Bankruptcies on Airports.
- Publication of Project 11-01(T8) The Law and Regulation of Airport Ownership.
- Publication of Project 11-01(T9) Survey of Elements of Disparity Studies for Airport Disadvantaged Business Enterprise Programs.
- Publication of Project 11-02(T3) Improving Stabilization and Use of Aircraft Evacuation Slides at Airports.
- Publication of Project 11-02(T5) Quarantine Facilities for Arriving Air Travelers: Identification of Planning Needs and Costs.
- Publication of Project 11-02(T7) Strategic Process for Developing ACRP Research Problem Statements
- Publication of Project 11-02(T8) Enhanced Modeling of Aircraft Taxiway Noise--Scoping
- Publication of Project 11-02(T10) Estimate of National Use of Aircraft and Airfield Deicing Materials
- Publication of Project 11-03(S02-01) Effects of Aircraft Noise: Update on Selected Topics
- Publication of Project 11-03(S02-02) Evaluating Airport Parking Strategies and Supporting Technologies
- Publication of Project 11-03(S03-02) Airport Ground Access/Egress Mode Choice Models.
- Publication of Project 11-03 / S03-03 Airport Economic Impact Methods and Models

- Publication of Project 11-03 / S04-02 Preventing Vehicle/Aircraft Incidents During Winter Operations
- Publication of Project 11-03 / S09-01 Effective Rubber Removal Techniques to Minimize Damage on Grooved Runways
- Publication of Project 11-03 / S10-02 Common Use Facilities and Equipment at Airports
- Publication of Project 11-03 / S10-03 Impacts of Airport Pavement Deicing Products on Aircraft and Airfield Infrastructure

FY 2009 PROGRAM REQUEST:

Vision 100 authorized $10 million per year for the ACRP. $10 million was appropriated in FY 2007. The FAA has requested $10 million for the ACRP in FY 2008, and $15 million in FY 2009 as part of the Airport Improvement Program. The additional funding in FY 2009 will be used specifically for topics on airport environmental research.

KEY FY 2009 MAJOR ACTIVITIES AND ANTICIPATED ACCOMPLISHMENTS:

TRB published reports documenting the airport research to be conducted.

- Publication of Project 1-01 Guidebook for Managing Small Airports.
- Publication of Project 01-04 Marketing Techniques for Small Airports
- Publication of Project 01-06 Guidebook for Developing an Airport Performance-Measurement System
- Publication of Project 01-07 Airport/Airline Agreements and Rate Methodologies—Practices and Characteristics
- Publication of Project 01-08 Developing Best Management Practices-Airport Leasing Policy and Metrics for Evaluating Private Investments on Airports
- Publication of Project 02-01 Alternative Aircraft and Airfield Deicing and Anti-Icing Formulations with Reduced Aquatic Toxicity and Biological Oxygen Demand
- Publication of Project 02-05 Guidebook on Community Responses to Aircraft Noise
- Publication of Project 02-07 Handbook for Analyzing the Costs and Benefits of Alternative Turbine Engine Fuels at Airports
- Publication of Project 02-08 Guidance for Quantifying the Contribution of Airport Emissions to Local Air Quality
- Publication of Project 02-09 Developing a Comprehensive Work Plan for a Multimodal Noise and Emissions Model
- Publication of Project 03-01 Light Detection and Ranging (LIDAR) Deployment for Airport Obstructions Surveys
- Publication of Project 03-05 Passenger Space Allocation Guidelines for Planning and Design of Airport Terminals Project Data
- Publication of Project 03-06 Guidebook for Planning and Implementing Automated People Mover Systems at Airports
- Publication of Project 03-07 A Guidebook for Measuring Performance of Automated People Mover Systems at Airports
- Publication of Project 3-08 Passenger Air Service Development Techniques
- Publication of Project 03-09 Guidebook for Strategic Planning in the Airport Industry
- Publication of Project 03-10 Innovative Approaches to Addressing Aviation Capacity Issues in Coastal Mega-Regions

- Publication of Project 03-12 Guidebook for Preparing Peak-Period and Operational Profiles to Improve Airport Facility Planning and Environmental Analyses
- Publication of Project 03-13 Understanding Airspace, Objects, and Their Effects on Airports
- Publication of Project 03-14 Airport Passenger Conveyance System Usage/Throughput
- Publication of Project 4-02 Lightning-Warning Systems for Use by Airports.
- Publication of Project 04-03 Guidebook for Approach Light System Hazard Assessment and Mitigation
- Publication of Project 04-04 Exercising Command-Level Decision Making for Critical Incidents at Airports
- Publication of Project 04-05 A Guidebook for Airport Safety Management Systems
- Publication of Project 04-06 Analysis and Best Management Practices for the Prevention of Wildlife Strikes at Small Airports
- Publication of Project 06-01 Airport and Air Carrier Resource Manual: Employees Coping with Traumatic Events
- Publication of Project 07-03 Developing Improved Civil Aircraft Arresting Systems
- Publication of Project 07-04 Spreadsheet Models for Airport Terminal Planning and Design
- Publication of Project 07-05 Airport Passenger Terminal Planning Guidebook
- Publication of Project 07-06 Airport Signage and Wayfinding Information Guidelines
- Publication of Project 10-01 Optimizing the Use of Aircraft Deicing and Anti-Icing Fluids
- Publication of Project 10-03 Evaluating Airport Parking Strategies and Supporting Technologies
- Publication of Project 10-04 Airports and the Newest Generation of General Aviation Aircraft
- Publication of Project 10-06 Effects of Constrained Public and Employee Parking on Airport Access
- Publication of Project 11-01 / Topic 02-01"The Legal Implications of Obstructions Affecting Navigable Airspace"
- Publication of Project 11-01 / Topic 02-02 Use and Success of Aviation Easements and Other Tools for Airport Compatible Land Use and Development of Model Language
- Publication of Project 11-01 / Topic 02-03 Case Studies on Community Challenges to Airport Development
- Publication of Project 11-01 / Topic 02-04 Analysis of Federal Laws, Regulations and Case Law Regarding Airport Proprietary Rights

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2007)	$19,900
FY 2008 Appropriated	10,000
FY 2009 Request	15,000
Out-Year Planning Levels (FY 2010-2013)	60,000
Total	$104,900

Budget Authority ($000)	**FY 2005 Enacted**	**FY 2006 Enacted**	**FY 2007 Enacted**	**FY 2008 Enacted**	**FY 2009 Request**
Contracts:					
Airport Cooperative Research Program	0	9,900	10,000	10,000	15,000
Personnel Costs	0	0	0	0	0
Other In-house Costs	0	0	0	0	0
Total	**0**	**9,900**	**10,000**	**10,000**	**15,000**

OMB Circular A-11, Conduct of Research and Development ($000)	**FY 2005 Enacted**	**FY 2006 Enacted**	**FY 2007 Enacted**	**FY 2008 Enacted**	**FY 2009 Request**
Basic	0	0	0	0	0
Applied	0	0	0	0	0
Development (includes prototypes)	0	9,900	10,000	10,000	15,000
Total	**0**	**9,900**	**10,000**	**10,000**	**15,000**

Airport Cooperative Research Program Product and Activities	FY 2009 Request ($000)	Program Schedule FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013
Airport Cooperative Research Program							
Safety-Related Research	**$5,000**						
Conduct research on selected AOC proposals		◆	◊	◊	◊	◊	◊
LIDAR Deployment for Obstruction Surveys		◆	◊				
Aircraft Overrun and Undershoot Analysis for RSAs		◆	◊				
Airport Lightning-Warning Systems		◆					
Runway Structure Hazard-Mitigation Analysis		◆	◊				
Training of Emergency Response Personnel		◆	◊				
Developing Airport Safety Management Systems		◆	◊				
Airport Emergency Plans for CBRNE Events		◆					
Improved Civil Aircraft Arresting Systems		◆	◊				
Improving Use of Aircraft Evacuation Slides		◆					
Airport Quarantine Facilities		◆					
Capacity-Related Research	**$5,000**						
Conduct research on selected AOC proposals		◆	◊	◊	◊	◊	◊
Airport Management – Contracts /Software/ Revenue		◆	◊				
Small Airport Management BMPs		◆	◊	◊	◊	◊	◊
Airport Passenger Movement/Processing Analysis		◆	◊	◊			
Enhancing Airport Land Use Compatibility		◆	◊	◊			
Automated People Mover Systems/Plans/Performance		◆	◊	◊			
Developing Airport Strategic Plans		◆	◊				
Airport Terminal Design		◆		◊			
Airfield Pavement Management		◆	◊				
Parking Technologies at Airports		◆					
Airport Impacts of Very Light Jets		◆	◊	◊			
Airport Legal Issues		◆	◊				
Improving Airport Ground Access		◆	◊				
Aviation Forecasting Techniques		◆					
Environment-Related Research	**$5,000**						
Conduct research on selected AOC proposals		◆	◊	◊	◊	◊	◊
Hazardous Air Pollutants Analysis		◆	◊				
Manage/Optimize Alternative Deicing Fluids		◆	◊				
Particulate Emissions Analysis		◆	◊				
Community Attitudes to Aircraft Noise		◆	◊				
Total Budget Authority	**$15,000**	**$10,000**	**$15,000**	**$15,000**	**$15,000**	**$15,000**	**$15,000**

◆ - Activities Accomplished ◊ - Activities Planned

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

FAA Budget Appropriation	Budget Item	Program Title	Budget Request
AIP	**N/A**	**Airport Technology Research – Capacity**	**$9,109,000**

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

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

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

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

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

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

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

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

- Built the NAPTF and dedicated it on April 12, 1999; began testing at the facility on June 4, 1999.
- In FY 2004, completed reconstruction and full-scale traffic testing of three concrete pavement test items at the NAPTF.
- In FY 2005, completed overlay construction at the NAPTF and conducted full-scale traffic testing of three asphalt concrete overlay test sections (rubblized sections as well as conventional overlay).
- Issued Layered Elastic Design (LED) FAA version 1.3, a pavement design-standard software based on NAPTF-generated data, to allow the introduction of the Airbus A380 and other new aircraft into the fleet mix.

- In FY 2006, delivered FAARFIELD 1.0 (FAA Rigid and Flexible Iterative Elastic Layered Design), a new desktop computer program for pavement thickness design that incorporates 3D finite element models of pavement structures
- Conducted technical workshops in airport pavement design using LEDFAA version 1.3 and the beta version of FAARFIELD (FEDFAA).
- Maintained an airport pavement database containing full-scale test data collected at the NAPTF, and gave on-line access to international researchers.
- Established or expanded cooperative programs with non-profit research foundations, located at the Innovative Pavement Research Foundation (IPRF) and Auburn University, to conduct research into concrete and asphalt airport pavement technology.
- In FY 2006, completed the first phase of full-scale testing of concrete-on-concrete overlay pavements at the NAPTF through the IPRF cooperative research program.
- Established a new Interagency Agreement with the U.S. Army Engineer Research and Development Center (ERDC) to cooperate on research projects of interest to both military and civil aviation.
- In FY 2005, released DOT/FAA/AR-04/46, a technical report entitled “Operational Life of Airport Pavements,” that addresses the extent to which current FAA thickness design standards for airport pavements conform to the Agency’s 20-year life requirement.
- Released ProFAA, a software program that combines an inertial profiler with simulations of the standard outputs from other commonly used devices, to analyze runway smoothness.
- In FY 2007, delivered the updated FAARFIELD 1.1 (FAA Rigid and Flexible Iterative Elastic Layered Design), a desktop computer program for pavement thickness design that incorporates 3D finite element models of pavement structures.
- In FY 2007, delivered the updated and rewritten Advisory Circular 150/5320-6E, “Airport Pavement Design and Evaluation” to include the new pavement design program FAARFIELD.
- In FY 2007, alpha factors used in the ICAO (International Civil Aviation Organization) ACN/PCN method developed and proposed by the FAA were accepted by IACO.

R&D Partnerships:

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

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

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

FY 2008 MAJOR ACTIVITIES AND ANTICIPATED ACCOMPLISHMENTS:

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

FY 2009 PROGRAM REQUEST:

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

KEY FY 2009 MAJOR ACTIVITIES AND ANTICIPATED ACCOMPLISHMENTS:

- Continue analyzing full-scale data from the NAPTF.
- Improve upon and update the pavement design procedures based on data from the FAARFIELD computer program.
- Continue conducting technical workshops in pavement design using FAARFIELD.
- Conduct technical workshops in pavement roughness criteria using PROFAA.
- Develop conceptual guidelines and computer tools for terminal building design.
- Conduct full-scale traffic tests on flexible pavement test items at the NAPTF.

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2007)	$46,087
FY 2008 Appropriated	8,907
FY 2009 Request	9,109
Out-Year Planning Levels (FY 2010-2013)	36,436
Total	$100,539

Budget Authority ($000)	**FY 2005 Enacted**	**FY 2006 Enacted**	**FY 2007 Enacted**	**FY 2008 Enacted**	**FY 2009 Request**
Contracts:					
Airports Technology Research – Capacity	4,400	6,725	7,337	7,414	7,536
Personnel Costs	0	1,200	1,318	1,493	1,573
Other In-house Costs	0	0	0	0	0
Total	**4,400**	**7,925**	**8,655**	**8,907**	**9,109**

OMB Circular A-11, Conduct of Research and Development ($000)	**FY 2005 Enacted**	**FY 2006 Enacted**	**FY 2007 Enacted**	**FY 2008 Enacted**	**FY 2009 Request**
Basic	0	0	0	0	0
Applied	0	0	0	0	0
Development (includes prototypes)	4,400	7,925	8,655	8,907	9,109
Total	**4,400**	**7,925**	**8,655**	**8,907**	**9,109**

Airport Technology Research - Capacity Product and Activities	FY 2009 Request ($000)	Program Schedule					
		FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013
Airport Technology Research – Capacity Goal							
Airport Technology Research - Capacity	**$7,536**						
Continue full-scale testing at NAPTF		◆	◊	◊	◊	◊	◊
Continue analysis of full-scale data from NAPTF; maintain equipment, instrumentation, conduct material testing, develop pavement specifications, demolition and reconstruction activities		◆	◊	◊	◊	◊	◊
Develop advanced airport pavement design procedures; conduct related workshops in development, programming and documentation		◆	◊	◊	◊	◊	◊
Next phase of rigid pavement design, analysis of slab curling, materials characterization, field instrumentation, and continue support of airport technology center of excellence		◆	◊				
Conduct non-destructive pavement testing		◆	◊	◊	◊	◊	◊
Support development of MicroPaver software		◆	◊	◊	◊	◊	◊
Conduct pavement roughness research		◆	◊	◊	◊		
Operate material testing lab		◆	◊	◊	◊	◊	◊
Improve paving materials		◆	◊	◊	◊	◊	
Develop conceptual guidelines and computer tools for terminal building design		◆	◊				
Develop models for airport funding strategies, and passenger surveys		◆					
Personnel and Other In-House Costs	**$1,573**						
Total Budget Authority	**$9,109**	**$8,907**	**$9,109**	**$9,109**	**$9,109**	**$9,109**	**$9,109**

◆ - Activities Accomplished ◊ - Activities Planned

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

FAA Budget Appropriation	Budget Item	Program Title	Budget Request
AIP	**N/A**	**Airport Technology Research – Safety**	**$10,239,000**

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

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

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

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

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

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

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

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

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

R&D Partnerships:

- FAA-U.S. Air Force, Tyndall Air Force Base*.
- FAA-USDA, National Wildlife Research Center, Sandusky, Ohio*.

- FAA-Agencies of Canadian Government (for pavement technology and winter operations safety)**.
- FAA-NASA (for joint runway traction research)*.
- FAA-Port Authorities of New York and New Jersey (for design and construction of aircraft arrestor bed)*.
- FAA-industry - soft-ground arrestor materials)**.

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

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

FY 2008 MAJOR ACTIVITIES AND ANTICIPATED ACCOMPLISHMENTS:

- Complete the study on effects of fuselage geometry on post crash fire behavior.
- Complete testing of non-fire portion of Next Generation High Reach Extendible Turret
- Complete EMAS Freeze-Thaw Durability Study
- Complete Canada goose movement study
- Complete Report on Switching Displaced Threshold Lights
- Complete Report on Refurbish Heliport Facility
- Complete Report on Switching Displaced Threshold Lights
- Complete evaluation of radar-based FOD detection system at TF Green Providence, RI.
- Complete installation of alternative runway groove shape on active asphalt runway at large airport.
- Complete installation of camera based FOD detection systems at Boston Logan and Chicago O'Hare.
- Complete deployment of Taxiway Deviation data collection systems at Manchester, NH and West Palm Beach, FL
- Complete baseline fires at New Large Aircraft Facility, Tyndall AFB, Panama City, FL.

FY 2009 PROGRAM REQUEST:

The Airport Technology FY 2008 research program is a collaborative effort among many government organizations, universities, and industry associations. The requested program funding provides the contract support necessary for an integrated, effective research program that delivers the standards and guidelines for maintaining and enhancing airport infrastructure.

KEY FY 2009 MAJOR ACTIVITIES AND ANTICIPATED ACCOMPLISHMENTS:

- Complete study of Next Generation High Reach Extendible Turret.
- Complete validation of commercial avian radars.
- Complete evaluation of alternative runway groove shape on asphalt and concrete runway surfaces.
- Complete evaluation of camera based FOD detection systems at Boston Logan and Chicago O'Hare.
- Complete evaluation of Taxiway Deviation data collection at Manchester, NH and West Palm Beach, FL.

- Complete agent quantity research for NLA.
- Initiate full scale testing of composite fires at NLA Facility, Tyndall AFB, Panama City, FL.
- Complete Report on New Photoluminescent Technology for Visible Surface Markings
- Evaluate effectiveness of a prototype alternative runway groove shape.

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2007)	$42,505
FY 2008 Appropriated	9,805
FY 2009 Request	10,239
Out-Year Planning Levels (FY 2010-2013)	40,956
Total	$103,505

Budget Authority ($000)	**FY 2005 Enacted**	**FY 2006 Enacted**	**FY 2007 Enacted**	**FY 2008 Enacted**	**FY 2009 Request**
Contracts:					
Airports Technology Research – Safety	4,200	8,375	7,897	8,312	8,580
Personnel Costs	0	1,200	1,318	1,493	1,668
Other In-house Costs	0	0	0	0	0
Total	**4,200**	**9,575**	**9,215**	**9,805**	**10,239**

OMB Circular A-11, Conduct of Research and Development ($000)	**FY 2005 Enacted**	**FY 2006 Enacted**	**FY 2007 Enacted**	**FY 2008 Enacted**	**FY 2009 Request**
Basic	0	0	0	0	0
Applied	0	0	0	0	0
Development (includes prototypes)	4,200	9,575	9,215	9,805	10,239
Total	**4,200**	**9,575**	**9,215**	**9,805**	**10,239**

Airport Technology Research - Safety Product and Activities	FY 2009 Request ($000)	Program Schedule					
		FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013
Airport Technology Research – Safety Goal							
Airport Technology Research - Safety	**$10,239**						
Complete the study on effects of fuselage geometry on post crash fire behavior.		◆	◊				
Complete testing of non-fire portion of Next Generation High Reach Extendible Turret		◆					
Complete EMAS Freeze-Thaw Durability Study		◆					
Complete Canada goose movement study		◆					
Complete Report on Switching Displaced Threshold Lights		◆					
Complete Report on Refurbish Heliport Facility		◆	◊				
Complete evaluation of radar-based FOD detection system at TF Green Providence, RI.		◆	◊				
Complete study of Next Generation High Reach Extendible Turret.		◆	◊				
Complete validation of commercial avian radars.		◆	◊	◊	◊		
Complete evaluation of alternative runway groove shape on asphalt and concrete runway surfaces.		◆	◊				
Complete evaluation of camera based FOD detection systems at Boston Logan and Chicago O'Hare.		◆	◊				
Complete evaluation of Taxiway Deviation data collection at Manchester, NH and West Palm Beach, FL.		◆	◊				
Complete agent quantity research for NLA.		◆	◊				
Initiate full scale testing of composite fires at NLA Facility, Tyndall AFB, Panama City, FL.		◆	◊	◊	◊		
Complete Report on New Photoluminescent Technology for Visible Surface Markings		◆	◊				
Personnel and Other In-House Costs							
Total Budget Authority	**$10,239**	**$9,805**	**$10,239**	**$10,239**	**$10,239**	**$10,239**	**$10,239**

◆ - Activities Accomplished ◊ - Activities Planned

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

FAA Budget Appropriation	Budget Item	Program Title	Budget Request
R,E&D	A11.g.	Flightdeck/Maintenance/System Integration Human Factors	$7,465,000

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

Intended Outcomes: The Flight Deck/Maintenance/System Integration Human Factors Program helps achieve FAA's Flight Plan goals for increased safety and greater capacity by:

- Developing more effective methods for pilot, inspector, and maintenance technician training.
- Enhancing the understanding and application of error management strategies in flight and maintenance operations.
- Increasing human factors considerations in certifying new aircraft and in equipment design and modification.
- Improving pilot, inspector, and maintenance technician task performance.
- Developing methodologies to identify and mitigate risk factors in automation-related operator errors.
- Developing requirements, knowledge, guidance, and standards for design, certification, and use of automation-based technologies, tools, and support systems.
- Addressing human performance and human-system performance requirements associated with transitioning from 2015 to 2025 NextGen capabilities.

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

Research Goals:

By FY 2008:

- Evaluate methods to mitigate the potential for incidents and accidents by assessing and removing causal factors of human error from flight deck operations and aviation maintenance.
- Begin analysis of how advanced technology in air and ground systems will impact inspection and maintenance processes in the future. Begin developing guidance on how advanced technology can be used for inspection training and reducing errors in transport and general aviation maintenance.
- Facilitate the operational implementation of the Human Factors Certification Job Aid, Version 8 for Parts 25 (Airworthiness Standards for Transport Category Airplanes) and 23 (Airworthiness Standards including Commuter Category Airplanes). This tool will support FAA certification personnel, aircraft designers, and researchers in addressing possible human factors concerns related to displays, controls, flight deck systems, pilot tasks, and procedures. It will also address equipment and testing assumptions.

By FY 2009:

- Develop a system safety approach to understand error patterns of pilots, maintenance personnel, and inspectors, and identify intervention strategies.
- Develop certification guidelines and human factors standards for integrating advanced technologies.

- Develop training guidelines for flight deck error management.
- Develop training guidelines for repair stations and maintenance shops. Include guidance on dealing with automation and new technologies.

By FY 2012:

- Provide guidance to improve design of computer-human interfaces to reduce information overload and resulting errors.
- Improve pilot situational awareness, and provide corrective mechanisms to compensate for pilot skills degradation or automation failure.
- Assess cognitive and contextual factors to improve operator performance and reduce errors.
- Apply program-generated knowledge of human factors to improve selection and training of aviation system personnel.
- Examine effective roles for pilots and how those roles are best supported by allocation of functions between human operators and automation.
- Address human automation integration issues regarding the certification of pilots, procedures, training, maintenance, and equipment associated with enhanced CNS/ATM operations necessary to achieve NextGen capabilities.

Customer/Stakeholder Involvement: Program researchers work directly with colleagues in FAA, other government agencies, academia, and industry to support the following R&D programs and initiatives:

- NASA's Aviation Safety Program.
- The FAA's Voluntary Safety Program Office initiatives including Advanced Qualification Program (AQP), Flight Operations Quality Assurance (FOQA), and Aviation Safety Action Program (ASAP).
- The FAA/Industry Safer Skies initiative – analyzes U.S. and global data to find the root causes of accidents and proposes the means to prevent their occurrence.
- The FAA Research, Engineering and Development Advisory Committee – Representatives from industry, academia, and other government agencies annually review the activities of the program and provide advice on priorities and budget.

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

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

Accomplishments: The program's accomplishments include:

FY 2007:

- Completed development of human factors Certification Job Aid for FAR Parts 25 and 23 flight decks.
- Developed reference manual describing pilot awareness, knowledge and skill elements for Technically Advanced Aircraft.
- Developed a "best practices" document to inform the aviation community of potential problems associated with fatigue in combination with environment when performing liquid penetrant and fluorescent magnetic particle inspection.
- Evaluate how well civilian, instrument rated helicopter pilots maintain control of their aircraft after inadvertent VFR flight into IMC across a variety of flight altitudes and speeds.
- Provided an understanding of how broadband technology may aid maintenance personnel in their tasks and improve the work environment
- Completed an international survey of maintenance human factors programs in maintenance organizations focused on training, error management, fatigue management, and other issues.
- Performed a field study of maintenance human factors issues in UAV systems to identify areas that will need new maintenance human factors guidance.
- Completed technical guidance for updating regulations regarding allowable manual control forces in aircraft control systems.
- Provided technical information for training and regulatory guidance consideration on pilot training and experience with transport category rudder control systems.
- Provided human factors guidance for design and use of synthetic vision systems.
- Completed initial technical assessment and recommendations for sensory deficiencies in the operation of unmanned aircraft.
- Provided guidance for the development of proficiency standards for very light jets.
- Completed electronic flight bag industry review, providing information on design characteristics, FAA approvals, and environmental qualifications.
- Completed validation study on the effectiveness of the Full Flight Training Simulator.
- Completed phase one study to identify current industry air carrier training issues.

FY 2006:

- Provided guidance for precision visual flight rules and simultaneous non-interfering routes that will allow rotorcraft with global positioning system navigation capabilities to stay within narrow, defined horizontal airspace limits while operating under visual flight rules.
- Completed detailed general aviation fatal accident human error analysis by using the Human Factors Analysis and Classification System to determine how often each error type is in the causal chain of events and finding the exact types of errors committed that lead to a fatal accident.
- Developed an industry-wide benchmark for aviation maintenance inspection. This computer based inspection training program will standardize inspection training processes in the general aviation industry.
- Provided guidance on an acceptable vision standard for personnel involved in nondestructive inspection and testing and visual inspection of aircraft and aircraft components.

- Improved a Line Operations Safety Audit (LOSA) methodology that has been adopted by the International Civil Aviation Organization (ICAO) to help air carriers identify human-centered safety vulnerabilities.
- Completed a Flight Plan Target automation report specifying pilot proficiency standards for Technically Advanced Aircraft.

FY 2005:

- Developed a manual adopted for use by ICAO that addresses appropriate human factors considerations in designing flight deck operating documents.
- Produced human factors design and evaluation considerations for aviation applications, such as electronic flight bags and head-up displays in air transports.
- Completed initial mapping of flight data parameters onto AQP qualification standards.
- Developed initial performance models for the use of automation in air carrier cockpits.
- Developed and validated a proceduralized pilot Crew Resource Management (CRM) training and assessment system.

FY 2004:

- Developed an inexpensive, reliable method to measure night vision goggle cockpit lighting compatibility.

FY 2008 MAJOR ACTIVITIES AND ANTICIPATED ACCOMPLISHMENTS:

Information Management and Display

- Develop guidance to address human factors issues associated with using synthetic vision for primary and multifunction displays.
- Provide human factors guidance for electronic flight bag certification, operational approval, and training.
- Develop proactive methods for general aviation data collection to facilitate risk assessment and accident prevention.
- Identify human factors issues in instrument procedures design.
- Identify pattern of aircrew error associated with general aviation accidents where flight from VFR into instrument meteorological conditions is a factor.
- Continue developing maintenance human factors “best practices” documents, practical tools, and surveillance tools to aid industry.
- Continue to identify factors that can maximize the likelihood of successful implementation of ASAP for aircraft maintenance programs.

Human-Centered Automation

- Develop certification guidelines for integrated technology in general aviation cockpits.
- Develop human factors guidance for ADS-B certification and operational approval.
- Distribute automation knowledge assessment, diagnosis and remediation methodology for air carrier training guidance development.
- Explore improved automation training for pilots, reflecting results from industry survey.
- Begin the investigation of automation and new technology impacts on maintenance process, safety, technician skills, and need for regulation.

Human Performance Assessment

- Develop guidance stipulating the minimum see-and-avoid optical system needed for an unmanned aerial vehicle ground station operator to detect an approaching airborne object.
- Provide human factors guidance for the operation of unmanned aerial vehicles within the NAS.
- Complete detailed general aviation fatal accident human error analysis, using Human Factors Analysis and Classification System, to determine how often each error type is the "initiating" error in the causal chain of events and what are the exact types of errors committed that lead to a fatal accident.
- Develop improved methods to record and analyze flight safety data to reduce the likelihood of air carrier incidents and accidents.
- Investigate methods to encourage air carriers to expand ASAP programs to other segments of operations.
- Study the decision process of voluntary safety teams to improve the accuracy and reliability of safety event classifications.
- Develop advanced data analysis methods for linking various voluntary safety data sources.

Selection and Training

- Validate simulator training requirements for low-time regional pilots.
- Identify the impact of selected weather-related training products on knowledge and behavior of general aviation pilots related to weather accident causes.
- Investigate methods to improve unexpected event pilot training.
- Investigate methods to incorporate safety data into scenario-based pilot training.
- Develop advanced methods to improve training and procedures for flight deck distractions during critical flight phases.
- Develop methods to incorporate situationally-oriented flight tasks into scenario-based training.
- Identify what human factors maintenance unmanned aircraft issues need be addressed so that FAA can begin to develop policies, procedures, and approval processes to enable operation of unmanned aerial vehicles.
- Develop educational materials that will help reduce general aviation accidents.
- Develop and evaluate off-the-shelf advanced technologies, such as virtual reality, for training and evaluation in aviation maintenance.
- Provide guidance and develop educational tools for the FAA/Industry Training Standards program that will integrate different technologies into any aircraft platform.
- Develop guidance for maintenance and operator training and qualification requirements related to the operation of unmanned aerial vehicles within the NAS.
- Investigate methods to improve new-hire pilot training for high density operations; develop guidelines.

FY 2009 PROGRAM REQUEST:

The program will continue to focus on providing technical information and advice to improve pilot, inspector, maintenance technician, and aviation system performance. The emphasis will remain on developing guidelines, tools, and training to enhance error capturing and mitigation capabilities in the flight deck and maintenance environments, and on developing human factors tools to ensure that human performance considerations are adequately addressed in the design, certification, and operational approval of flight decks, equipment, and procedures. Additional emphasis will be placed on encouraging maintenance shops and repair stations to have human factors maintenance programs and to offer maintenance human factors training.

Information Management and Display

- Develop guidance to address human factors issues associated with using synthetic vision for primary and multifunction displays.
- Provide human factors guidance for electronic flight bag certification, operational approval, and training.
- Develop proactive methods for general aviation data collection to facilitate risk assessment and accident prevention.
- Develop human factors guidance for instrument procedures design.
- Report on methodology to encourage air carriers to implement Aviation Safety Action Program across operations.
- Investigate methods to apply Voluntary Aviation Safety Information-Sharing Program taxonomies to pilot training data.

Human-Centered Automation

- Develop certification guidelines for integrated technology in general aviation cockpits.
- Develop human factors guidance for ADS-B equipment certification operational approval.
- Develop improved automation training methods for new hire pilots.
- Continue the investigation of automation and new technology impacts on maintenance process, safety, technical skills, and need for regulation. Begin formulation of strategies to deal with these issues.
- Determine training vulnerabilities and investigate advanced training methods to address issues identified in automation survey of pilots.

Human Performance Assessment

- Develop guidance stipulating the minimum see-and-avoid optical system needed for an unmanned aerial vehicle ground station operator to detect an approaching airborne object.
- Provide human factors guidance for the operation of unmanned aerial vehicles within the NAS.
- Identify intervention strategies to either prevent or reduce the likelihood of general aviation accidents.
- Develop improved methods to record and analyze flight safety data to reduce the likelihood of air carrier incidents and accidents.
- Distribute recommendations on establishing effective decision-making strategies within voluntary safety program teams.
- Distribute report on financial analysis methods to determine the cost of FOQA events.
- Explore methods for advancing the linking of voluntary safety data sources.

Selection and Training

- Validate simulator training requirements for both low-time regional pilots and pilots transitioning to new aircraft.
- Develop training tools to quickly incorporate safety data into scenario-based pilot training and evaluation.

- Report on training methods to prepare new-hire pilots to handle unexpected events in high density operations.

KEY FY 2009 MAJOR ACTIVITIES AND ANTICIPATED ACCOMPLISHMENTS:

Information Management and Display

- Develop guidance to address human factors issues associated with using synthetic vision for primary and multifunction displays.
- Provide human factors guidance for electronic flight bag certification, operational approval, and training.
- Develop proactive methods for general aviation data collection to facilitate risk assessment and accident prevention.
- Develop human factors guidance for instrument procedures design.
- Complete guidance on communicating maintenance ASAP derived actions and recommendations using the web-based ASAP safety-information and program-tracking tool.
- Develop maintenance human factors "best practices" documents, practical tools, and surveillance tools to aid industry.
- Report on methodology to encourage air carriers to implement ASAP across operations.
- Investigate methods to apply VASIP taxonomies to pilot training; prepare phase I report.

Human-Centered Automation

- Develop certification guidelines for integrated technology in general aviation cockpits.
- Develop human factors guidance for ADS-B equipment certification and operational approval.
- Update automation knowledge assessment and diagnosis tool, and update remediation methodology and training guidelines; distribute report to industry.
- Develop new guidelines for training automation skills for new-hire pilots.
- Identify human error risks and mitigation strategies associated with new air carrier operations.
- Investigate automation and new technology impacts on maintenance human factors process, safety, technician skills, and need for regulation. Results can become the basis for strategies for dealing with maintenance of automation and new technologies as well as identifying best practices and tools for dealing with the issues identified.
- Based on results of the earlier air carrier pilot automation survey, determine training vulnerabilities and investigate advanced training methods to address the topic areas.

Human Performance Assessment

- Develop guidance stipulating the minimum see-and-avoid optical system needed for an unmanned aerial vehicle ground station operator to detect an approaching airborne object.
- Provide human factors guidance for the operation of unmanned aerial vehicles within the NAS.
- Distribute recommendations on establishing effective decision-making strategies within voluntary safety program teams.
- Provide a report on current LOSA analysis results.
- Distribute a report on financial analysis methods to determine the cost of FOQA events.
- Explore methods for advancing the linking of voluntary safety data sources.

Selection and Training

- Validate simulator training requirements for both low-time regional pilots and pilots transitioning to new aircraft.
- Test the application of advanced training technology, like virtual reality, for maintenance.
- Report on methods to link Threat and Error Management ASAP classification schemes to LOSA and AQP data.
- Develop training tools to quickly incorporate safety data into scenario-based pilot training and evaluation.
- Update training guidelines and procedures for flight deck distractions during critical flight phases.
- Develop new methods for improved jet upset training.
- Explore methods to overcome the expectancy effect in pilot simulator training and evaluation.
- Develop and validate standards to evaluate training methodologies proposed by air carriers.
- Report on training methods to prepare new-hire pilots to handle unexpected events in high-density operations.

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2007)	$203,863
FY 2008 Appropriated	9,200
FY 2009 Request	7,465
Out-Year Planning Levels (FY 2010-2013)	30,470
Total	$250,998

Budget Authority ($000)	**FY 2005 Enacted**	**FY 2006 Enacted**	**FY 2007 Enacted**	**FY 2008 Enacted**	**FY 2009 Request**
Contracts:					
Flight deck/Maintenance/System Integration Human Factors	8,157	5,338	4,954	5,957	4,714
Personnel Costs	2,664	2,626	2,902	3,066	2,587
Other In-house Costs	879	135	143	177	164
Total	**11,700**	**8,099**	**7,999**	**9,200**	**7,465**

OMB Circular A-11, Conduct of Research and Development ($000)	**FY 2005 Enacted**	**FY 2006 Enacted**	**FY 2007 Enacted**	**FY 2008 Enacted**	**FY 2009 Request**
Basic	0	0	0	0	0
Applied	11,700	8,099	7,999	9,200	7,465
Development (includes prototypes)	0	0	0	0	0
Total	**11,700**	**8,099**	**7,999**	**9,200**	**7,465**

A11g – Flight Deck/Maintenance/System Integration Human Factors Product and Activities	**FY 2009 Request** ($000)	**Program Schedule**					
		FY 2008	**FY 2009**	**FY 2010**	**FY 2011**	**FY 2012**	**FY 2013**
081-110 Flightdeck/Maintenance/System Integration Human Factors							
Selection and Training	**$1,514**						
Develop training guidelines to improve new-hire pilot training for high density operations		◆	◊				
Validate simulator training requirements for low-time regional pilots and pilots transitioning to new aircraft		◆	◊	◊			
Develop training for critical skill retention		◆	◊	◊	◊	◊	◊
Provide guidance/develop educational tools for FAA/Industry Training Standards program that will integrate technologies into any aircraft platform		◆	◊	◊			
Develop and evaluate off-the-shelf advanced technologies, such as virtual reality, for training and evaluation in aviation maintenance		◆	◊				
Develop guidance on how advanced technology can be used for inspection training and reducing errors in general aviation maintenance		◆	◊	◊			
Human Performance Assessment	**$1,000**						
Develop recommendations for effective decision-making among voluntary safety program teams		◆	◊	◊	◊	◊	◊
Provide human factors guidance for the operation of unmanned aerial vehicles within the NAS		◆	◊	◊			
Identify intervention strategies to either prevent or reduce the likelihood of general aviation accidents		◆	◊	◊	◊		
Human-Centered Automation	**$950**						
Develop human factors guidance for ADS-B certification and operational approval		◆	◊	◊	◊		
Develop certification guidelines for integrated technology in general aviation cockpits		◆	◊	◊	◊	◊	◊
Investigate automation and new technology impacts on maintenance process, safety, technician skills, and need for regulation.		◆	◊	◊			
Information Management and Display	**$1,250**						
Develop guidelines for instrument procedures design		◆	◊	◊	◊	◊	◊
Develop proactive methods for general aviation data collection		◆	◊	◊			
Develop guidance to address human factors issues associated with using synthetic vision for primary and multifunction displays		◆	◊				
Develop maintenance human factors "best practices" documents, practical tools, and surveillance tools to aid industry		◆	◊				
Identify factors that can maximize the likelihood of successful implementation of ASAP for aircraft maintenance programs		◆	◊	◊			
Personnel and Other In-House Costs	**$2,751**						
Total Budget Authority	**$7,465**	**$9,200**	**$7,465**	**$7,580**	**$7,604**	**$7,630**	**$7,656**

◆ - Activities Accomplished ◇ - Activities Planned

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

FAA Budget Appropriation	Budget Item	Program Title	Budget Request
R,E&D	A11.h.	Aviation Safety Risk Analysis/System Safety Management	$12,488,000

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

Intended Outcomes: The Aviation Safety Risk Analysis/System Safety Management Program (formerly known as the Aviation Safety Risk Analysis Program) helps achieve FAA's strategic goal of increasing aviation safety by promoting and expanding safety information sharing and safety risk management initiatives efforts. The program develops risk management methodologies, prototype tools, technical information, and safety management system procedures and practices that will improve aviation safety. In addition, the program aims to develop an infrastructure that enables the free sharing of de-identified, aggregate safety information that is derived from various government and industry sources in a protected, aggregated manner. It also conducts research to evaluate proposed new technologies and procedures, which will improve safety by making relevant information available to the pilot during terminal operations.

Agency Outputs: The program will develop an infrastructure that enables the free sharing of de-identified, safety information that is derived from various government and industry sources in a protected, aggregated manner. In addition, the program is providing methodologies, research studies, and guidance material that provide aviation safety inspectors, aircraft certification engineers, analysts, and managers the capabilities of systematically assessing potential safety risks and applying proactive solutions to reduce aviation accidents and incidents. The program is also conducting research and analysis to maintain the desired level of safety while accommodating the need for more efficient use of the terminal area.

Research Goals: To reduce the number of aviation accidents and incidents by developing a secured safety information and analysis system that provides access to numerous databases, maintains their currency, enables interoperability across their different formats, provides the ability to identify future threats, conducts a causal analysis of those threats, and recommends solutions.

- By 2011, develop automated tools to monitor each database for potential safety issues and to analyze disparate data drawn from multiple sources, enhancing discovery, identification, and evaluation of safety risks.
- By 2012 develop advanced software capable of automatically gathering information from other databases and providing safety management personnel with information integrated with their day-to-day operations and duties.
- By 2013, expand the secured safety information and analysis system to other aviation users beyond the commercial operators.

To reduce the risk for passengers and crews and enhance the traffic control process in the terminal area operations, pilot-in-the-loop simulation evaluations and operational flight data analysis will be conducted.

- By 2010, characterize risks associated with undesired laser cockpit illumination, providing FAA with data to determine mitigation strategies.
- By 2011, complete an evaluation of air traffic and flight procedures for terminal area operations by using pilot-in-the-loop flight simulator.

- By 2012, develop methods to model unusual attitude encounters outside the normal operating envelope, allowing FAA to approve advanced flight simulators that more realistically model the behavior of an actual aircraft.
- By 2012, identify new navigation technologies and data requirements for the development of new procedures to enhance the capacity and safety of the terminal area.
- By 2013, identify contributing factors and develop models for landing performance of selected make, model, and series aircraft using standard operating practices to improve the safety and capacity in terminal areas.

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

- Subcommittee on Aircraft Safety of the FAA Research, Engineering and Development Advisory Committee – representatives from industry, academia, and other government agencies annually review the program's activities.
- Technical Community Representative Groups – FAA representatives apply formal guidelines to ensure that the program's research projects support new rule making and the development of alternate means of compliance with existing rules.
- JPDO, Safety Working Group – a national-level integrated safety management framework that addresses all facets of the air transportation system, building safety design assurance into operations and products.
- Commercial Aviation Safety Team – a FAA/industry collaborative effort to develop and implement data-driven safety initiatives.

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

- National Aeronautics and Space Administration via collaborative agreements to integrate advanced research text and digital analysis products into the Aviation Safety Information and Analysis Sharing (ASIAS) research efforts.
- The Civil Aviation Authority of the Netherlands to conduct joint research on aviation system safety initiatives via a Memorandum of Cooperation.
- Technical expertise from air carriers to provide industry reviews and recommendations regarding safety and efficiency of terminal area operations as well as air carriers' cooperation with data sharing agreements and governance models that allow for the free sharing of aviation data in accordance with approved voluntary safety information sharing agreements.

Accomplishments: Significant accomplishments from prior years include:

Risk Management Decision Support

FY 2007:

- Produced technical descriptions of the various business relationships between Title 14 Code of Federal Regulations (14 CFR 121) operators and 14 CFR 145 repair stations; the models will be used to identify the hazards and assess the risks involved these types of relationships.
- Completed a prototype software tool that contains an integrated framework and methodology for the identification, classification, and assessment of aviation maintenance and flight operations hazards.

FY 2006:

- Released a working prototype of an integrated framework that describes the methodology for identification, classification, and assessment of aviation system hazards and risks.

- Developed a preliminary methodology which provides a baseline assessment of the current safety oversight for effectiveness, efficiency, and sustainability and identifies data inputs and could provide metrics such as the responsiveness of the air carriers to corrective and preventive actions, effects of oversight on safety precursors, inspection output and inspector workload and readiness.

Aviation Safety Information and Analysis Sharing

FY 2007:

- Released first draft of the ASIAS Concept of Operations (CONOPS) that is focused on the new data sharing concepts among commercial aviation stakeholders.

Aircraft Maintenance - Maintainability and Reliability

FY 2007:

- Proposed a new quality management system to perform and monitor tool calibration at maintenance facilities; the new system will improve safety by reducing aircraft maintenance errors due to the use of out-of-tolerance tools.

FY 2005:

- Completed enhancements to the Maintenance Malfunction Information Reporting (MMIR) System with capability to collect usage and flight profile data – the helicopter industry and FAA are using the MMIR data to improve maintenance reliability and product design.

FY 2004:

- Provided technical data and recommendations for designing an effective repair station training program, including the recommended number of hours and topics for training mechanics, managers, supervisors, and inspectors. The FAA issued Advisory Circular (AC) 145-10 "Repair Station Training Program" in July 2005.

FY 2003:

- Developed an all-encompassing quality audit and quality assurance system that is referenced in AC 120-79, "Developing and Implementing a Continuing Analysis and Surveillance System (CASS)" that provides guidance to air operators in meeting the CASS requirement of 14 CFR Parts 121.373 and 135.431.

Safety Analysis Methodology

FY 2007:

- Completed a methodology to provide a different level of certification credit for design features intended to reduce flight crew errors.

FY 2005:

- Provided technical data on standard probabilities of certain environmental and operational conditions to support transport airplane certification or safety assessment purposes.

Terminal Area Safety

FY 2007:

- Completed flight evaluation of the critical terminal area situations under which red Land and Hold Short Operations lights must be illuminated and extinguished during high capacity operations at an airport by using pilot-in-the-loop flight simulation.

- Developed assessment tools and procedures to evaluate pilot workload during various flight conditions by using the LifeShirt® technology in simulated flight operations.

FY 2006:

- Developed methods to identify commercial aircraft touchdown points during commercial operations by using ILS or non-ILS information, these methods will aid in understanding causes of aircraft overruns and runway excursions.

FY 2005:

- Provided measures of pilot reaction to laser illumination collected using FAA's B-737 flight simulator to support AC 70-1 "Outdoor Laser Operations" and AC 70-2 "Reporting of Laser Illumination of Aircraft".

FY 2008 MAJOR ACTIVITIES AND ANTICIPATED ACCOMPLISHMENTS:

Aviation Safety Information and Analysis Sharing

- Complete the ASIAS CONOPS that is focused on the new data sharing concepts among commercial aviation stakeholders.
- Develop ASIAS architecture for the implementation of emerging technologies and system to support the sharing of information between commercial aviation stakeholders.
- Develop automated tools to monitor databases for potential safety issues.
- Develop prototype ASIAS system and associated reports that show the benefit of using diverse textual and digital data sets for analyzing commercial aviation safety metrics and enhancements.
- Conduct analytical studies using ASIAS and other aviation safety data to (a) address hazards and risks of operating aircraft in the National Airspace System, and (b) to determine the effectiveness of FAA recommended and industry implemented safety enhancements.

Risk Management Decision Support

- Release a prototype decision support system that provides the FAA with improved certificate management and oversight capabilities. The major products will be identification of databases within FAA purview, redesigned databases, and possible location of and access to existing databases needed to populate the described methodology.

Aircraft Maintenance - Maintainability and Reliability

- Complete technical data for the purpose of preparing standards for carbon monoxide detection devices and inspection methods to determine the integrity of exhaust systems.

Safety Analysis Methodology

- Determine injury ratios for well-defined unsafe conditions (e.g., structure failure, electrical system failure, landing gear vibration, power plant failure, and so forth) on aircraft systems or components.

Terminal Area Safety

- Evaluate the use of pilot-in-the-loop flight simulators for training of advanced maneuvers related to terminal area operations.
- Develop testing procedures and requirements to identify required navigational performance (RNP) constraints related to terminal area operations.
- Evaluate air traffic and flight procedures for terminal area operations by using the pilot-in-the-loop flight simulator.

- Evaluate devices and risks associated with undesired laser cockpit illumination.
- Analyze operational landing distance performance of selected aircraft make/model/series.
- Develop tools to model the safety hazards of rejected landing procedure and to identify possible training solutions.

FY 2009 PROGRAM REQUEST:

Ongoing Activities

Government, industry, and academia aviation safety subject matter experts will be invited to demonstrate a working prototype of a network-based integration of information extracted from diverse, distributed sources. The research will continue to develop innovative, advanced tools and methodologies that will for the first time be able to convert and integrate aviation safety data that is currently distributed across multiple organizations and archives into information on the operational performance and safety of the aviation system. Using ASIAS and other aviation safety data, analytical studies to identify safety issues and verify mitigation and safety enhancements will continue. Research and analysis will continue to ensure that the FAA maintains a desired level of safety while accommodating the need for more efficient use of the terminal area.

New Initiatives

No new initiatives are planned for FY 2009.

KEY FY 2009 MAJOR ACTIVITIES AND ANTICIPATED ACCOMPLISHMENTS:

Aviation Safety information Analysis and Sharing (ASIAS)

- Expand ASIAS architecture to include the sharing of air traffic information and air carrier information among industry stakeholders.
- Continue development of automated tools to monitor databases for potential safety issues.
- Expand prototype system to include the concepts of sharing information and applications among industry stakeholders from an enterprise-level, allowing diverse industry stakeholders to analyze data on an industry-wide basis rather than individual organizational level. The prototype system will contain a technical process to query de-identified safety data from any participating airline Flight Operations Quality Assurance or Aviation Safety Action Program, aggregate it through a distributed database and make it accessible to appropriate industry stakeholders.
- Conduct analytical studies, e.g., aircraft hazard analysis, determination of risk values for potential unsafe conditions, and flight crew intervention design credit, using ASIAS and other aviation safety data. .
- Develop methods and risk models to evaluate advanced aircraft systems and component integration.

Terminal Area Safety

- Complete testing procedures and requirements to identify RNP constraints related to terminal area operations.
- Evaluate air traffic and flight procedures for terminal area operations by using the pilot-in-the-loop flight simulator.
- Analyze the operational landing distance performance of selected aircraft make/model/series.
- Evaluate devices and risks associated with undesired laser cockpit illumination.

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2007)	$69,398
FY 2008 Appropriated	9,517
FY 2009 Request	12,488
Out-Year Planning Levels (FY 2010-2013)	49,787
Total	$141,190

Budget Authority ($000)	**FY 2005 Enacted**	**FY 2006 Enacted**	**FY 2007 Enacted**	**FY 2008 Enacted**	**FY 2009 Request**
Contracts:					
Aviation Safety Risk Analysis	6,260	3,303	3,232	6,402	9,608
Personnel Costs	2,091	1,494	1,947	2,892	2,669
Other In-house Costs	220	86	113	223	211
Total	**8,571**	**4,883**	**5,292**	**9,517**	**12,488**

OMB Circular A-11, Conduct of Research and Development ($000)	**FY 2005 Enacted**	**FY 2006 Enacted**	**FY 2007 Enacted**	**FY 2008 Enacted**	**FY 2009 Request**
Basic	0	0	0	0	0
Applied	8,571	4,883	5,292	9,517	12,488
Development (includes prototypes)	0	0	0	0	0
Total	**8,571**	**4,883**	**5,292**	**9,517**	**12,488**

A11h - Aviation Safety Risk Analysis/System Safety Management Product and Activities	FY 2009 Request ($000)	Program Schedule					
		FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013
060-110 Aviation Safety Risk Analysis							
Risk Management Decision Support							
Release a prototype decision support system that provides the FAA with improved certificate management and oversight capabilities oversight capabilities		◆					
Aviation Safety Information Analysis and Sharing	$7,613						
Complete ASIAS Concept of Operations (CONOPS) focused on the new data sharing concepts among commercial aviation stakeholders.		◆					
Develop an architecture for ASIAS		◆	◊				
Develop automated tools to monitor databases for potential safety issues		◆	◊	◊	◊		
Develop prototype ASIAS system and associated reports		◆	◊	◊	◊	◊	
Conduct analytical studies using ASIAS and other aviation safety data		◆	◊	◊	◊	◊	◊
Develop methods and risk models to evaluate advanced aircraft systems and component integration.		◆	◊	◊	◊		
Aircraft Maintenance – Maintainability & Reliability							
Develop standards for carbon monoxide detection devices and inspection methods to determine the integrity of exhaust systems		◆					
Safety Analysis Methodology							
Determine the injury ratio for a limited number of well-defined unsafe conditions		◆					
Terminal Area Safety	$1,995						
Complete pilot-in-the-loop flight simulators for training of advanced maneuvers in terminal area operations		◆					
Develop testing procedures and requirements to identify RNP constraints		◆	◊				
Evaluate air traffic and flight procedures for terminal area operations by using pilot-in-the-loop flight simulator		◆	◊	◊	◊		
Evaluate devices and risks associated with undesired laser cockpit illumination		◆	◊	◊			
Identify contributing factors and develop models for landing performance of selected make/model/series aircraft using standard operating practices to improve the safety and capacity in terminal areas		◆	◊	◊	◊	◊	◊
Complete development of tools to model the safety hazards of rejected landing procedure and to identify possible training solutions.		◆					
Personnel and Other In-House Costs	$2,880						
Total Budget Authority	$12,488	$9,517	$12,488	$12,589	$12,497	$12,401	$12,300

◆ - Activities Accomplished ◇ - Activities Planned

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

FAA Budget Appropriation	Budget Item	Program Title	Budget Request
R,E&D	**A11.i.**	**Air Traffic Control / Technical Operations Human Factors**	**$10,469,000**

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

Intended Outcomes: The Air Traffic Control/Technical Operations (ATC/TO) Human Factors Program supports FAA strategic goals for increased safety, greater capacity, and organizational excellence by developing research products and promoting the use of those products to meet the future demands of the aviation system. This research examines the roles of controllers and maintainers at increased capacity levels and how those roles are best supported by allocation of functions between human operators and automation. The ATC/TO program generates requirements for human interface characteristics of future air traffic workstations. It is enhancing our understanding of the role that ATC supervisors play in mitigating operational errors and runway incursions. The program also provides material to reduce human error incidents associated with the performance of controllers, system maintainers, and others who fill important safety roles. In addition, researchers are determining effective methods to present weather information to air traffic specialists for severe weather avoidance and accident prevention, developing methods to select new air traffic service providers and maintainers so that the applicant screening process is valid, reliable, and fair, and improving human-system integration in a manner that allows controllers to manage an increased number of aircraft in a sector while reducing task loading.

The research program works to improve system safety by:

Developing:

- Methods to identify new potential human error problems as the air traffic service providers' roles and responsibilities change as a result of increasing automation levels.
- Organizational changes to transform the Technical Operations ATO safety culture.
- Effective methods to present air traffic specialists weather information for accident prevention through severe weather avoidance.

Improving:

- Supervisory best practices so that first-line ATC supervisors can implement effective methods that suppress the operational error rate and reduce existing error severity.
- Methods to select new air traffic service providers and maintainers so that the applicant screening process is valid, reliable, and fair.

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

Developing:

- Integrated workstations that allow air traffic service providers to meet increased service demand at a reduced staffing level.
- Methods to assess the value of proposed changes to workstations to determine if human-in-the-loop performance is enhanced to the required level.
- Advanced workstation concepts for airport traffic control towers that use automation and advanced technology to increase services, increase capacity, and decrease the cost of air traffic services.

Improving:

- Human-system integration in a manner that allows air traffic service providers and pilots to cooperatively manage traffic loads as cockpit technology and air traffic workstations are more closely connected to efficiently move NAS air traffic.
- Roles and responsibilities between air traffic service providers and pilots as technology evolves to meet future demands.

Agency Outputs: The Air Traffic Control/Technical Operations Human Factors Research Program provides leadership and products to motivate NAS evolution to assure that the system's human component will reliably perform to meet the flying public's needs.

Outputs include:

- Air traffic workstations and concepts that increase workforce productivity by identifying key workload factors that must be mitigated to enable the humans in the system to manage the future NAS traffic flow.
- Candidate technology evaluations that purport to provide a specified human-in-the-loop performance level or safety benefit when used by the ATO workforce.
- ATO safety culture transformation through research in the Technical Operations community to identify needed effective interventions to move the ATO toward a "Just Culture."
- Future air traffic service provider and maintainer personnel selection criteria to enhance screening process efficiency and effectiveness.

Research Goals:

- By FY 2009, complete the future en route workstation second development stage that demonstrates potential controller productivity and sector capacity increases.
- By FY 2009, identify efficient automation use and the sharing of responsibilities between air traffic service providers and NAS users such as pilots and dispatchers.
- By FY 2012, improve computer-human interface design to reduce information overload and resulting errors.
- By FY 2012, apply program-generated human factors knowledge to improve aviation system personnel selection and training.

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

- *Advanced Air Traffic Systems Requirements Group* – En Route and Terminal Service units as well as System Engineering in Operations Planning operational personnel and systems developers articulate human factors research requirements for measuring the proposed technology benefits to controllers and maintainers. FAA Flight Standards and Aircraft Certification organizations will participate in the research requirements definition associated with pilot/controller interface with air-ground integration weather aspects as the FAA moves toward a future NAS vision.
- *Individual and Team Performance Requirements Group* – ATO Safety, En Route, Terminal, Technical Operations and System Engineering service units participate to identify human performance research needs involving safety culture, human error hazard identification, age, operational errors, runway incursion prevention, and employee attitudes.
- *Technical Operations Requirements* Group – The Technical Operations, En Route, and Terminal service units recommend NAS infrastructure operational and maintenance research including ATC systems displays, controls, and maintainability features specification.

- *Personnel Selection and Training Requirements Group* – ATO Technical Training and Development, Human Resources, FAA Academy, Workforce Services, and the Financial Services groups address personnel selection, training, and retention including the ability to successfully screen applicants for controller positions and for reduced training cost and time.

R&D Partnerships:

- Collaborative research with NASA includes identifying future NAS human factors air-ground integration research issues as technology brings changes to flight deck capabilities.
- Collaboration with EUROCONTROL includes participation in semi-annual Air Traffic Management (ATM) Seminars, leadership of an Action Plan 15 Safety workgroup for human reliability, and ATM Safety Research symposia participation.
- Program personnel represent the agency in the Normal Operations Safety Survey (NOSS) Study Group of ICAO.
- The University of Texas has performed NOSS research at ATM facilities in New Zealand, Australia, Canada, and Finland with ICAO endorsement.
- Cooperative research grants are in place with Massachusetts Institute of Technology (MIT), St. Louis University, New Mexico State University, Texas Tech University, and American Institutes for Research.

Accomplishments: Program highlights include:

FY 2007:

- Completed simulations that evaluate capacity enhancements when en route workstations are provided with data communications and aircraft self-spacing and self-separation provisions.
- ATC safety alerts study completion in response to National Transportation Safety Board concerns that controllers are not responding properly to prevent mid-air collisions and controlled flight into terrain accidents.
- Tower situation display demonstration with integrated flight data to reduce display clutter and integrate tower controller tasks.
- Initiation of a tower controller external vision requirements study to support staffed virtual tower development with no direct airport surface view.
- Safety Culture improvement project expansion to more facilities enabling the technical operations community to improve safety
- Transfer of the National Air Traffic Professionalism Program (NATPRO) to the En Route service unit as a research product that is making the transition to the operational domain.
- Updated en route and terminal job task analyses and developed air traffic controller performance standards.

FY 2006:

- Explored human performance limitations to find controller workload limits using current technology and procedures as traffic levels increase.
- Completed an initial effort to transform the ATO work force safety culture.
- Initiated data collection to update the anthropometric database to guide maintenance workstation ergonomic design.
- Developed a maintenance domain alerts and alarms human factors design standard.
- Initiated development of a pre-screening alternative form for air traffic controller job applicants that are selected to take the Air Traffic Selection and Training (AT-SAT) test battery.

- Initiated a tower controller duties and functions task analysis to enhance the terminal training option method of selecting candidates.

FY 2005:

- Completed a proposed en route display systems performance analyses to determine if projected controller time and error savings were achievable.
- Performed a simulation that assessed the benefits of improved terminal weather displays for severe weather avoidance and demonstrated a potential six to 10 percent capacity enhancement.
- Developed a human error hazard analysis method for use in the early investment analysis stages to include the human error risk in the early requirement and decision process.
- Developed a safety audit method for air traffic controllers to manage risk during normal operations.

FY 2008 MAJOR ACTIVITIES AND ANTICIPATED ACCOMPLISHMENTS:

- Initiation of an advanced terminal workstation demonstration to increase terminal airspace throughput, respond to changes in aircraft mix in the terminal environment including very light jets and Unmanned Aircraft Systems, and decrease environmental impact.
- Conduct an advanced integrated en route controller workstation assessment to move toward the goal of demonstrating a 66 percent increase in controller efficiency.
- Develop initial requirements for an advanced TRACON workstation that will increase capacity by at least 30 percent.
- Demonstrate integrated tower electronic flight data handling human factors aspects as the initial phase of staffed virtual tower development.
- Complete supervisory best practices development to reduce runway incursions.
- Complete the first stage of transforming the safety culture of the Technical Operations organization and assess intervention effectiveness.
- Complete data collection for the technical operations work force anthropometric measurement database.
- Complete method validation to assign applicants to tower versus radar training.
- Assess new technology and advance automation impact on selection and training for future air traffic service providers and maintainers.
- Completed tower supervisor best practices for the prevention of runway incursions.
- Developed interim color vision test for air traffic controller evaluation.

FY 2009 PROGRAM REQUEST

The program will continue to provide research that addresses human performance issues in ATC systems acquisition, design, operation, and maintenance over the next several years. The development of human factors concepts for future air traffic workstations that will accommodate increases in air traffic. The proactive analysis of human error causal factors continues to be the focus of a portion of this research program.

Advanced Air Traffic Systems

- Defining the characteristics of methods to meet the goal in the National Aviation Research Plan (NARP) to increase en route controller efficiency by 66 percent including air-ground integration aspects.

- Investigating human factors challenges in terminal airspace to increase traffic flow and integrate new procedures and technology such as data communications and fuel-efficient approaches that are forecast to be part of trajectory based operations.
- Simulating traffic loads predicted for the 2015 period and assessing how automation should be used at the controller workstation to meet capacity goals.
- Develop the airport traffic control workstation concept with emphasis on maintaining the day VFR operational tempo under reduced visibility operations.

Individual and Team Performance

- Continue work in human error analysis and reporting by expanding the application of research in transformation of the ATO safety culture.
- Refresh research in controller fatigue to develop scheduling tools and other mitigation methods as countermeasures for fatigue as a result of controller shift rotations.

Advanced Technical Operations (TO) Systems

- Assessing methods to reduce the potential for human error in system maintenance to enhance NAS reliability and availability.
- Design and develop training system and job aid specifications that reduce the amount of time that technicians spend away from their job in training.

Personnel Selection and Training

- Perform a strategic job task analysis based on the NextGen Concept of Operations to determine the knowledge, skills and abilities that will be needed by service providers in the future NAS.
- Refine the air traffic selection processes using the results of the updated Job Task Analysis activities to derive measures of controller performance for use in selection, training, and system development.
- Identify the critical performance requirements of the NAS maintainer job and the skills required to effectively perform on-the-job to develop personnel selection criteria.
- Conduct a task analysis for selected Technical Operations functions to identify a set of knowledge and skills, equipment, technical data, and discrete/critical steps required for the development of job aids.

New Initiatives

New initiatives will focus on the terminal portions of the ATC system. The NAS architecture plan introduces several automation concepts including variable separation minima and continuous decent approaches as methods to use automation and decision support tools to increase services, increase capacity in response to changes in demand, and decrease the cost of air traffic services. The research will address advanced terminal workstations:

- Perform an analysis to determine the human factors aspects of changes to services in the terminal area that emerge through the introduction of technology such as data communications.
- Determine air-ground integration issues particularly as they affect roles and responsibilities of pilots and air traffic service providers when servicing an environment with mixed aircraft equipage.
- Develop an advanced workstation concept for the terminal area to assure that the air traffic service provider can manage an increase in traffic.

- Plan and prepare for simulations of advanced terminal workstation concepts to determine the displays, controls, communication needs, surveillance information, and flight data information required to provide services and assure safety in the terminal area.

KEY FY 2009 MAJOR ACTIVITIES AND ANTICIPATED ACCOMPLISHMENTS:

Advanced Air Traffic Systems

- Develop concept and design guidelines for standard automation platforms usable by controllers in converging TRACON and en route domains.
- Conduct simulations to determine the appropriate use of data communications in terminal airspace.
- Conduct an air-ground integration simulation regarding improved weather products at the controller workstation to enhance safety in the NAS.

Individual and Team Performance

- Develop the transition plan and educational material to transfer control of the technical operations safety culture project to a national level under operational management and funding.
- Develop a tool for human reliability analysis in collaboration with EUROCONTROL human factors experts to assess the impact of changes to air traffic management planned by both the US and European air traffic service providers.

Advanced Technical Operations (TO) Systems

- Deliver a human factors specification/standard for the design of TO workstations.
- Initiate a Human System Integration Study of the impact future air traffic maintenance concepts on the Technical Operations workforce.

Personnel Selection and Training

- Deliver the results of the strategic job task analysis to determine if changes to technology and operation of the NAS will demand a change to the selection and training of Air Traffic Service providers.
- Prepare strategic training analyses for new roles and responsibilities of Air Traffic Service providers in the future NAS.
- Undertake a task analysis for Technical Operations that provides a set of knowledge and skills, equipment, technical data, and discrete/critical steps required to perform tasks and develop job aid guidelines.

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2007)	$162,105
FY 2008 Appropriated	10,000
FY 2009 Request	10,469
Out-Year Planning Levels (FY 2010-2013)	44,500
Total	$227,074

Budget Authority ($000)	**FY 2005 Enacted**	**FY 2006 Enacted**	**FY 2007 Enacted**	**FY 2008 Enacted**	**FY 2009 Request**
Contracts:					
Air Traffic Control/Technical Operations	2,756	4,234	4,130	4,333	4,042
Personnel Costs	4,765	5,079	5,285	5,443	6,128
Other In-house Costs	1,870	245	239	224	299
Total	**9,391**	**9,558**	**9,654**	**10,000**	**10,469**

OMB Circular A-11, Conduct of Research and Development ($000)	**FY 2005 Enacted**	**FY 2006 Enacted**	**FY 2007 Enacted**	**FY 2008 Enacted**	**FY 2009 Request**
Basic	0	0	0	0	0
Applied	9,391	9,558	9,654	10,000	10,469
Development (includes prototypes)	0	0	0	0	0
Total	**9,391**	**9,558**	**9,654**	**10,000**	**10,469**

A11i – Air Traffic Control/Technical Operations Human Factors Product and Activities	FY 2009 Request ($000)	Program Schedule					
		FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013
082-110 Air Traffic Control/Technical Operations Human Factors							
Advanced Air Traffic Systems	**$1284**						
Develop low visibility tower display concepts			◊	◊	◊		
Develop common automation platform concept and guidelines			◊	◊	◊		
Conduct simulations to determine appropriate use of data communications in terminal airspace		◆	◊	◊	◊	◊	
Conduct simulation to assess improved weather products for controllers			◊	◊	◊	◊	
Individual and Team Performance	**$1,354**						
Transform the technical operations work force safety culture		◆	◊				
Develop Human Reliability Analysis tool		◆	◊				
Technical Operations (TO)	**$450**						
Develop human factors specification for TO workstations		◆	◊	◊	◊		
Conduct Human System Integration study of the impact of maintenance concepts on the Technical Operations workforce			◊	◊			
Personnel Selection and Training	**$954**						
Conduct Strategic job task analysis for air traffic personnel selection		◆	◊	◊	◊		
Conduct strategic training analysis for new air traffic roles and responsibilities in the future NAS		◆	◊				
Conduct job task analysis for Technical Operations supporting personnel selection criteria		◆	◊	◊	◊	◊	◊
Personnel and Other In-House Costs	**$6,427**						
Total Budget Authority	**$10,469**	**$10,000**	**$10,469**	**$10,768**	**$10,998**	**$11,240**	**$11,494**

◆ - Activities Accomplished ◇ - Activities Planned

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

FAA Budget Appropriation	Budget Item	Program Title	Budget Request
R,E&D	**A11.j.**	**Aeromedical Research**	**$8,395,000**

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

Intended Outcomes: The Aeromedical Research Program supports FAA's Flight Plan Goal for Increased Safety by:

- Investigating and analyzing injury and death patterns in civilian flight accidents and incidents to determine their cause and develop preventive strategies.
- Supporting FAA regulatory and medical certification processes that develop safety and health regulations covering all aerospace craft occupants and their flight environments.
- Recommending and developing equipment, technology, and procedures for optimal:
    - Evacuation and egress of humans from aerospace craft;
    - Dynamic protection and safety of humans on aerospace craft; and
    - Safety, security and health of humans on aerospace craft.

Research program outcomes include improved safety, security, protection, survivability and health of aerospace craft passengers and aircrews. The Aeromedical Research Program supports FAA's Flight Plan goals to reduce the commercial fatal accident rate and the number of general aviation fatal accidents by:

- Exploiting new and evaluating existing bioaeronautical guidelines, standards, and models for aerospace craft cabin equipment, procedures and environments.
- Providing research data to serve as the basis for new regulatory action in evaluation of existing regulations to continuously optimize human performance and safety at a minimum cost to the aviation industry.
- Analyzing pilot medical and flight data, information from accidents and incidents, and advanced biomedical research results to propose standards and assess certification procedures that optimize performance capability.
- Evaluating the complex mix of pilot, flight attendant and passenger activities in a wide range of environmental, behavioral, and physiological situations to propose standards and guidelines that will enhance the health, safety, and security of all aerospace travelers.

Agency Outputs: The Civil Aerospace Medical Institute (CAMI) is uniquely positioned to exploit new and evaluate existing bioaeronautical guidelines, standards, and models for aerospace craft cabin equipment, procedures, and environments. Aeromedical research serves as the basis for new regulatory action and evaluation of existing regulations to continuously optimize human performance and safety at a minimum cost to the aviation industry. This research program analyzes pilot medical and flight data, information from accidents and incidents, and advanced biomedical research results to propose standards and assess certification procedures that optimize performance capability. The complex mix of pilot, flight attendant, and passenger activities in a wide range of environmental, behavioral, and physiological situations is evaluated to propose standards and guidelines that will enhance the health, safety, and security of all aerospace travelers.

Research Goals:

- By FY 2008, publish an assessment of the clarity and utility of signs and symbols used in passenger safety information. Research directly supports certification and harmonization.

- By FY 2009, develop enhanced medical/toxicological intervention methodologies to support standards and guidelines that will enhance the health, safety, and security of pilots, flight attendants and passengers.
- By FY 2010, establish fact-based criteria for the design of occupant restraint systems that will support occupant crash protection that is equivalent to the aircraft structure.
- By 2012, accomplish experimental projects in support of the following regulatory and certification operations:
    - Integrate analysis of biomedical, toxicological and molecular biological factors and stressors in uneventful flight and in aerospace craft incidents and accidents.
- Developing quantitative bioengineering criteria related to:
    - Optimum aerospace craft seat and restraint system certification.
    - Enhanced egress, flotation and onboard life support/rescue equipment certification.
- Developing quantitative bioaeronautical data associated with:
    - Regulatory oversight of health, safety and security risks for flight deck, cabin crew, and other occupants.
    - Aerospace radiation and environmental factors and their threat to all aerospace craft occupants.
    - Bioaeronautical, bioengineering and performance factors required to support cabin evacuation certification.
- Developing quantitative biomedical and performance criteria and recommendations to support development of:
    - Optimum life support equipment, emergency medical equipment, and operational procedures certification.
    - Aircrew medical standards, assessment/certification procedures, and pilot special medical issuance.

Customer/Stakeholder Involvement: The Aeromedical Research Program:

- Directly supports the bioaeronautics agenda set forth in the 2008 National Aviation Research Plan.
- Provides research for FAA, European Aviation Safety Authority and Transport Canada under the Aircraft Cabin Safety Research Plan. This is a coordinated, living plan to maximize the cost/benefit of aerospace craft cabin safety research nationally and internationally.
- Supports multi-year collaborative studies by FAA and other government and industrial entities to evaluate flight crew and passenger symptomatology, disease, and impairment.

R&D Partnerships: Staff members collaborate with and hold memberships, fellowships, and leadership positions in the following scientific, medical, and bioengineering societies associated with aerospace medicine and safety:

- Cabin Safety Harmonization Working Group.
- Seat Certification Streamlining Effort.
- The National Safety Council.
- Society of Automotive Engineers committee addressing safety research related to the work of this program.
- Aerospace Medical Association.
- Civil Aviation Medical Association.
- Professional Aeromedical Transport Association.

- American Society of Mechanical Engineers.
- American Opthomological Society.
- Direct collaboration with the DoD and NASA on crashworthiness, in-flight turbulence, aerospace medicine, ocular injury from lasers, and exposure to cosmic radiation.
- Participates in NATO aerospace medical advisory groups, the European Union, and many independent scientific organizations and academic institutions.
- Develops cooperative research and development agreements with industry to ensure collaborative projects benefiting both FAA and the aviation industry.
- Established National Research Council (NRC) postdoctoral associates to conduct research in molecular biology and environmental physiology at the Civil Aerospace Medical Institute.
- Collaborated academically with over 30 students/faculty members annually participating in aeromedical research.

Accomplishments:

FY 2007:

- Determined the distribution of fluoxetine, vardenafil, glucose, hemoglobin A1c, and sedating antihistaminics levels in postmortem cases from aviation accidents.
- Validated the differential expression of select biologically interesting genes discovered by microarray analysis during the course of an alcohol study using amplified RNA.
- Determined molecular changes as a result of decreased cabin oxygen levels at altitudes with significance to both the aviation industry and military pilots.
- Determined the clinical aspects of radiation exposure resulting from a terrorist attack, estimated the radiation levels in low-earth orbits, including radiation in Van Allen radiation belts, and estimated contribution of alpha particles from the sun to radiation levels at specific flight-altitudes and latitudes, during solar particle events.
- Evaluated atrial fibrillation in civil aviation.
- Compared personality inventories used in aviation research data.
- Developed cabin evacuation design computer model for very large transport aircraft and developed passenger management strategies using research data from flight attendant location trials.
- Conducted research to assess passenger safety awareness, evaluated the comprehensibility of graphical symbols for use on signs and placards aboard transport aircraft, and evaluated presentation media for maximum effectiveness in passenger safety briefings.
- Assessed head/neck injury potential for various aircraft interiors; assessed the injury potential in aircraft side-facing seats, and provided engineering/biodynamic requirements to support revision to TSO-C100 and SAE AS5276.
- Initiated collaborative research with industry partners to develop modeling strategies and validation techniques applicable to aircraft seat certification by analysis.
- Provided recommendations for life support equipment and medical requirements in civilian spacecraft
- Assessed risk of extended flight at altitudes less than 25,000 feet above sea level.
- Reviewed accidents involving Commemorative Air Force Aircraft 1968 to 2005.
- Evaluated design requirements for pulse oxygen systems to support development of engineering certification criteria.
- Evaluated the medical aspects of extending first-class FAA medical certificate for pilots under age 40 to 12 months.

- Developed software and procedures to support quality assurance evaluation of airman medical records.
- Presented analysis of civilian air show accidents.
- Evaluated the effectiveness of simulators in upset recovery training.
- Developed an Aircraft Accident/Injury and Autopsy Data System (AA-IADS) to provide injury description and injury mechanisms analysis to support the development of prevention/mitigation strategies.
- Evaluated aircraft windscreen transmittance characteristics as they relate to emerging laser technologies employed in the NAS, and evaluated potential vision protection modalities and/or procedures available to civilian aviators and ground-crew personnel. .

FY 2006:

- Completed gene expression research review to identify fatigue in collaboration with the US Air Force.
- Conducted biodynamic evaluations to assess the head/neck injury potential relative to head impact with various aircraft interior structures. Research included initial evaluations of lap belt and shoulder strap mounted airbags to determine their potential for head/neck injury mitigation.
- Developed mathematical techniques to assess the performance of the above-mentioned test devices and aid the development of advanced modeling capability. Development of computer-modeling methods will provide faster, safer, more cost-effective aircraft certification decisions.
- Provided advisory materials for enhancing human health relative to in-flight cosmic and solar radiation exposures and cabin air quality via the internet and through other widely available media for all participants in aerospace flight. The solar radiation alert system provided near real-time warning of solar events, with recommendations for reduced aircraft flight altitudes and potential diversions for polar routes.

FY 2005:

- Continuously provided integrated toxicological and biomedical data on all aerospace accidents and significant incidents. Current findings indicate that about one in five pilots fatally injured in a civilian aircraft accident shows evidence of using a prescription drug; one in six has taken an over- the-counter drug; 1 in 20 has alcohol in excess of FAA regulations; and 1 in 12 is using a significant controlled dangerous substance. State-of-the-art techniques and methodology are continuously maintained in this world-class research program.
- Developed a research program to evaluate the potential use of centrifuge-based simulators for aircraft upset recovery training. Established a cooperative research grant with Embry-Riddle University to conduct background research relative to the use of centrifuge based simulators in upset recovery and to evaluate the effectiveness of simulator training in actual aircraft upset recovery situations. Established a contract with an industrial manufacturer to develop and demonstrate basic simulator methodology to perform upset recovery training using a short arm centrifuge based training device.
- Initiated development of cabin evacuation computer modeling to evaluate aircraft evacuation from current transport aircraft. Transport aircraft are currently certified by manned testing to determine if the aircraft evacuation capability meets requirements. Certification tests are expensive, can result in injured test subjects, and generally evaluate specific scenarios that may not be representative of actual evacuation requirements. Advancements in bioinformatics and the high costs of human subject testing have driven the development of cabin evacuation models to replace and/or streamline portions of manned tests.

FY 2008 MAJOR ACTIVITIES AND ANTICIPATED ACCOMPLISHMENTS:

- Assess flight crew health risks during a flying career.
- Analyze the suitability for component tests and mathematical modeling as an alternative for showing regulatory compliance with crashworthiness standards for aircraft.
- Assess impact protection performance of aircraft seating systems.
- Develop protective equipment fit, comfort, and performance standards.
- Develop dynamic modeling capabilities in support of cabin safety, protection, and aircraft accident research.
- Assess guidelines to reduce in-flight sudden/subtle incapacitation.
- Evaluate autopsy data from fatal aviation accidents to determine protective equipment and design practices.
- Optimize life support equipment, emergency medical equipment, and operational procedures certification.
- Develop processes to ensure laboratory accreditation and ISO-9000 competency.
- Continue epidemiological assessments of biochemical, toxicological and molecular biological factors associated with fatal civilian aviation accidents.
- Develop advanced molecular biochemical techniques to enhance aviation forensic toxicology.
- Complete recommendations for life support equipment and medical requirements in civilian spacecraft.
- Complete technical and customer reports on the physiological evaluation of pulse oxygen systems for general aviation aircraft.
- Evaluate potential for airbag and advanced occupant restraint systems to reduce injury and allow unassisted aircraft evacuation.
- Develop advanced database technology to provide statistical and graphical analysis to evaluate medical certification criteria and mechanisms of injury in aircraft accidents/incidents.
- Support research conducted by industrial organizations to develop/analyze methods to detect/mitigate aircraft cabin contamination.
- Evaluate performance and protection characteristics of aircrew eye/respiratory protective equipment, including protection from chemical/biological agents.
- Develop research recommendations for Aviation Rule-Making Advisory Committee reviews of cabin air quality and altitude safety rules.
- Complete guidelines for maintaining aircraft cabin occupant health to include re-evaluation of the effectiveness of Automatic External Defibrillators (AEDs) and the use of medical kit components in the flight environment.
- Evaluate physiological effect of hypoxia at altitudes that, under current regulations, do not require the use of supplemental oxygen.
- Develop instructional material on the radiation (cosmic and visual) environment during air travel.
- Establish an aircraft accident medical database.
- Develop vision standards for maintenance non-destructive inspection and testing.
- Conduct advanced aeromedical accident and pilot certification data analyses.
- Develop research program on crew and passenger safety requirements for very high altitude air or spacecraft.

- Develop data to support medical certification related to the use of vision testing technology developments.

FY 2009 PROGRAM REQUEST:

Complex medical decisions, based on epidemiological assessments, accompany initial and follow-up medical assessments of airmen who request special medical certification to allow continued flying despite clinical abnormalities. Cabin safety, health, and security for all human occupants of civilian aerospace craft require careful, cost-effective certification and regulation. To ensure fact-based scientific decisions concerning these issues, the following research will ensure optimal human safety, security, and health by providing a scientific basis for all decisions.

Ongoing Activities

Evaluate:

- Trends in toxicological, biochemical, molecular biological, physiological, and clinical findings from all major civil aviation aircraft crashes using advanced bioinformatic analytical systems.
- Effectiveness of programs dedicated to the enhancement of passenger safety, health, security, and performance in emergencies and uneventful flight.
- Risk posed by pilots with special medical issuances.
- Sensor systems to provide real time warning and support actions to mitigate the effects of intentional or unintentional chemical or biological aircraft contaminants.

Recommend:

- Safer aircraft cabin evacuation certification guidelines/procedures.
- Effective limits to radiation exposure (laser and ionizing).
- Methods to reduce head, neck, torso, and extremity injuries in aircraft crash environments to improve evacuation capability and improve certification procedures.
- Development of functional genomics technology to support accident investigation and fatigue identification in aircrew aerospace stress response analysis.

Initiatives:

- Implement molecular biological techniques in forensic toxicological investigations of aircraft accidents.
- Conduct collaborative research linking medical aircraft accident investigation with biodynamic and cabin evacuation research programs to develop bioaeronautical safety criteria.
- Expand biodynamic mathematical modeling and model validation to allow partial or full certification of aircraft restraint systems to include complex occupant protection systems.

KEY FY 2009 MAJOR ACTIVITIES AND ANTICIPATED ACCOMPLISHMENTS:

Integrate analysis of biomedical, toxicological and molecular biological factors and stressors in uneventful flight and in aerospace craft incidents and accidents:

- Analyze accuracy of pilot-reported medication usage compared with actual toxicology findings.
- Perform epidemiological assessment of toxicology factors from fatal civilian aviation accidents.
- Analyze use of molecular biological laboratory methods to enhance forensic toxicological investigation of aircraft accidents/incidents.

- Analyze the rate at which postmortem alcohol can be produced in specimens from fatal aviation accident victims to aid in the discrimination between ethanol ingestion and postmortem formation.
- Analyze application of gene expression technology in prevention of fatigue related accidents.
- Develop instructional material on the radiation (cosmic and visual) environment during air travel.
- Develop guidelines to reduce in-flight sudden/subtle incapacitation.
- Establish an aircraft accident medical database.
- Conduct advanced aeromedical accident and pilot certification data analyses.
- Evaluate autopsy data from fatal aviation accidents to determine protective equipment and design practices.

Develop quantitative bioengineering criteria:

- Develop process to evaluate the use of component tests and mathematical modeling for improved aircraft seat certification criteria and anthropomorphic test devices to establish the correlation of occupant injury and measured impact dynamics.
- Assess impact protection performance of aircraft seating systems.
- Develop performance-based narrow and wide bodied aircraft cabin evacuation approval guidelines.
- Develop protective equipment fit, comfort, and performance standards.
- Develop dynamic modeling capabilities in support of cabin safety, protection, and aircraft accident research.

Develop quantitative bioaeronautical data:

- Enhance guidelines for maintaining aircraft cabin occupant health, including the CARI-6 radiobiological computer program covering large solar particle events.
- Support research conducted by industrial organizations to develop/analyze methods to detect/mitigate aircraft cabin contamination.
- Assess flight crew health risks during a flying career.
- Develop quantitative biomedical and performance criteria and recommendations.
- Analyze effectiveness of oxygen systems at very high altitudes.

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2007)	$124,658
FY 2008 Appropriated	7,760
FY 2009 Request	8,395
Out-Year Planning Levels (FY 2010-2013)	36,515
Total	$177,328

Budget Authority ($000)	**FY 2005 Enacted**	**FY 2006 Enacted**	**FY 2007 Enacted**	**FY 2008 Enacted**	**FY 2009 Request**
Contracts:					
Aeromedical Research	3,776	3,569	1,504	1,712	2,038
Personnel Costs	4,761	5,091	5,383	5,893	6,177
Other In-house Costs	1,542	140	145	155	180
Total	**10,079**	**8,800**	**7,032**	**7,760**	**8,395**

OMB Circular A-11, Conduct of Research and Development ($000)	**FY 2005 Enacted**	**FY 2006 Enacted**	**FY 2007 Enacted**	**FY 2008 Enacted**	**FY 2009 Request**
Basic	0	0	0	0	0
Applied	10,079	8,800	7,032	7,760	8,395
Development (includes prototypes)	0	0	0	0	0
Total	**10,079**	**8,800**	**7,032**	**7,760**	**8,395**

A11j – Aeromedical Research Product and Activities	FY 2009 Request ($000)	Program Schedule					
		FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013
086-110 Aeromedical Research	**$2,038**						
Quantitative bioaeronautical data							
Assess flight crew health risks during a flying career		◆	◊	◊	◊	◊	
Support research conducted by industrial organizations to develop / analyze methods to detect / mitigate aircraft cabin contamination		◆	◊	◊			
Quantitative bioengineering criteria							
Analyze the suitability for component tests and mathematical modeling as an alternative for showing regulatory compliance with crashworthiness standard for aircraft		◆	◊	◊	◊		
Assess impact protection performance of aircraft seating systems		◆	◊	◊	◊	◊	◊
Develop performance-based narrow and wide bodied aircraft cabin evacuation approval guidelines		◆	◊	◊	◊	◊	◊
Develop protective equipment fit, comfort, and performance standards		◆	◊	◊	◊		
Develop dynamic modeling capabilities in support of cabin safety, protection, and aircraft accident research		◆	◊	◊	◊	◊	◊
Integrate analysis of biomedical, toxicological and molecular biological factors and stressors in uneventful flight and in aerospace craft incidents and accidents							
Perform epidemiological assessment of toxicology factors from fatal civilian aviation accidents		◆	◊	◊	◊	◊	◊
Develop guidelines to reduce in-flight sudden/subtle incapacitation		◆	◊	◊	◊	◊	◊
Evaluate autopsy data from fatal aviation accidents to determine protective equipment and design practices		◆	◊	◊	◊	◊	◊
Develop advanced molecular biochemical techniques to enhance aviation forensic toxicology		◆	◊	◊	◊	◊	◊
Develop instructional material on the radiation (cosmic and visual) environment during air travel		◆	◊				
Establish an aircraft accident medical database		◆	◊	◊	◊	◊	◊
Develop vision standards for maintenance non destructive inspection and testing							
Conduct advanced accident and pilot certification data analyses		◆	◊	◊	◊	◊	◊
Quantitative biomedical and performance criteria and recommendations							
Analyze effectiveness of oxygen systems		◆	◊	◊	◊	◊	◊
Personnel and Other In-House Costs	**$6,357**						
Total Budget Authority	**$8,395**	**$7,760**	**$8,395**	**$8,699**	**$8,976**	**$9,267**	**$9,573**

◆ - Activities Accomplished ◇ - Activities Planned

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

FAA Budget Appropriation	Budget Item	Program Title	Budget Request
R,E&D	**A11.k.**	**Weather Program**	**$16,968,000**

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

Intended Outcomes: The Weather Program helps achieve FAA's strategic goal of increasing aviation safety by reducing the number of accidents associated with hazardous weather conditions. The Weather Program strives to increase capacity by reducing the impacts of adverse weather events on the operational capacity of the National Airspace System (NAS). This research program also supports FAA Flight Plan goals of greater capacity. The FAA efforts undertaken in collaboration with the National Weather Service (NWS) and NASA increase FAA's ability to provide improved short-term and mid-term forecasts of naturally occurring atmospheric hazards, such as turbulence, severe convective activity, icing, and restricted visibility. Improved forecasts enhance flight safety, reduce air traffic controller and pilot workload, enable better flight planning, increase productivity, and enhance common situational awareness.

Agency Outputs: The weather research program develops new and improved weather algorithms for NAS platforms such as the Weather and Radar Processor, the Integrated Terminal Weather System, the Operational and Supportability Implementation System, the Advanced Technologies and Oceanic Procedures, the Dynamic Ocean Track System, and the Enhanced Traffic Management System. The NWS platforms also use these improved algorithms. The weather research program also provides knowledge that can be used by the FAA to support design approvals for weather data link systems and to issue appropriate operational approvals for weather products for use in the cockpit.

The weather capabilities developed by FAA provide the following benefits:

- Depiction of current and forecasted in-flight icing areas – enhances safety and regulatory adherence.
- Interactive data assimilation, editing, forecast and dissemination tools – improves aviation advisories and forecasts issued by the NWS as well as accessibility to users of aviation weather information.
- Depiction of current and forecast precipitation type and rate – enhances safety in the terminal area.
- Depiction of current and forecast terminal and en route convective weather – enhances terminal and en route capacity.
- Short-term prediction and forecast of ceiling and visibility in the national area – enhances en route safety.
- In-situ, remote detection, and forecast of en route turbulence, including clear-air turbulence – enhances en route safety.
- Design approval guidance for weather products, enabling depiction hardware, weather product software, and archiving weather data.
- Operational approval guidance for new products and non-government vendors.

Research Goals: Research is on-going to provide weather observations, warnings, and forecasts that are more accurate, accessible, and efficient, and to meet current and planned regulatory requirements. The goals of the research are:

- By FY 2009, develop a baseline consolidated convective weather forecast capability.

- By FY 2015, develop high-glance-value weather capabilities with longer forecast lead times and increased accuracy, for turbulence, severe convective activity, icing, and restricted visibility to be available electronically to all aviation users.
- By FY 2015, employ the aircraft as a node in the NAS. Enable flight deck weather information technologies that allow pilots and aircrews to engage in shared situation awareness and shared responsibilities with controllers, dispatchers, Flight Service Station specialists, pertaining to preflight, en route and post flight aviation safety decisions involving weather.

Customer/Stakeholder Involvement: The Weather Program works within FAA, industry and government groups to assure its priorities and plans are consistent with user needs. This is accomplished through:

- Close collaboration with FAA organizations such as the Air Traffic Organization Oceanic and Off-Shore Programs Office, various Aviation Safety Offices.
- Guidance from the FAA Research, Engineering, and Development Advisory Committee.
- Inputs from the National Aviation Weather Initiatives, which are strongly influenced by other NAS drivers including "Safer Skies" and Flight Plan Safety Objectives.
- Guidance from the Joint Planning and Development Office Next Generation Air Transportation System initiative.
- Inputs from the aviation community, such as the annual National Business Aircraft Association /Friends/Partners in Aviation Weather Forum, and scheduled public user group meetings.
- Feedback received from documents and publications.

R&D Partnerships: The Weather Program collaborates with the Department of Commerce in promoting and developing meteorological science, and in fostering support of research projects through the use of private and governmental research facilities. The program also leverages research activities with members of industry, academia, and other government agencies through interagency agreements, university grants, and Memorandums of Agreement.

Partnerships include:

- National Center for Atmospheric Research (in-flight icing, convective weather, turbulence, ceiling and visibility, modeling, weather radar techniques).
- National Oceanic and Atmospheric Administration laboratories (convective weather, turbulence, modeling, weather radar techniques, quality assessment/verification).
- Massachusetts Institute of Technology's Lincoln Laboratory (convective weather).
- National Weather Service's Aviation Weather Center and Environment Modeling Center (modeling).
- Naval Research Laboratory (volcanic ash, flight level winds, ceiling and visibility).
- NASA Research Centers (in-flight icing, turbulence, satellite data).
- Army Cold Regions Research and Engineering Laboratory (in-flight icing).
- Universities (modeling).
- Airlines, port authorities, cities (user assessments).

Accomplishments:

FY2007:

- Implemented in-flight icing severity nowcast capability operationally

- Obtained approval of turbulence detection algorithm by NWS NEXRAD System Recommendation and Evaluation Committee for operational implementation.
- Provided Helicopter Emergency Medical Services Aviation Digital Data Service (ADDS) enhancement to enable pilots to make NO-GO weather decisions.

FY2006:

- Obtained approval of in-flight icing severity nowcast capability for operational use.
- Implemented four-hour winter precipitation capability into Weather Support to Decision Making System, including Liquid Water Equivalent technology.
- Implemented terminal convective weather forecast capability into Integrated Terminal Weather System.

FY2005:

- Implemented improved accuracy and resolution of data on upper winds, temperature, and moisture through 13 kilometer rapid-update-cycle analyses and forecasts at the NWS.
- Implemented in-flight icing nowcast capability with higher resolution into ADDS.

FY2004:

- Implemented, up to 12-hour forecast of in-flight icing conditions into ADDS.
- Implemented up to 12-hour forecast of marine stratus burn-off at San Francisco International Airport.

Previous Years:

- Achieved the Department of Commerce 2003 Silver Medal.
- Implemented operationally new capabilities of:
    - Current and up to two-hour forecast of convective weather.
    - Current and up to 12-hour forecasts of clear-air turbulence above 30,000 feet.
- Implemented operationally at the NWS the enhanced ADDS with a flight path tool depicting vertical cross sections of weather along user-specified flight routes.
- Completed convective storm growth and decay field tests in Dallas, Orlando, Memphis, and New York. This research resulted in the accurate short-term prediction of the initiation, growth, and decay of storm cells, and enhanced the strategic and tactical flow management planning that allows more effective routing of traffic to and from airports and runways.

FY 2008 MAJOR ACTIVITIES AND ANTICIPATED ACCOMPLISHMENTS:

- Approved in-flight icing severity forecast capability for operational readiness.
- Implemented mid-level turbulence forecast capability operationally.
- Developed a baseline consolidated convective weather forecast capability.
- Developed continental states display of ceiling, visibility, and flight category analysis capability.
- Implemented an experimental Rapid Refresh Weather Research and Forecast (WRF) model.
- Developed volcanic ash dispersion forecast capability.
- Implemented turbulence detection algorithm into NEXRAD operations.
- Developed network enabled operations capability to interface ADDS to the System Wide Information Management platform.

- Conducted quality assessment evaluations utilizing the Real-Time Verification System (RTVS) of weather research capabilities to support the FAA/NWS aviation weather technology transfer process.
- Demonstrated capability to provide metadata tags via the RTVS to the SWIM architecture for JPDO verification.
- Completed a study to baseline weather products and determine pilot weather information needs in the cockpit.
- Completed revised Minimum Performance Standards Technical Standard Order (TSO)-C63c and certification methodology for certification of airborne weather radar with turbulence detection capability.
- Developed a database of pilot deviations, emergencies, and Air Traffic Flight Assists related to weather that will be used to define improvements to private pilot and instrument training for general aviation operators.

FY 2009 PROGRAM REQUEST:

Ongoing Activities

- Develop consolidated convective weather forecast capability.
- Develop volcanic ash dispersion forecast capability.
- Transition weather research capabilities to operations in the NWS, FAA, and industry weather systems.
- Develop weather product evaluation process for certification and operational guidance.
- Define and validate pilot training requirements needed to effectively operate and interpret weather products correctly.
- Develop and validate software to assist the GA pilot with weather related decision-making, both pre-flight and en route.
- Identify, validate, and document data link system attributes that may affect the provision and use of weather-in-the-cockpit products and services.

New Initiatives

No new initiatives are planned in FY 2009.

KEY FY 2009 MAJOR ACTIVITIES AND ANTICIPATED ACCOMPLISHMENTS:

- Develop in-flight icing nowcast and forecast capabilities for Alaska.
- Test baseline consolidated convective weather forecast capability.
- Implement probabilistic and mountain-wave turbulence forecast capabilities for experimental use.
- Develop continental states display of ceiling, visibility, and flight category forecast capability.
- Integrate Canadian radar data into the real-time national three dimensional radar mosaics.
- Obtain FAA approval to test the flight level winds capability.
- Implement the Rapid Refresh Weather Research and Forecast model into NWS operations.
- Conduct quality assessment evaluations utilizing the RTVS of weather research capabilities to support the FAA/NWS aviation weather technology transfer process.
- Develop prototype RTVS-NEXGEN for meeting SWIM architecture requirements
- Define a weather product evaluation process for certification and operational guidance.
- Commence turbulence radar and Turbulence Auto-PIREP System infusion into the NAS.

- Complete development of software algorithms to assist GA pilot with weather related decision making in-flight.

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2007)	$354,725
FY 2008 Appropriated	16,888
FY 2009 Request	16,968
Out-Year Planning Levels (FY 2010-2013)	65,713
Total	$454,294

Budget Authority ($000)	FY 2005 Enacted	FY 2006 Enacted	FY 2007 Enacted	FY 2008 Enacted	FY 2009 Request
Contracts:					
Weather Program	19,248	19,212	18,432	15,936	15,855
Personnel Costs	1,224	1,074	1,035	863	979
Other In-house Costs	199	90	78	89	134
Total	**20,671**	**20,376**	**19,545**	**16,888**	**16,968**

OMB Circular A-11, Conduct of Research and Development ($000)	FY 2005 Enacted	FY 2006 Enacted	FY 2007 Enacted	FY 2008 Enacted	FY 2009 Request
Basic	0	0	0	0	0
Applied	20,671	20,376	19,545	16,888	16,968
Development (includes prototypes)	0	0	0	0	0
Total	**20,671**	**20,376**	**19,545**	**16,888**	**16,968**

A11k – Weather Program – Product and Activities	FY 2009 Request ($000)	Program Schedule FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013
041-110 Aviation Weather Analysis and Forecasting							
Convective Analysis and Forecast Improvement	**$3,497**						
Develop consolidated conv wx forecast capability		◆		◇	◇		
Test baseline consolidated conv wx forecast capability			◇				
Implemented turbulence detection alg. into NEXRAD ops.		◆					
Integrate Canadian radar data into rl/tme nat'l 3D mosaic			◇				
Analysis and Forecast Improvement	**$5,058**						
Approve for operational readiness the in-flight icing oceanic nowcast							◇
Approved icing severity forecast capability for operational readiness		◆					
Develop icing nowcast & forecast capabilities for Alaska			◇	◇			
Approve AK icing forecast for operational readiness					◇		
Implement AK icing forecast capability for AK operationally						◇	
Implemented experimental rapid refresh WRF model		◆					
Implement rapid refresh WRF model into NWS operations			◇				
Implemented mid-level turbulence forecast capability operationally		◆					
Implement probabilistic & mountain wave turbulence forecast capabilities for experimental use			◇				
Implement convectively-induced turbulence forecast capability operationally					◇		
Implement turbulence forecast capability for all flight levels operationally							◇
Developed continental states display of ceiling, vis. & flt. category analysis capability		◆					
Develop CONUS ceil, vis, and flt cat forecast capabilities			◇				
Implement AK C&V analysis products operationally							◇
Developed vol ash dispersion forecast capability		◆					
Obtain approval to test the flight level winds capability			◇				
Implement vol ash dispersion forecast operationally							◇
Verification and Technology Implementation	**$4,250**						
Demonstrated capability to provide metadata tags via RTVS to SWIM architecture for JPDO verification		◆					
Develop prototype RTVS-NEXGEN for SWIM arch req.			◇				
Implement AWTT approved products at the AWC		◆	◇	◇	◇	◇	◇
Conduct QA evaluations for AWTT process		◆	◇	◇	◇	◇	◇
Developed NEO capability to interface ADDS to SWIM		◆					
Define weather prod evaluation process for certification & operational guidance		◆	◇				
Completed guidance for certification of airborne weather radar with turbulence detection capability		◆					
Complete tech guidance to implement weather technologies for use in the cockpit							◇
Information Management and Display	**$3,050**						
Complete baseline of weather products & determine pilot information needs		◆					
Developed a database of incidents related to weather to define improvements to GA weather training		◆					
Identify changes to flight training, recurrence requirements, and guidance materials		◆	◇				
Complete development of software algorithms to assist GA pilot with weather related decision making in-flight		◆					
Define and validate pilot training requirements needed to operate and interpret weather products		◆	◇	◇	◇	◇	◇
Document data link system attributes for use of weather-in-the-cockpit products and service		◆	◇	◇	◇	◇	
Personnel and Other In-House Costs	**$1,113**						
Total Budget Authority	**$16,968**	**$16,888**	**$16,968**	**$16,954**	**$16,615**	**$16,259**	**$15,885**

◆ - Activities Accomplished ◇ - Activities Planned

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

FAA Budget Appropriation	Budget Item	Program Title	Budget Request
R,E&D	**A11.l.**	**Unmanned Aircraft Systems Research**	**$1,876,000**

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

Intended Outcomes: The Unmanned Aircraft System (UAS) Research Program supports FAA's strategic goal of increasing safety by conducting research needed to ensure the safe integration of the UAS in the NAS. The program's research activities focus on technology surveys, methodology development, data collection and generation, laboratory and field validation, and technology transfer.

Agency Outputs: Researchers are developing methodologies and tools to define UAS design and performance characteristics. They are evaluating technologies, conducting laboratory and field tests, performing analyses and simulations, and generating data to support standardization of UAS civil operations. New standards are being implemented to establish UAS certification procedures, airworthiness standards, operation requirements, inspection and maintenance processes, and safety oversight responsibilities. Policies and guidance materials are also being published to equip FAA certification engineers and safety inspectors with the knowledge and tools they need to ensure the safe integration of UAS into the NAS.

Research Goals: To safely integrate UAS into the NAS, FAA needs to develop airworthiness standards, devise operational requirements, establish maintenance procedures, and conduct safety oversight activities. The program is structured into seven research areas: technology survey; detect, sense and avoid (DSA); control, command, and communication (C3); flight termination, system safety, certification and airworthiness standards, and maintenance and repairs. The research will begin with a baseline survey to determine the existing technologies used in UAS. Technologies used to avoid mid-air collusions due to UAS operations will be examined. Communications issues that may arise due to the introduction of UAS into the NAS, as well as necessary safety procedures for the flight termination of UAS, will be researched. A system safety approach will be used to identify the severity of potential hazards, perform risk assessments, and evaluate mitigation strategies for UAS safe operations in the NAS. Data systems will be established to collect data on UAS design, operation, and maintenance that will provide required information to establish design and operation standards and provide technical basis for safety oversight.

- By FY 2010, complete UAS technology survey and gap analysis and document results in a technical report.
- By FY 2012, determine performance characteristics and operational requirements for DSA technologies.
- By FY 2012, analyze data on the safety implications of system performance impediments to C3 in different classes of airspaces and operational environment.
- By FY 2015, conduct field evaluations of UAS technologies in an operational environment, including DSA, C3, and flight termination technologies. The documented results will be used to develop certification and airworthiness standards.

Customer/Stakeholder Involvement: Full and safe integration of UAS into civil aviation requires FAA to work closely with other government and private agencies that have experience in developing and operating UAS:

- FAA Research, Engineering, and Development Advisory Committee (REDAC) Aircraft Safety Subcommittee – subcommittee representatives from industry, academia, and other government agencies annually review the activities of the program.

- Technical Community Representatives Groups – FAA representatives apply formal guidelines to ensure that the program's R&D projects support new rule making and the development of alternate means of compliance with existing rules.
- Department of Defense (DoD) – the DoD is the largest UAS user requesting unrestricted access to the NAS. The FAA will collaborate with DoD through Memorandum of Understanding (MOU) and Interagency Agreements (IA) to leverage resources and implement new technologies for civil applications.
- JPDO – the JPDO has identified UAS integration to NAS as one of the emerging challenges to the nation's air transportation system.

R&D Partnerships:

- IA's with other government agencies (DoD and Department of Homeland Security) and Memorandum of Cooperation with foreign civil aviation authorities.
- The FAA Air Transportation Center of Excellence – various consortiums of university and industry partners who conduct R&D for FAA on a cost-matching basis, which currently consists of seven centers in different technical disciplines.
- The Civil Aviation Authority of the Netherlands to conduct joint research on unmanned aircraft system initiatives via a Memorandum of Cooperation.

Accomplishments:

FY2007:

- Established UAS research program plan.
- Completed the first sets of FAA-USAF joint flight tests to evaluate a DSA technology.

FY 2008 MAJOR ACTIVITIES AND ANTICIPATED ACCOMPLISHMENTS:

- Complete survey of existing DSA capabilities and publish technical reports on UAS technology survey and gap analysis results.
- Conduct technology survey on UAS designs and operations.
- Determine performance characteristics and operational requirements for DSA technologies.
- Establish UAS data collection and information system.
- Determine potential safety implications of system performance impediments to C3.
- Determine initial system-level hazard identification for UAS operations in the NAS, determine their severities, analyze mitigation strategies, and make safety recommendations.
- Develop UAS system safety management framework as well as methods, and tools to determine impacts of specific hazards, mitigation strategies, recommended approaches, safety measurements, and oversight requirements.

FY 2009 PROGRAM REQUEST:

New Initiatives

- A safety mitigation strategy for particular UAS operations in given classes of airspaces will be initiated. This effort will be based on results of the initial study on UAS hazards and recommendations from the UAS Systems Safety Risk Working Group.

KEY FY 2009 MAJOR ACTIVITIES AND ANTICIPATED ACCOMPLISHMENTS:

- Complete technology survey on UAS designs and operations.
- Determine performance characteristics and operational requirements for DSA technologies.
- Determine potential safety implications of system performance impediments to C3.

- Complete the initial system-level hazard identification for UAS operations in the NAS, determine their severities, analyze mitigation strategies, and make safety recommendations.
- Develop UAS system safety management framework as well as methods, and tools to determine impacts of specific hazards, mitigation strategies, recommended approaches, safety measurements, and oversight requirements.
- Establish UAS data collection and information system and conduct system safety analysis on specific UAS operations.

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2007)	$1,200
FY 2008 Appropriated	2,920
FY 2009 Request	1,876
Out-Year Planning Levels (FY 2010-2013)	7,968
Total	$13,964

Budget Authority ($000)	**FY 2005 Enacted**	**FY 2006 Enacted**	**FY 2007 Enacted**	**FY 2008 Enacted**	**FY 2009 Request**
Contracts:					
Unmanned Aircraft System Research	0	0	1,200	2,768	735
Personnel Costs	0	0	0	136	1,080
Other In-house Costs	0	0	0	16	61
Total	**0**	**0**	**1,200**	**2,920**	**1,876**

OMB Circular A-11, Conduct of Research and Development ($000)	**FY 2005 Enacted**	**FY 2006 Enacted**	**FY 2007 Enacted**	**FY 2008 Enacted**	**FY 2009 Request**
Basic	0	0	0	0	0
Applied	0	0	1,200	2,920	1,876
Development (includes prototypes)	0	0	0	0	0
Total	**0**	**0**	**1,200**	**2,920**	**1,876**

A11.l. – Unmanned Aircraft Systems Research Product and Activities	FY 2009 Request ($000)	Program Schedule					
		FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013
069-110 Unmanned Aircraft System Research							
Technology Surveys							
Conduct survey of existing DSA capabilities		◆					
Conduct technology survey on UAS designs and operations		◆	◊				
Detect, Sense, and Avoid (DSA) Research							
Determine performance characteristics and operational requirements for DSA technologies		◆	◊	◊	◊		
Conduct field evaluation of DSA technology						◊	◊
Command, Control, and Communications (C3)							
Determine potential safety implications of system performance impediments to C3		◆	◊	◊			
Study requirements of Ground Control System for certification and operations					◊		
Conduct C3 field tests and evaluate technologies						◊	◊
Flight Termination							
Determine requirements, risks, and mitigation strategies for flight termination				◆	◊		
Conduct flight termination procedure field test and evaluate technologies						◊	◊
UAS System Safety Management	**$735**						
Determine initial system-level hazard identification for UAS operations in the NAS, determine their severities, analyze mitigation strategies, and make safety recommendations.		◆	◊				
Develop UAS system safety management framework as well as methods, and tools to determine impacts of specific hazards, mitigation strategies, recommended approaches, safety measurements, and oversight requirements.		◆	◊	◊	◊	◊	◊
Establish UAS data collection and information system and conduct system safety analysis on specific UAS operations.		◆	◊	◊	◊	◊	◊
Development of UAS Certification and Airworthiness Standards							
Conduct dada analyses to determine UAS design and airworthiness certification requirements				◊	◊	◊	◊
Develop methodologies and analysis tools				◊	◊	◊	◊
UAS Maintenance and Repair Issues							
Identify requirements of UAS maintenance and repairs for continuing airworthiness				◊	◊	◊	◊
Develop tools and methods to support safety oversight by FAA aviation safety inspectors				◊	◊	◊	◊
Personnel and Other In-House Costs	**$1,141**						
Total Budget Authority	**$1,876**	**$2,920**	**$1,876**	**$1,929**	**$1,970**	**$2,012**	**$2,057**

◆ - Activities Accomplished ◊ - Activities Planned

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

FAA Budget Appropriation	Budget Item	Program Title	Budget Request
R,E&D	**A12.a.**	**Joint Planning and Development Office (JPDO)**	**$14,494,000**

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

Intended Outcomes: As the steward of NextGen, the JPDO seeks to address long-term imbalances in aviation capacity and demand. At the same time, it seeks to ensure that the future operating environment is safe, well managed, environmentally responsible, and harmonized with international standards. The JPDO's mission is to lead the transformation of today's aviation system into that of the future, the scope of which contributes to all of FAA's current strategic goals.

Agency Outputs: The JPDO is responsible for defining and facilitating the implementation of NextGen. At this stage in the transformation, outputs are a series of plans and analyses that define a proposed end-state and a path for achieving it. The objective is to drive collaborative decisions—involving government and industry—that will ultimately achieve the transformation.

Research Goals:

FY 2009:

- Continue to refine and update the NextGen Enterprise Architecture products: Concept of Operations, Enterprise Architecture, and Integrated Work Plan.
- Continue to coordinate with aviation and aeronautics research programs to ensure that research results in decisions that influence the most effective investment and implementation decision-making.
- Consistent with the enterprise architecture, continue to identify and facilitate all pre-implementation activities to support identification and resolution of policy issues, optimized technology transfer, risk management and a broad range of analysis to support decision-making.
- Track and ensure that partner agencies are implementing programs that support a transition to the end-state architecture as defined in the Integrated Work Plan.
- Develop FY 2011 Formulation Package to support NextGen resource planning and development of the NextGen business case and work with partner agencies to ensure alignment of partner agency budgets to the FY 2011 budget request.
- Continue NextGen modeling and simulation efforts that result in improved NextGen alternatives analysis, cost/benefits estimation, and integrate rationale and decisions into the NextGen business case.
- Develop FY 2011 NextGen business case.
- Continue to coordinate and conduct demonstrations that will test operational concepts, address operational challenges, and provide alternatives for architectural trade-offs. Demonstrations will explore human factors and safety characteristics of trajectory-based operations, high-density airport operations, airspace security, and globally interoperable system integration.

FY 2010:

- Continue research in key areas such as Trajectory Based Operations and Collaborative Air Traffic Management as well as other priority areas identified in the Integrated Work Plan.

- Based on research results, assist agencies in deploying critical infrastructure for NextGen operations.
- Establish Policy for NAS wide aircraft equipage rules and Airspace/Route access.
- Initiate research in key areas such as Trajectory Based Operations and Collaborative Air Traffic Management.

FY 2011-2013:

- Continue research and development to support all OEP solution sets.

FY 2014 and Beyond:

- Continue development to support all OEP solution sets.
- Identify alternatives as a result of needed research that may be immature.

Customer/Stakeholder Involvement: The JPDO is truly a collaborative enterprise. Employees from NASA and the Departments of Transportation, Commerce, Defense, and Homeland Security actively lead and/or participate in JPDO activities. Similarly, the JPDO Board includes executives from each department/agency, as well as the White House Office of Science and Technology Policy. And the Senior Policy Committee includes Secretaries, Deputy Secretaries, and/or Administrators from the participating organizations, as well as the Director of the Office of Science and Technology Policy.

The private sector is also an integral part of the JPDO's work. In FY 2006, the NextGen Institute was established as an alliance of major aviation stakeholder communities. The Institute operates under guidelines set forth in the funding agreement between FAA/JPDO and the host organization, the National Center for Advanced Technologies. The agreement states that the Institute will be governed by a 16-member council that is broadly representative of the aviation community. The Institute supports JPDO by recruiting and assigning industry experts to participate in forums and perform funded technical work. The Institute has already hosted a series of workshops to gather input on research, demonstrations, operational concepts, and financial implications. The Institute performs a variety of tasks in support of the planning process including studies, demonstration support, and strategic assessments and recommendations for NextGen design issues.

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

FY 2007:

- Released Version 2 of the Enterprise Architecture and Concept of Operations.
- Released the initial baseline version of the Integrated Work Plan, which outlines the steps necessary to achieve the ConOps.
- Completed the NextGen Research and Development Plan, a five year view of the research and investment activities required to revise, coordinate, and cost the research and implementation agendas.
- Completed the first NextGen business case (Exhibit 300).

FY 2006:

- Developed the NextGen Block-to-Block Concept of Operations and coordinated it through the NextGen stakeholder community for comment and feedback.
- Developed the NextGen Block-to-Block Enterprise Architecture, aligned the Architecture with the Concept of Operations, and began coordination and review through the NextGen stakeholder community.

- Baselined the Operational Improvement Roadmap to set research targets for the Integrated Product Teams.
- Published the NextGen FY 2008 Agency Budget Guidance for Research and Implementation, which begins to align programs to NextGen and identify key research areas.
- Delivered the FY 2005 Progress Report to Congress describing the JPDO's progress in carrying out the NextGen Integrated Plan.
- Developed initial JPDO Systems Engineering Management Plan (SEMP) to facilitate interaction with other agencies and stakeholders.
- Established the Architecture Integration Council, which includes the chief architects for all partner agencies. This body will ensure the cooperation and engagement of the relevant agencies' chief architects during development of the NextGen architecture.

FY 2005:

- Made significant progress in resource alignment within the federal government and U.S. industry to develop and implement the NextGen in the most expedient and cost-effective manner.
- Produced and updated the NextGen Integrated Plan as the long-term strategic business plan, detailing goals, objectives, and requirements for eight transformational areas.
- Established and staffed—with federal and industry participants—eight integrated product teams to work collaboratively with government and industry to develop research agendas and strategies for achieving NextGen.
- Performed the first major evaluation of the Operational Vision in Portfolio Segments, to validate the ability to deliver two to three times today's capacity.
- Established the NextGen Operational Improvement Roadmap to guide the transition from today's system to the next generation.
- Developed initial NextGen Segment Portfolios of policy, research and modernization requirements based on the OI Roadmap.

FY 2004:

- Initiated resource alignment within the federal government and U.S. industry to develop and implement the NextGen in the most expedient and cost-effective manner.
- Produced the outline for the Integrated National Plan as the long-term strategic business plan for NextGen that detailed NextGen goals and objectives, and requirements for transformation in eight specific areas, each individually significant yet interdependent on the others.
- Produced the framework for establishing with federal and industry participants eight integrated product teams that would work collaboratively with government and industry to plan for and develop research agendas and strategies for achieving NextGen.
- Established the framework for the NextGen Operational Improvement (OI) Roadmap to guide the transition from today's system to the NextGen.
- Developed initial plan for the NextGen Segment Portfolio's of needed policy, research and modernization requirements based on the NextGen OI Roadmap.

FY 2008 MAJOR ACTIVITIES AND ANTICIPATED ACCOMPLISHMENTS:

FY 2008:

- Released refinements and updates to the Enterprise Architecture and Concept of Operations.
- Released the Integrated Work Plan Version 1.

- Conducted analysis, modeling, and simulations to support FY 2010 business case development.
- Released the FY 2010 NextGen Business Case and Exhibit 300.
- Refined program management processes including risk management.
- Defined NextGen National Information Sharing framework and multi-agency governance.
- Developed NextGen Weather Functional Requirements and established NextGen Network Enabled Weather Program Office and multi-agency governance.
- Defined Aviation Safety Information Analysis and Sharing Concept and multi-agency governance.
- Developed National Safety Management System Standard and National Aviation Safety Strategic Plan.

FY 2009 PROGRAM REQUEST:

Ongoing Activities

- Continue modeling, simulation, and evaluation to ensure benefits, costs, and trade-offs are understood across the full range of goals.
- Revise, coordinate, and cost the research and implementation agendas for subsequent years.
- Refine NextGen business case and work with agencies and industry on research areas and implementation of NextGen-related programs.
- Continue refining Concept of Operations, Enterprise Architecture, and Integrated Work Plan in response to the outcome of demonstrations, research, changes in agency budgets, etc.
- Continue facilitating strategic alignment of agency goals and objectives with NextGen goals and objectives and performance metrics.

New Initiatives

- Conduct demonstrations that will test operational concepts, demonstrate technologies that could address operational challenges, and provide alternatives for architectural tradeoffs.
- Facilitate the transfer of technologies from research programs that are ready for implementation (e.g., NASA, FAA, DHS and DoD Advanced Research Projects Agency program) to the federal agencies with operational responsibilities and to the private sector, as appropriate.

KEY FY 2009 MAJOR ACTIVITIES AND ANTICIPATED ACCOMPLISHMENTS:

Planning and Agency/Industry Alignment

- Update, coordinate, validate and begin implementing the early opportunity for NextGen, and identify other opportunities for subsequent implementation.
- Coordinate aviation and aeronautics research programs to achieve the goal of more effective and directed research that will result in only performing the most promising and applicable research.
- Set goals, priorities and metrics and reporting structure, and coordinate research activities within JPDO member agencies and with U.S. aviation and aeronautical firms.
- Facilitate the transfer of technologies from research programs that are ready for implementation (e.g., NASA and DoD Advanced Research Projects Agency program) to the federal agencies with operational responsibilities and to the private sector, as appropriate.

Systems Integration and Transformation Analysis

- Continue to refine research plans, which will describe research and supporting activities required to drive implementation decisions to effect the NextGen transformation.
- Continue refining Concept of Operations, Enterprise Architecture, and Integrated Work Plan in response to the outcome of demonstrations, research, changes in agency budgets, etc.
- Continue modeling planned improvements to test their efficacy in accomplishing NextGen goals.
- Conduct analyses, trade studies, and demonstrations to select the best approaches/alternatives for transforming the current air transportation system to NextGen.

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2007)	$44,078
FY 2008 Appropriated	14,321
FY 2009 Request	14,494
Out-Year Planning Levels (FY 2010-2013)	57,136
Total	$130,029

Budget Authority ($000)	**FY 2005 Enacted**	**FY 2006 Enacted**	**FY 2007 Enacted**	**FY 2008 Enacted**	**FY 2009 Request**
Contracts:					
Joint Planning & Development Office	3,659	16,539	16,112	12,910	12,088
Personnel Costs	1,200	1,313	1,867	1,256	2,173
Other In-house Costs	200	67	121	155	233
Total	**5,059**	**17,919**	**18,100**	**14,321**	**14,494**

OMB Circular A-11, Conduct of Research and Development ($000)	**FY 2005 Enacted**	**FY 2006 Enacted**	**FY 2007 Enacted**	**FY 2008 Enacted**	**FY 2009 Request**
Basic	0	0	0	0	0
Applied	5,059	17,919	18,100	14,321	14,494
Development (includes prototypes)	0	0	0	0	0
Total	**5,059**	**17,919**	**18,100**	**14,321**	**14,494**

A12.a - Joint Planning & Development Office Product and Activities	FY 2009 Request ($000)	Program Schedule					
		FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013
Joint Planning & Development Office	**$12,088**						
Planning and Agency/Industry Alignment:							
Update and carry out an integrated plan for a Next Generation Air Transportation System.		◆	◊	◊	◊	◊	◊
Coordinate and facilitate the transfer of technologies from aeronautics research programs and direct research that will result in achieving NextGen.		◆	◊	◊	◊	◊	◊
Systems Integration and Transformation Analysis:							
Accomplish the coordination to create and carry out the plan to achieve more directed programs through applicable research and systems integration.		◆	◊	◊	◊	◊	◊
Develop Enterprise Architecture for systems-of systems engineering and expand lower levels of the enterprise.		◆	◊	◊	◊	◊	◊
Evaluate and validate cross Working Groups, integrated system-wide concepts, procedures, policies, business cases, etc. to assure potential alternatives exist that could meet all the National Plan Objectives.		◆	◊	◊	◊	◊	◊
Conduct policy analyses that focus on early decisions to establish guiding principles for the transformation		◆	◊	◊	◊	◊	◊
Model the planned system improvements to validate their efficacy in accomplishing the NextGen goals. Update roadmaps and research agenda's as required.		◆	◊	◊	◊	◊	◊
Assist agencies in selecting the best approaches/alternatives for transforming the current air transportation system to NextGen;		◆	◊	◊	◊	◊	◊
Personnel and Other In-House Costs	**$2,406**						
Total Budget Authority	**$14,494**	**$14,321**	**$14,494**	**$14,560**	**$14,382**	**$14,195**	**$13,999**

◆ - Activities Accomplished ◇ - Activities Planned

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

FAA Budget Appropriation	Budget Item	Program Title	Budget Request
R,E&D	**A12.b.**	**Wake Turbulence**	**$10,132,000**

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

Intended Outcomes: The Wake Turbulence Program addresses FAA's goal for capacity and the DOT Reduced Congestion Strategic Objective to "Advance accessible, efficient, inter-modal transportation for the movement of people and goods." The program was originally focused on the near-term objectives of increasing airport capacity and the capacity of terminal airspace during inclement weather by developing modifications to air traffic control wake turbulence mitigation procedures used during these weather conditions. The program, in FY 2009, will address the broader research agenda required to progress to the envisioned NextGen. The Wake Turbulence Research Program will address how to mitigate wake turbulence and collision risk impacts to enable more efficient use of congested airspace and existing/future runways at the nation's busiest airports. Program outcomes include:

- Increased NextGen capability for more flights during less than visual flight rules conditions.
- Aircraft are able to fly closer together with the same or reduced safety risk.

Agency Outputs: The Wake Turbulence Program conducts applied research to develop improved air traffic control aircraft separation processes that will help solve operational problems associated with today's generalized and static air navigation service provider (ANSP) wake turbulence and collision risk mitigation based separation standards. As an example, during periods of less than ideal weather and visibility conditions, implementation of an ANSP decision support tool that adjusts required wake separations based on wind conditions will allow air traffic control to operate these airports at arrival rates closer to their design capacity. Additionally, the research program will develop wake mitigation and collision risk technology application solutions that safely enable reduced aircraft separations in congested air corridors and during arrival and departure operations at our nation's busiest airports. The research program in FY 2009 will continue work begun in FY 2008 to address the feasibility and benefit of a wake/collision avoidance decision support capability for the flight deck.

Research Goals:

- By FY 2010, determine pilot and ANSP situational aircraft separation display concepts required for implementation of the NextGen "Trajectory Based Operation" and "High Density" concepts.
- By FY 2012, determine the NAS infrastructure requirements (ground and aircraft) for implementing the NextGen "Trajectory Based Operation" and "High Density" concepts within the constraints of aircraft generated wake vortices and aircraft collision risk.

Customer/Stakeholder Involvement: The program addresses the needs of the ATO and works with the agency's Aviation Safety organization to ensure new procedures and technology solutions are safe and that the airports and air routes targeted for their implementation are those with critical needs to reduce airport capacity constraints and air route congestion. The program works with controllers, airlines, pilots and aircraft manufacturers to include their recommendations and ensure that training and implementation issues are addressed in the program's research from the start.

Customers:

- Pilots;
- Air navigation service provider personnel;
- Air carrier operations; and
- Airport operations.

Stakeholders:

- Joint Planning and Development Office;
- Commercial pilot unions;
- FAA air navigation service provider unions;
- Other ICAO air navigation service providers; and
- Aircraft manufacturers.

R&D Partnerships: In addition to maintaining its partnership with the agency's Aviation Safety organization, this research program accomplishes its work via working relationships with industry, academia, and other government agencies. The coordination and tasking are accomplished through joint planning/reviews, contracts and interagency agreements with the program's partners:

- Volpe National Transportation Center;
- MITRE/Center for Advanced Aviation and Systems Development (CAASD);
- NASA Ames and Langley Research Centers;
- EUROCONTROL and associated research organizations; and
- Massachusetts Institute of Technology's Lincoln Laboratory.

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

- FY 2007 - Implement dependent staggered ILS approaches to St. Louis closely spaced parallel runways 12R/L and 30R/L.
- FY 2007 - Complete FAA assessment of NASA's concept for wind dependent wake turbulence mitigation procedure for aircraft arriving on closely spaced parallel runways.
- FY 2005-2007 – By analysis, simulation and evaluation prototype; demonstrated feasibility of a cross-wind based air traffic wake turbulence mitigation decision support tool concept for enabling more closely spaced departures from an airport's closely spaced parallel runways.
- FY 2005-2007 – Provided wake turbulence evaluation support in the integration of a new aircraft into the National Airspace System.
- FY 2004-2007 – Cooperative data exchange with European wake turbulence data collection efforts.
- FY 2002-2007 – Developed the most extensive wake turbulence transit and characterization data base in the world, used to determine feasibility of proposed changes to air traffic control's wake turbulence mitigation procedures.
- FY 2006 – Provided wake turbulence information necessary for the ICAO determination of wake turbulence mitigation separations required for the A-380 aircraft.
- FY 2006 – Completed a detailed proposal for modifying the current air traffic wake turbulence mitigation procedures used for dependent staggered instrument landing system (ILS) approaches to an airport's CSPR.

- FY 2005-2006 – Enhanced the pulsed Light Detection and Ranging (LIDAR), which can measure distance, speed and rotation, for wake data collection capability, enabling it to capture wakes from both arriving and departing aircraft.
- FY 2005 – Utilizing analyses of the wake turbulence data collected at San Francisco International Airport (SFO) and Lambert – St. Louis International Airport (STL) upgraded FAA's wake turbulence encounter model used for evaluating proposed changes to air traffic control procedures for routing aircraft into and out of airports.
- FY 2003-2004 – Three prototype pulsed LIDAR systems purchased and added to the STL wake turbulence data collection facility.
- FY 2003 – Provided for the development of a ground based pulsed Light Detection and Ranging (LIDAR) prototype system for detecting and tracking aircraft generated wake vortices.
- FY 2003 – Wake turbulence data collection facility established at STL.
- FY 2002 – Continued wake turbulence data collection at SFO.

FY 2008 MAJOR ACTIVITIES AND ANTICIPATED ACCOMPLISHMENTS:

- Develop a national change to Air Traffic Order 7110.65 as it applies to the use of closely spaced parallel runways for dependent integrated landing system approach operations.
- Continue wake data collection and analyses at additional airports to support national and airport specific changes to air traffic control procedures for dependent integrated landing system approaches to an airport's closely spaced parallel runways.
- Evaluate reports of wake turbulence encounter as part of the FAA Safety Management System assurance process for changes to air traffic control procedures.
- Complete development of the enhanced suite of wake turbulence encounter analysis tools and begin their application in the evaluation of air route changes, modifications to en route air traffic control aircraft separation procedures changes and introduction of new aircraft designs.
- Analysis of wake turbulence data base to upgrade computational models of wake vortex transport and decay.
- Accomplish air traffic procedure/air route proposal reviews utilizing the enhanced suite of wake turbulence encounter analysis tools.
- Develop airport specific procedure modifications to enable dependent ILS approaches to closely spaced parallel runways.
- Development of wind prediction algorithm suitable for use in the development of a cross wind dependent wake mitigation for ground based decision support tool for approaches of 757 and "heavy" category aircraft to closely spaced parallel runways.
- Initiate development of ground and aircraft based situational display concepts (joint work with EUROCONTROL) relative to separation constraints (wake, weather, and visibility) required for implementation of the NextGen concept for air routes and approach/departure paths.
- Initiate program to evaluate the impact to fuel efficiency from the addition of a spiroid winglet to an aircraft's wing.

FY 2009 PROGRAM REQUEST:

In FY 2009, FAA must continue developing the capabilities needed to enable aircraft separation processes supportive of NextGen shared separation and dynamic spacing super density operations. These capabilities are highly dependent on technologies that accurately predict aircraft tracks, the track/decay of their generated wake vortices and provide this information to pilots and controllers. Some aspects of the NextGen Concept of Operations are dependent upon the aircraft being a participant in efficient, safe air traffic control processes that would minimize the effects of wake turbulence, reduce collision risk and keep traffic flowing in all weather and visibility conditions. The Wake Turbulence Program's research will result in enhanced technology assisted processes for safely mitigating aircraft wake encounter and collision risks while optimizing capacity, for all flight regimes, including the effects of weather.

KEY FY 2009 MAJOR ACTIVITIES AND ANTICIPATED ACCOMPLISHMENTS:

- Incorporate wake transport/decay and aircraft navigation performance analysis results into FAA wake encounter and collision risk models.
- Accomplish air traffic procedure/air route proposal reviews utilizing the enhanced suite of wake turbulence encounter and collision risk analysis tools.
- Complete two airport specific procedure modifications to enable dependent ILS approaches to closely spaced parallel runways.
- Continued data collection to determine the characteristics of wake vortices generated by departing and arriving aircraft. Data will be used in development of air navigation service provider decision support tools in reducing the required wake mitigation separation applied to airport single runway arrivals and departures.
- Continue development of ground and flight deck based situational display concepts (joint work with EUROCONTROL) for showing separation constraints (driven by collision risk, wake encounter risk, weather, and visibility) for aircraft operating in NextGen air corridors and high density airspace.
- Initiate development (joint work with EUROCONTROL) of analytical capability-benefit tradeoff models of potential procedures/processes/systems that would provide the desired Flight Deck capability for self separating from adjacent aircraft and their wakes.
- Complete development of approach to evaluate system-wide safety risk associated with the NextGen pair-wise separation concepts.
- Conduct experiments/analyses and aviation community forums to define in terms of collision and wake encounter hazard – what is a low, major and catastrophic impact safety event and acceptable safety risk for each.
- Initiate development of an air navigation service provider prototype decision support system for use in reducing required wake mitigation separations in dependent instrument landing system arrivals of B-757 and heavier aircraft on an airport's closely spaced parallel runways.

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2007)	$22,223
FY 2008 Appropriated	12,813
FY 2009 Request	10,132
Out-Year Planning Levels (FY 2009-2012)	41,601
Total	$86,769

Budget Authority ($000)	FY 2005 Enacted	FY 2006 Enacted	FY 2007 Enacted	FY 2008 Enacted	FY 2009 Request
Contracts					
Wake Turbulence	3,966	2,036	2,833	12,543	9,734
Personnel Costs	163	225	222	251	374
Other In-house Costs	133	12	11	19	24
Total	**4,262**	**2,273**	**3,066**	**12,813**	**10,132**

OMB Circular A-11, Conduct of Research and Development ($000)	FY 2005 Enacted	FY 2006 Enacted	FY 2007 Enacted	FY 2008 Enacted	FY 2009 Request
Basic	0	0	0	0	0
Applied	4,262	2,273	3,066	12,813	10,132
Development (includes prototypes)	0	0	0	0	0
Total	**4,262**	**2,273**	**3,066**	**12,813**	**10,132**

A12.b.- Wake Turbulence Product and Activities	FY 2009 Request ($000)	Program Schedule FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013
041-150 - Wake Turbulence							
Incorporate Wake Transport/decay and aircraft navigation performance into FAA models	**$600**	◆	◊	◊	◊	◊	◊
Continued data collection to determine the characteristics of wake vortices generated by arriving and departing aircraft – for use in determining potential achievable separation reduction in single runway operations	**$1,600**	◆	◊	◊	◊	◊	
Development of enhanced analysis tools for evaluating wake encounter and collision risk resulting from the design of airspace efficient routes, air traffic procedure changes, and the introduction of new aircraft designs	**$800**	◆	◊	◊			
Accomplish wake turbulence and collision risk assessments of potential air traffic routing and separation changes associated with evolution to NextGen	**$830**	◆	◊	◊	◊	◊	◊
Develop national modification to Air Traffic Control Order 7110.65 as it affects closely spaced parallel runway approaches		◆					
Develop airport specific procedure modifications to enable dependent ILS approaches to closely spaced parallel runways	**$600**	◆	◊	◊	◊		
Development of ground based and flight deck based situational display concepts for showing separation constraints for aircraft operating in NextGen air corridors and high density airspace	**$1,438**	◆	◊	◊	◊	◊	
Initiate development of analytical capability-benefit tradeoff models of potential procedures/processes/systems that would provide the desired Flight Deck capability for self separating from adjacent aircraft and their wakes.	**$800**		◊	◊			
Conduct experiments/analyses and aviation community forums to define in terms of allowable safety risk for potential results from wake encounter or blunder in aircraft navigation	**$900**		◊	◊			
Development of ANSP prototype decision support system for use in reducing required wake mitigation separations in dependent instrument landing system arrivals of 757 and heavier aircraft on an airport's closely spaced parallel runways	**$1,448**	◆	◊	◊	◊		
Develop an approach and evaluate system-wide safety risk for NextGen era reduced separation standards	**$718**	◆	◊	◊	◊	◊	◊
Evaluate the fuel efficiency impact from addition of a spiroid winglet to an aircraft's wing	**$0**	◆	◊				
Personnel and Other In-House Costs	**$398**						
Total Budget Authority	**$10,132**	**$12,813**	**$10,132**	**$10,369**	**$10,580**	**$10,409**	**$10,235**

◆ - Activities Accomplished ◇ - Activities Planned

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

FAA Budget Appropriation	Budget Item	Program Title	Budget Request
R,E&D	**A12.c.**	**NextGen – Air Ground Integration**	**$2,554,000**

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

Supports FAA R&D Goal: Air-Ground Integration.

Intended Outcomes: Demonstrate that operations (e.g., day and night, all weather), procedures and information can be standard and predictable for users (e.g., pilots, controllers, airlines, passengers) at all types of airports and for all aircraft.

Integration of air and ground capabilities poses challenges for pilots and controllers. A central core human factors issue is ensuring the right information is provided to the right human operators at the right time to make the right decisions. Transitions of increasingly sophisticated automation and procedures must be accompanied by supporting interoperability, with baseline systems and refinement of procedures to ensure efficient operations and mitigate potential automation surprises.

The safety factors that primarily have an impact on separation assurance must be jointly approached by both the flight deck and air traffic research communities. The increased levels of automation and new enabling technologies that will likely transform the NAS in the future will bring new and interesting human factors challenges.

REDAC findings are being addressed in both the baseline research programs and as part of future research planning. Ongoing research efforts support human factors guidelines for the design of instrument procedures, including the development of future procedures based on area navigation (RNAV) and the required navigation performance (RNP) of the aircraft. Execution of robust and leveraged research plans will be commensurate with program funding to address the most critical issues.

Other research efforts address operational and design constraints affecting human error detection and recovery, error prediction, and managing distractions in order to ensure continued situation awareness by the air crew. Training of pilots must be designed to ensure adequate understanding of avionics and automation capabilities, which are key to ensuring efficiency and effectiveness as pilots take on increased spacing and separation responsibilities.

Operational Improvements include provision for self-spacing, merging and passing in en route airspace via CDTI and ADS-B, with procedures based on RTSP for less than three-mile separation. Lateral and in-trail separation would be reduced to near VFR levels for single runway and for converging and closely spaced parallel runway operations using CDTI, ADS-B and wake vortex ground detection. Aircraft-to-aircraft separation would be delegated to the flight deck in oceanic airspace, with reduced longitudinal and lateral spacing via RNP, ADS/CDTI and data communication.

Agency Outputs: The Flightdeck/Maintenance/System Integration Human Factors Program addresses the pilot side of the air-ground integration challenge, and collaborates with the Air Traffic Control/Technical Operations Human Factors Program to ensure robust air-ground integration research. Through use of modeling, simulation, and demonstration, the program assesses interoperability of tools, develops design guidance, determines training requirements, and verifies procedures for ensuring efficient and effective human system integration in transitions of NextGen capabilities.

Outputs include:

- Define the changes in roles and responsibilities between pilots and controllers, and between humans and automation, required to implement NextGen.
- Define human and system performance requirements for design and operation of aircraft and air traffic management systems.
- Develop and apply error management strategies, mitigate risk factors, and reduce automation-related errors.
- Demonstrate the transition of self-separation responsibility to pilots.

Research Goals:

By FY 2008:

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

By FY 2009:

- Develop a system safety approach to understand error patterns of pilots, maintenance personnel, and inspectors, and identify intervention strategies.
- Develop certification guidelines and human factors standards for integrating advanced technologies.
- Develop training guidelines for flight deck error management.

By FY 2012:

- Improve design of computer-human interfaces to reduce information overload and resulting errors.
- Improve pilot situational awareness, and provide corrective mechanisms to compensate for pilot skills degradation or automation failure.
- Assess cognitive and contextual factors to improve operator performance and reduce errors.
- Apply program-generated knowledge of human factors to improve selection and training of aviation system personnel.
- Examine effective roles for pilots and how those roles are best supported by allocation of functions between human operators and automation.
- Address human automation integration issues regarding the certification of pilots, procedures, training, and equipment associated with enhanced CNS/ATM operations necessary to achieve NextGen capabilities.

Customer/Stakeholder Involvement: Program researchers work directly with colleagues in FAA, other government agencies, academia, and industry to support the following R&D programs and initiatives:

- NASA's Aviation Safety Program.
- FAA's Voluntary Safety Program Office initiatives including Advanced Qualification Program (AQP), Flight Operations Quality Assurance (FOQA), and Aviation Safety Action Program (ASAP).
- FAA Research, Engineering and Development Advisory Committee – representatives from industry, academia, and other government agencies annually review the activities of the program and provide advice on priorities and budget.

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

- Collaborative research with NASA on its safety, airspace and air portal projects includes the identification of human factors research issues in the NextGen as technology brings changes to aircraft capabilities. Complex full mission demonstrations using a distributed simulation architecture will leverage NASA cockpit and ATM simulation facilities and other resources.
- Grants will be used with universities to address NextGen human factors issues.
- Coordination on research issues and plans with aircraft and avionics manufacturers and operators.

Accomplishments: This is a new program starting in FY 2009.

FY 2009 PROGRAM REQUEST:

The program will assess human system integration issues in use of airborne NextGen concepts, capabilities, and procedures, and ATM leading to a full mission demonstration in 2015.

Roles and Responsibilities

- Define a transition roadmap for delegating spacing and separation responsibilities to the pilot, while ensuring concomitant changes in controller roles and procedures.

Human System Integration

- Develop certification and operational approval guidelines for NextGen integrated technology and applications.
- Identify requirements for collaborative ATM in use of probabilistic weather information by pilots and controllers.

Error Management

- Assess information requirements for use of pilot-automation interfaces necessary for NextGen separation.

Integrated Demonstrations

- Define a plan to integrate complex demonstrations, simulations, and field trials, which includes goals, operational environments, NextGen separation procedures, participants, roles and responsibilities, and measurements, supporting incremental transitions of NextGen concepts and capabilities.

KEY FY 2009 MAJOR ACTIVITIES AND ANTICIPATED ACCOMPLISHMENTS:

Roles and Responsibilities

- Develop guidance addressing allocation of functions between the aircrew and automation, including information automatically displayed to the pilot compared to manually requested information.

- Develop guidance in changing roles as responsibilities shift from air traffic controllers to pilots.

Human System Integration

- Develop guidance for certification of NextGen avionics and flight deck integration.
- Identify human factors issues in the operational approval of NextGen avionics enabled capabilities.
- Complete a preliminary cognitive task analysis supporting common information between pilots and controllers in use of probabilistic weather information.
- Assess communication and display issues in use of NextGen weather information supporting collaborative ATM.

Error Management

- Develop guidance for use of pilot-automation interfaces necessary for NextGen separation.

Integrated Demonstrations

- Develop a simulation and demonstration roadmap laying out incremental objectives, simulation requirements, assumptions, and risks for assessing integration of controller tools, including for weather and wake separation.

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2007)	$0
FY 2008 Appropriated	0
FY 2009 Request	2,554
Out-Year Planning Levels (FY 2010-2013)	45,900
Total	$48,454

Budget Authority ($000)	**FY 2005 Enacted**	**FY 2006 Enacted**	**FY 2007 Enacted**	**FY 2008 Enacted**	**FY 2009 Request**
Contracts:					
NextGen-Air Ground Integration					2,485
Personnel Costs					69
Other In-house Costs					0
Total					**2,554**

OMB Circular A-11, Conduct of Research and Development ($000)	**FY 2005 Enacted**	**FY 2006 Enacted**	**FY 2007 Enacted**	**FY 2008 Enacted**	**FY 2009 Request**
Basic					0
Applied					2,554
Development (includes prototypes)					0
Total					**2,554**

A12.c. – NextGen Air - Ground Integration	FY 2009 Request ($000)	Program Schedule					
		FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013
111-110 NextGen Air-Ground Integration							
Roles and Responsibilities	**$697**						
Develop a transition plan to implement pilot separation			◊	◊	◊	◊	◊
Develop guidance in changing roles as responsibilities shift from air traffic controllers to pilots			◊	◊	◊	◊	
Human System Integration	**$788**						
Develop guidance for certification of NextGen avionics and flight deck integration			◊	◊	◊	◊	
Identify human factors issues in the operational approval of NextGen avionics enabled capabilities			◊	◊	◊	◊	◊
Complete a preliminary cognitive task analysis for use of NextGen concepts and capabilities in technically advanced aircraft				◊	◊		
Identify training issues for assessing pilot proficiency for NextGen advanced avionics. Assess preliminary simulator training requirements for NextGen advanced avionics				◊	◊	◊	◊
Complete a preliminary cognitive task analysis supporting common information between pilots and controllers in use of probabilistic weather information			◊	◊	◊		
Assess communication and display issues in use of NextGen weather information supporting collaborative ATM				◊	◊	◊	
Define procedural requirements for separation				◊	◊		
Identify requirements for use of probabilistic weather information by pilots and controllers			◊	◊	◊	◊	
Error Management	**$500**						
Provide interface design guidance			◊	◊	◊	◊	
Develop training and procedural requirements for automation failure				◊	◊	◊	◊
Develop guidance to reduce cognitive errors				◊	◊	◊	◊
Integrated Demonstrations	**$500**						
Develop roadmap for integrated demonstrations			◊				
Define simulation requirements				◊	◊		
Develop a framework for a data repository				◊	◊	◊	◊
Demonstrate transition to airborne separation				◊	◊	◊	◊
Demonstrate procedures for airborne weather and wake separation				◊	◊	◊	
Demonstrate integrated pilot and controller functional capabilities				◊	◊	◊	◊
Field trial to demonstrate core pilot separation responsibilities				◊	◊	◊	◊
Personnel and Other In-House Costs	**$69**						
Total Budget Authority	**$2,554**	**$0**	**$2,554**	**$11,337**	**$11,720**	**$11,521**	**$11,322**

◆ - Activities Accomplished ◇ - Activities Planned

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

FAA Budget Appropriation	Budget Item	Program Title	Budget Request
R,E&D	A12.d.	NextGen – Self Separation	$8,025,000

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

Supports FAA R&D Goal: Self-Separation.

Intended Outcomes: By 2015, develop initial standards and procedures for self-separation.

New technologies such as GPS, ADS-B, and CDTI afford the possibility of transitioning from classic air traffic control separation assurance procedures to aircraft self-separation. Many NextGen enhanced capabilities are based on various aircraft oriented activities such as spacing, merging, passing, etc. Research will assess the human factors risks and requirements associated with these various separation policies, procedures and maneuvers. The research results will provide technical information to support the development of standards, procedures, and training by Flight Standards to implement the JPDO plan for separation. Human factors research required to provide the scientific and technical information to address human performance issues include:

- Providing human factors assessments on new information requirements to allow pilots to perform separation maneuvers safely and effectively.
- Providing robust assessments of separation procedures to ensure non-normal and emergency operations are evaluated including system failures and reversion impacts. The NextGen benefits associated with reduced aircraft spacing at high density arrival and departure terminal and airports also leaves less buffer to accommodate non-normal events. The impact on safety and efficiency will be addressed.
- Understanding changing roles and responsibilities associated with shifting separation responsibility between pilot and controller under different operational separation situations.
- Developing advanced methods to certify pilots and automation for different separation operations.
- Developing error management strategies to identify and mitigate human-system errors in separation operations.
- Providing guidance for training pilots to assure adequate understanding of automation functions and limitations as they apply to separation operations.

This effort intends to support several NextGen Operational Improvements including:

- Self-spacing, merging and passing in en route airspace is allowed under certain conditions in certain airspace via cockpit display of traffic information (CDTI) and ADS-B.
- Procedures based on required total system performance (RTSP) for less than three mile separation are implemented.
- Trajectories are exchanged via data communications.

Procedural requirements need to be assessed for use of CDTI-assisted visual separation for increasing arrival and departure capacity including during instrument meteorological conditions. This would support several NextGen Operational Improvements including:

- In-trail separation is reduced to near VFR levels for single runway departure operations using ground based wake vortex prediction and detection, CDTI, and ADS-B.
- In-trail separation is reduced to near VFR levels for converging and closely spaced parallel runways based on ground based wake vortex prediction and detection, CDTI, and ADS-B.

The research program will develop plans addressing human performance requirements in transitions to airborne separation assurance and self-separation consistent with the NextGen Concept of Operations. This includes total system performance requirements, human error reduction, and mixed equipage with the effort supporting Operational Improvements such as:

- Aircraft-to-aircraft separation is delegated to the flight deck in oceanic airspace via CDTI and improved CNS (lower RTSP) and oceanic automation (satellite, aircraft, ground surface).
- Aircraft-to-aircraft oceanic longitudinal and lateral spacing is reduced to 15 X 15 nm by use of RNP, ADS/CDTI and data communications.

Agency Outputs: The Flightdeck/Maintenance/System Integration Human Factors Program develops human factors technical information to address roles and responsibilities for pilots and air service providers, human system integration, and error management strategies to implement Trajectory Based Operations, High-Density Arrival/Departure Airports, Flexible Terminal and Airports, and Networked Facilities capabilities. Human factors technical information will also support the standards, procedures, training, and policy required to implement the operational improvements leading to self-separation.

Outputs include:

- Define human factors technical information needed to support the development of standards, procedures, and training by Flight Standards to implement plans for aircraft separation.
- Develop and implement human-systems integration process for separation activities, e.g., spacing, merging, and passing, leading to self-separation.
- Define the changes in roles and responsibilities between pilots and controllers and between humans and automation required to implement separation activities.
- Define human and system performance requirements for separation activities, e.g., spacing, merging, and passing, leading to self-separation.
- Define the potential impact and human factors issues of new technologies such as enhanced vision, synthetic vision, and electronic flight bags on separation activities.
- Develop and apply error management strategies, mitigate risk factors, and reduce automation-related errors associated with separation activities.
- Develop the human factors criteria for the successful use of conflict alerts as they relate to separation maneuvers and how they are communicated and resolved between flight deck and ground monitors.

Research Goals: Conduct R&D to support the standards, procedures, training, and policy required to implement the NextGen operational improvements leading to self-separation including improved awareness of surface/runway operations, reduced separation, and shared separation.

- By 2011, enable oceanic and en route pair-wise separation.
- By 2015, complete research to enable surface movement in zero visibility conditions guided by cockpit display of aircraft and ground vehicles and associated procedures.
- By 2015, complete research and provide human factors guidance to reduce arrival and departure spacing including variable separation in a mixed equipage environment.
- By 2015, enable self-separation in oceanic airspace and high density en route corridors.

Customer/Stakeholder Involvement: Program researchers work directly with colleagues in FAA, other government agencies, academia, and industry to support the following R&D programs and initiatives:

- Guidance from the Joint Planning and Development Office Next Generation Air Transportation System initiative.
- NASA's Aviation Safety Program.
- Close collaboration with FAA organizations, notably Flight Standards and Aircraft Certification in the AVS line of business.
- FAA's Voluntary Safety Program Office initiatives including Advanced Qualification Program (AQP), Flight Operations Quality Assurance (FOQA), and Aviation Safety Action Program (ASAP).
- FAA Research, Engineering and Development Advisory Committee – representatives from industry, academia, and other government agencies annually review the activities of the program and provide advice on priorities and budget.

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

- Collaborative research with NASA on its aviation safety and airspace projects includes the identification of human factors research issues in the NextGen as technology brings changes to aircraft capabilities. Complex full mission simulations using a distributed simulation architecture will leverage NASA cockpit and ATM simulation facilities and other resources.
- Grants will be used with universities to address NextGen human factors issues.
- Coordination on research issues and plans with aircraft and avionics manufacturers and operators.
- Coordination will occur with appropriate RTCA Committees, e.g., Airborne Separation Assistance System.

Accomplishments: This is a new program starting in FY 2009.

FY 2009 PROGRAM REQUEST:

The program will assess human system integration issues in use of airborne NextGen concepts, capabilities, and procedures, and ATM leading to a full mission simulation in 2015.

Level 1 – Surface/Runway Operations Awareness

- Address human factors issues for the cockpit display of aircraft and ground vehicles to guide surface movement during low visibility conditions including runway queuing and runway configuration change.
- Develop human factors criteria for conflict alerting for use in modeling collision risk in surface movement.
- Develop the aircrew requirements for aircraft display and certification criteria necessary for use of staffed virtual towers.

Level 2 – Reduced Separation

- Assess human factors issues to support performance-based ATM.
- Define human factors issues and develop guidance for integrating RSP and RCP with RNP.
- Assess human factors issues for transition to RNP.
- Conduct modeling and simulation to assess pilot performance in reducing separation.
- Assess human factors issues in cockpit display requirements to transition from current operations to the 2015 goal of reduced arrival and departure spacing, including variable separation in a mixed equipage environment.

Level 3 – Shared Separation

- Develop human factors criteria for pilot training in use of limited delegation of separation authority in the oceanic environment.

Level 4 – Self-Separation

- Conduct modeling and simulation to assess human factors issues for airborne self-separation in classic and ANSP flow airspace involving high density en route corridors.

Cross-cutting all four levels

- Provide human factors assessments on new information requirements to allow pilots to perform separation maneuvers safely and effectively.
- Provide robust assessments of separation procedures to ensure non-normal and emergency operations are evaluated including system failures and reversion impacts.
- Assess changing roles and responsibilities associated with shifting separation responsibility between pilot and controller under different operational separation situations.
- Develop advanced methods to certify pilots and automation for different separation operations.
- Develop error management strategies to identify and mitigate human-system errors in separation operations.
- Provide guidance for training pilots to assure adequate understanding of automation functions and limitations as they apply to separation operations.

KEY FY 2009 MAJOR ACTIVITIES AND ANTICIPATED ACCOMPLISHMENTS:

Level 1 – Surface/Runway Operations Awareness

- Define pilot information requirements for runway queuing and runway configuration change during low visibility conditions.
- Assess standards for conflict alerting of aircraft and ground vehicles in surface movement.
- Complete a cognitive task analysis for surface movement for different aircraft types and mixed equipage for use of staffed virtual towers.

Level 2 – Reduced Separation

- Address pilot performance requirements in use of automatic maneuvers.
- Assess interoperability and procedural issues for integrating RSP and RCP with RNP.
- Identify pilot training and procedures for transition to RNP.
- Through modeling and simulation, assess pilot use of flight deck decision support for reduced separation.
- Define human factors issues for display requirements to support reducing arrival and departure spacing, including closely spaced parallel runways.

Level 3 – Shared Separation

- Evaluate pilot training requirements for use of limited delegation of separation authority in the oceanic environment.

Level 4 – Self-Separation

- Conduct preliminary modeling and simulation to assess pilot performance during self separation in classic and ANSP flow airspace.

Cross-cutting all four levels

- Provide human factors assessments on new information requirements to allow pilots to perform separation maneuvers safely and effectively.
- Provide robust assessments of separation procedures to ensure non-normal and emergency operations are evaluated including system failures and reversion impacts.
- Assess changing roles and responsibilities associated with shifting separation responsibility between pilot and controller under different operational separation situations.
- Develop advanced methods to certify pilots and automation for different separation operations.
- Develop error management strategies to identify and mitigate human-system errors in separation operations.
- Provide guidance for training pilots to assure adequate understanding of automation functions and limitations as they apply to separation operations.

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2007)	$0
FY 2008 Appropriated	0
FY 2009 Request	8,025
Out-Year Planning Levels (FY 2010-2013)	39,694
Total	$47,719

Budget Authority ($000)	FY 2005 Enacted	FY 2006 Enacted	FY 2007 Enacted	FY 2008 Enacted	FY 2009 Request
Contracts:					
NextGen - Self Separation					7,956
Personnel Costs					69
Other In-house Costs					0
Total					**8,025**

OMB Circular A-11, Conduct of Research and Development ($000)	FY 2005 Enacted	FY 2006 Enacted	FY 2007 Enacted	FY 2008 Enacted	FY 2009 Request
Basic					0
Applied					8,025
Development (includes prototypes)					0
Total					**8,025**

A12.d. - NextGen - Self-Separation Product and Activities	FY 2009 Request ($000)	Program Schedule					
		FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013
111-120 NextGen – Self Separation							
Surface/Runway Operations Awareness	**$1, 619**						
Complete human factors guidance for staffed virtual towers			◊	◊			
Model collision risk for surface movement				◊	◊		
Display aircraft and vehicles in the cockpit			◊	◊	◊		
Assess surface movement in zero visibility conditions			◊	◊	◊	◊	◊
Reduced Separation	**$1,850**						
Develop guidance for pilot use of automatic maneuvers				◊	◊		
Assess training and procedural issues with RNP			◊	◊	◊		
Complete human factors guidance for closely spaced parallel runways			◊	◊	◊	◊	◊
Assess procedures for flight deck decision support			◊	◊	◊	◊	◊
Shared Separation	**$1,375**						
Evaluate pilot training requirements for limited delegation of separation authority			◊				
Complete assessment of issues in oceanic pair-wise separation			◊	◊	◊		
Complete assessment of issues in en route pair-wise separation				◊	◊		
Self-Separation	**$750**						
Assess pilot performance in classic and ANSP flow airspace				◊	◊	◊	
Define guidance for self-separation in oceanic airspace and high density en route corridors			◊	◊	◊	◊	◊
Cross-Cutting	**$2,362**						
Provide human factors assessments of new information requirements			◊	◊	◊	◊	
Provide robust assessment of separation procedures to ensure non-normal and emergency operations are evaluated, including system failures and reversion impacts				◊	◊	◊	◊
Assess impacts of changing roles and responsibilities			◊	◊	◊		
Develop advanced methods to certify pilots and automation for different separation operations			◊	◊	◊	◊	◊
Develop error management strategies to identify and mitigate human-system errors				◊	◊	◊	
Provide guidance for training pilots for automation use in separation operations			◊	◊	◊	◊	◊
Personnel and Other In-House Costs	**$69**						
Total Budget Authority	**$8,025**	**$0**	**$8,025**	**$9,805**	**$10,136**	**$9,963**	**$9,790**

◆ - Activities Accomplished ◇ - Activities Planned

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

FAA Budget Appropriation	Budget Item	Program Title	Budget Request
R,E&D	**A12.e.**	**NextGen – Weather Technology in the Cockpit**	**$8,049,000**

Supports FAA Strategic Goals: Increased Safety and International Leadership.

Intended Outcomes: By 2015, demonstrate common real-time awareness of current and forecast weather data by pilots and controllers.

To achieve a three times increase in capacity, increase arrival rates to 95 percent, and reduce gate-to-gate transit time by 30 percent – while maintaining safe operations – there must be a common weather picture to pilots, controllers, and users. Weather data, combined with other ATM system data, shall support a common situational awareness by pilots and controllers and automated and collaborative flight planning and decision making.

Although in many cases Part 121 operators have onboard weather, there are incongruities between how pilots view weather and what is used by controllers. NextGen intends to provide increasingly sophisticated weather products to controllers that should more closely parallel capabilities on the flight deck. Accruing NextGen benefits for weather necessitates effective integration of what information is provided to pilots and controllers and the training and procedures for its use.

For Part 91 operators failing to recognize and flying into adverse weather conditions is the leading factor of GA fatalities. There is a wide spectrum of weather products available to GA pilots and research is necessary to support the development of standards for weather products and weather data available to pilots and the appropriate use of weather data.

Use of weather information in Part 135 operations varies by size and type of aircraft. Research needs to examine differences and develop standards on its use.

Several Operational Improvements (OIs) identified by the JPDO Weather IPT (OIs #2, 12, 13, 22, and 29) can not be implemented without the completion of the research within the weather technology in the cockpit program.

Agency Outputs: Weather technology in the cockpit enables pilots and aircrews to engage in shared situational awareness and shared responsibilities with controllers, dispatchers, Flight Service Station (FSS) specialists, and others, pertaining to safe and efficient preflight, en route, and post flight aviation safety decisions involving weather.

There are two parts to this program: Cockpit Weather Technologies and Human Factors for Cockpit Weather Technologies. Cockpit Weather Technologies develops policy and standards for hardware and software requirements, including update rates, and guidelines and procedures for testing, evaluating, and qualifying weather systems for certification and operation on aircraft. Human Factors for Cockpit Weather Technologies addresses policy, standards, and guidance for the display of weather information and its use, including design guidance, training, procedures, and error management.

Research Goals: Research will enable development of policy, standards, and guidance needed to safely implement weather technologies in the cockpit to provide shared situational awareness and shared responsibilities. The goals of the research are:

- By 2010, develop design approval guidance for hardware and software standards.
- By 2010, develop design approval guidance for archiving weather data.
- By 2010, develop initial guidance for operational approval of new products and products from non-government vendors.

- By 2015, support a full mission demonstration assessing weather information in integrated NextGen air and ground capabilities for controllers and pilots.

Customer/Stakeholder Involvement: The Weather Program works within FAA, industry and government groups to assure its priorities and plans are consistent with user needs. This is accomplished through:

- Guidance from the JPDO Next Generation Air Transportation System initiative.
- Inputs from the aviation community, such as the annual National Business Aircraft Association conference, the Friends/Partners in Aviation Weather Forum, scheduled public user group meetings, and domestic and international aviation industry partners including Boeing.
- Subcommittees of the FAA Research, Engineering and Development Advisory Committee – representatives from industry, academia, and other government agencies annually review program activity, progress, and plans.
- RTCA SC-206 and Society of Automotive Engineers G-10 subcommittees.

R&D Partnerships: The Weather Program leverages research activities with members of industry, academia, and other government agencies through interagency agreements, university grants, and Memorandums of Agreement.

Partnerships include:

- National Center for Atmospheric Research.
- NASA Langley and Glenn Research Centers.
- Army Cold Regions Research and Engineering Laboratory.
- Universities.
- Airlines, pilots, and manufacturers.

Accomplishments: This narrative describes additional funding requested in FY 2009 for the weather technology in the cockpit initiative. The base funding for the weather technology in the cockpit initiative is described in the base Weather Program (A11.k). Accomplishments prior to FY 2009 are listed there.

FY 2008 MAJOR ACTIVITIES AND ANTICIPATED ACCOMPLISHMENTS:

FY 2008 major accomplishments and activities are listed in the base Weather Program (A11.k) narrative.

FY 2009 PROGRAM REQUEST:

Ongoing Activities (Acceleration of activities in the base program)

- Identify, validate, and document data link system attributes that may affect the provision and use of weather-in-the-cockpit products and services.
- Develop initial guidance for operational approval of new products and products from non-government vendors.
- Accelerate turbulence radar and Turbulence Auto-PIREP System infusion into the NAS.

New Initiatives (Additions to those listed in the base program)

- Develop CONOPS for weather-in-the-cockpit, including GA operations.
- Evaluate use of aircraft to collect, process, and disseminate weather data (aircraft as a node in the system).
- Develop prototype weather products for use in the cockpit.
- Develop standards and guidance for design approval of weather decision support for cockpit use including integration of weather information with existing CNS/ATM information on multi-function displays.
- Develop guidance to weather program to enhance usability of forecasting products for pilot decision making.
- Evaluate procedures to include weather information into the flight deck decision process to include the use of internal, e.g., onboard weather radar, and external sources of weather information.
- Develop guidelines to identify and mitigate pilot errors related to weather information usage.
- Develop methods for effective cooperative use of weather information among pilots, controllers, dispatch, and Air Traffic Operation Centers to enhance weather-related safety and efficiency decisions.

KEY FY 2009 MAJOR ACTIVITIES AND ANTICIPATED ACCOMPLISHMENTS:

- Develop CONOPS for weather in the cockpit, including integration of weather information into flight deck decision support tools, weather dissemination management.
- Initiate feasibility study for use of aircraft to collect, process, and disseminate weather information.
- Develop standards and guidance for design approval of weather decision support for cockpit use including integration of weather information with existing CNS/ATM information on multi-function displays.
- Develop guidance to weather program to enhance usability of forecasting products for pilot decision making.
- Evaluate procedures to include weather information into the flight deck decision process to include the use of internal, e.g., onboard weather radar, and external sources of weather information.
- Develop guidelines to identify and mitigate pilot errors related to weather information usage.
- Develop methods for effective cooperative use of weather information among pilots, controllers, dispatch, and Air Traffic Operation Centers to enhance weather-related safety and efficiency decisions.

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2007)	$0
FY 2008 Appropriated	0
FY 2009 Request	8,049
Out-Year Planning Levels (FY 2010-2013)	39,987
Total	$48,036

Budget Authority ($000)	FY 2005 Enacted	FY 2006 Enacted	FY 2007 Enacted	FY 2008 Enacted	FY 2009 Request
Contracts:					
NextGen – Weather Technology in the Cockpit					7,894
Personnel Costs					155
Other In-house Costs					0
Total					**8,049**

OMB Circular A-11, Conduct of Research and Development ($000)	FY 2005 Enacted	FY 2006 Enacted	FY 2007 Enacted	FY 2008 Enacted	FY 2009 Request
Basic					0
Applied					8,049
Development (includes prototypes)					0
Total					**8,049**

A12.e – Weather Technology in the Cockpit Product and Activities	FY 2009 Request ($000)	Program Schedule					
		FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013
111-140 Weather in the Cockpit							
Cockpit Weather Technologies	**$2,702**						
Develop CONOPS for weather in the cockpit			◊	◊			
Conduct feasibility study for aircraft as a node				◊	◊		
Develop weather technology roadmaps			◊	◊			
Develop initial guidance for operational approval of primary products				◊			
Assess safety impact of weather products used in cockpit					◊		
Select concept and initial systems engineering of weather decision support into cockpit system					◊	◊	
Develop and test operational prototype for weather decision support tools in the cockpit						◊	◊
Human Factors for Cockpit Weather Technologies	**$5,192**						
Develop guidance for airman training and evaluation criteria				◊	◊	◊	◊
Develop standards and guidance for design approval of weather decision support tools			◊	◊	◊	◊	
Develop guidance to enhance use of forecasting products for pilot decision making			◊	◊	◊	◊	◊
Evaluate procedures to include weather information into the flight deck decision process			◊	◊	◊	◊	
Develop guidelines to identify and mitigate pilot errors related to weather information usage			◊	◊	◊	◊	◊
Develop methods for cooperative use of weather information among pilots, controllers, and dispatch			◊	◊	◊	◊	◊
Personnel and Other In-House Costs	**$155**						
Total Budget Authority	**$8,049**	**$0**	**$8,049**	**$9,867**	**$10,202**	**$10,040**	**$9,878**

◆ - Activities Accomplished ◇ - Activities Planned

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

FAA Budget Appropriation	Budget Item	Program Title	Budget Request
R,E&D	**A13.a.**	**Environment and Energy**	**$15,608,000**

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

Intended Outcomes: The Environment and Energy Program helps achieve FAA's environmental compatibility goal and supports the FAA Flight Plan. The program also provides fundamental knowledge and tools to support the Next Generation Air Transportation System (NextGen) research and development plan. The efforts complement activities in technology and operational solutions and environmental management systems and models development under NextGen research.

The Program specifically supports the following outcomes:

The Flight Plan Noise Exposure Performance Target to reduce the number of people exposed to significant noise by four percent per year through FY 2012 as measured by a three-year moving average, from the three-year average for calendar year 2000 – 2002.

Specific activities include:

- Conduct research and develop analytical tools to understand better the relationship between noise and emissions and different types of emissions, and to provide the cost-benefit analysis capability necessary for data-driven decision-making.
- Through the PARTNER Center of Excellence (COE) identify and better measure the issues and impacts associated with aircraft noise, and generate improved solutions to mitigate these problems.
- Identify and assess the impact and enable implementation of operational procedures to reduce noise in the NAS.
- Minimize the impact of aircraft noise – actions include: advancing the state of science/knowledge concerning effects of aircraft noise; improving aircraft certification standards and existing operational procedures; and implementing improved noise control and mitigation measures.

The Flight Plan Aviation Fuel Efficiency Performance Target improves aviation fuel efficiency per revenue passenger-mile by one percent each year through FY 2012, as measured by a three-year moving average, from the three-year average for calendar years 2000-2002.

Specific activities include:

- Conduct research and develop analytical tools to understand better the relationship between noise and emissions and different types of emissions, and to provide the cost-benefit analysis capability necessary for data-driven decision making.
- Through the Partnership for AiR Transportation Noise and Emissions Reduction (PARTNER) Center of Excellence (COE) identify and better measure the issues and impacts associated with aviation emissions, and generate improved solutions to mitigate these problems.
- Assess the impact and enable implementation of operational procedures to reduce aviation emissions in the NAS.
- Minimize the impact of aviation emissions – actions include: advancing the state of science/knowledge concerning atmospheric/health effects of aviation emissions; and improving aircraft certification standards and operational procedures; and implementing improved emissions control and mitigation measures.

Flight Plan International targets include fostering international environmental standards, recommended practices, and guidance material that are technically feasible, economically reasonable, provide a measurable environmental benefit and take interdependencies between various emissions and between missions and noise into account. Specific activities include:

Specific activities include:

- Working with the international aviation community to reduce aircraft noise – actions include:
  - Improving aircraft certification standards and operational procedures.
  - Promoting compatible land use.
  - Applying abatement technologies around populations exposed to aircraft operations.

The Program also contributes to the following outcomes:

- • NextGen goal to promote environmental stewardship by reducing significant community noise and local air quality emissions impacts in absolute terms, limiting or reducing the impact of aviation greenhouse gas emissions on global climate, and balancing aviation's environmental impact with other societal objectives. Specific activities include:
  - Develop fundamental knowledge to aid in better science-based understanding of impacts of aircraft noise and aviation emissions on local air quality and climate change to enable the NextGen goal of three-fold growth in capacity by 2025, while reducing significant community noise and local air quality emissions in absolute terms.
  - Developing tools to assess the ability of technologies for airframes, more efficient engines, advanced propulsion concepts, new fuels and materials to reduce source noise and emissions.

Agency Outputs: The program is developing and validating methodologies, models, metrics, and tools to assess and mitigate the effect of aircraft noise and aviation emissions in a manner that balances the interrelationships between emissions and noise and considers economic consequences. It is also developing computer models and impact criteria for use by civil aviation authorities in assessing proposed actions. Researchers are also developing a better science-based understanding of the effects of aircraft noise and aviation emissions.

Research Goals:

- By FY 2009, develop and distribute a second generation of more robust integrated noise and emission prediction and modeling tools for global applications.
- By FY 2009, develop a second generation airline and technology environmental cost module for integrated noise and emissions tools using updated methodologies.
- By FY 2009, continue to develop and implement as they become available methods and models to analyze aircraft, auxiliary power units, and ground support equipment emissions and their impact on air quality.
- By FY 2009, implement a methodology for assessing hazardous air pollutant emissions in the vicinity of an airport; issue updated guidelines for national consistency in environmental assessment.
- By FY 2009, exercise databases of particulate matter emissions to assess trends as a function of engine combustor technology and other emissions, and impacts on health and welfare, in order to advise options for mitigation, as required.
- By FY 2009, advance our understanding of the evolution of volatile particulate matter emissions in order to specify measurement and sampling procedures for regulatory consideration.

- By FY 2009, complete an assessment of technology response to more stringent oxides of nitrogen (NOx) emissions standards, taking into account interdependencies and any tradeoffs among emissions and with noise.
- By FY 2009, establish benefits of implementation of a new continuous-descent arrival (CDA) noise abatement and fuel burn (emissions) reduction procedure at low-traffic airports during nighttime operations.
- By FY 2009, develop new technical guidance for noise and aircraft engine emissions certification.
- By FY 2010 provide computer models and impact criteria for use by civil aviation authorities in environmental assessments.
- By FY 2010, test and deploy first elements of the website to educate and inform the public about aviation and the environment and to enable the community to participate actively in public processes.
- By FY 2011, develop and disseminate a preliminary planning version of Aviation Environmental Design Tool that will allow integrated assessment of noise and emissions impact at the local and global levels.
- By FY 2013, develop and field a fully validated suite of tools, including the Environmental Design Space (EDS) and Aviation Environmental Portfolio Management (APMT) tools, which will allow cost benefit analyses.
- By FY 2013, use hazardous air pollutants and particulate matter direct measurements from engines to replace approximation methods and factors used in modeling tools.

In addition, the program is conducting government-industry sponsored research through the Partnership for AiR Transportation Noise and Emissions Reduction (PARTNER) Center of Excellence (COE) to identify and measure more accurately the issues and impacts associated with aircraft noise and aviation emissions, and generate improved solutions to deal with these problems.

Specifics of these cooperative research efforts include:

- By FY 2009 develop and disseminate new standards and methodologies to quantify and assess the impact of aircraft noise and aviation emissions for use by industry, government, and the public – also suggest a new metric to assess the acceptability of sonic boom from supersonic aircraft.
- By FY 2009, develop preliminary methodologies to quantify and assess the impact of Particulate Matter and Hazardous Air Pollutants (HAP).
- By FY 2010, assess the impacts of aviation on regional air quality including the effects of NOx emissions that result when aircraft climb and cruise.
- By FY 2010 test and deploy elements of an Internet capability to educate and inform the public about aviation and the environment.
- By FY 2011, assess the level of certainty of aviation's impact on climate change and advance the state of practical science research, with special emphasis on addressing the identified major uncertainties and gaps in our understanding of current and projected impacts of aviation on climate and to develop metrics that will enable us to characterize those impacts for purposes of advising options for mitigation.

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

- *The FAA Aviation Rulemaking Advisory Committee* – a formal standing committee composed of representatives from aviation associations and industry. The committee conveys its recommendations, advice, and information to FAA for consideration in rule making activities, and its harmonization working groups ensure that domestic and international aircraft noise certification regulations impose uniform standards upon the aircraft of all countries.
- *International Civil Aviation Organization's (ICAO) Committee on Aviation Environmental Protection (CAEP)* – this committee establishes and continually assesses the adequacy of international aviation environmental standards for aircraft noise and engine exhaust emissions.
- *The Federal Interagency Committee on Aviation Noise (FICAN)* – encourages debate and agreement over needs for future aviation noise abatement and resulting new research efforts. FICAN conducts annual public forums in different geographic regions with the intent to better align noise abatement research with local public concerns.
- *Aviation Emissions Characterization (AEC) Roadmap* – developed by government and industry to coordinate research and regulatory activities. The objective of this long-range action plan is to gain the necessary understanding of particle formation, composition, and growth and transport mechanisms for assessing aviation's particulate emissions, and hazardous air pollutants, and understanding their impact on human health and the environment. Ultimately, if warranted, this activity will guide the development of aviation related technology that results in reduced particulate emissions.
- *NextGen* – FAA is leading an Environmental Working Group (E-WG) responsible for leading environmental dimensions of the JPDO. The WG comprises FAA, NASA, the Environmental Protection Agency (EPA), DoD, Department of Commerce, Council on Environmental Quality, Department of the Interior, and Office of the Secretary of Transportation, as well as industry, academia, local government, and community groups. The efforts of the E-WG are centered on advancing the national vision and recommendations for aviation in the NextGen and in the congressionally mandated study on "Aviation and the Environment."
- *Climate Change Science Program (CCSP)* – The FAA is working with the CCSP program office and its individual member agencies to focus research efforts that address the uncertainties and gaps in our understanding of current and projected impacts of aviation on climate, and to develop metrics to characterize these impacts.

R&D Partnerships: Through a series of Memorandums of Agreement (MOA), FAA works closely with NASA to identify long-term source abatement technologies for noise and emissions. Together, the agencies also work with industry and academia to assess the possible global impact of aircraft engine exhaust emissions. In FY 2005, FAA signed an MOA with DoD to pursue joint activities to understand and mitigate aviation noise and emissions. The FAA is also pursuing collaborative agreements with DoE, and EPA to leverage resources to address aviation's environmental impact.

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

- The Volpe National Transportation Systems Center continues, in collaboration with the Environment and Energy Program, to provide substantial technical assistance in the areas of aircraft noise and engine emissions measurement and assessment.
- FICAN also offers a forum for partnership, as the Committee comprises all federal agencies concerned with aviation noise. The FAA works with this committee to foster greater, more cost-effective partnering in aviation noise research among all agencies.

Accomplishments: The number of people exposed to significant noise levels was reduced by about 90 percent between 1975 and 2007. Today's aircraft are also 70 percent more fuel-efficient-per-passenger-mile than jet aircraft of the 1960s. Reduced fuel consumption and technologies to reduce emissions have also led to a 90 percent reduction in carbon monoxide, smoke, and other aircraft emissions. Specific recent accomplishments include:

FY 2007:

- Developed and demonstrated the first versions of AEDT, EDS and APMT. These tools will revolutionize approaches to aviation environmental assessment and regulation by enabling a comprehensive approach that assesses interdependencies and optimizes solutions based on cost-benefit analyses of impacts and mitigation. The tools will provide significant cost savings and other benefits to users.
- Released new versions of computer models to assess noise and emissions exposure incorporating the latest science and methodologies
- Completed the analyses supporting a Report to Congress, jointly with EPA, on the impact of aircraft emissions on air quality in nonattainment areas; ways to promote measures that allow aviation to enhance fuel efficiency and to reduce emissions; and opportunities to reduce air traffic inefficiencies that both waste fuel and increase emissions.
- Completed an assessment of the feasibility of using alternative fuels in commercial aviation. The assessment included a comprehensive assessment of well to tail emissions from coal and gas derived and renewable alternative fuels.

FY 2006:

- Released advanced version of highly influential advanced computer models for airport and heliport noise analysis –over 1000 users in over 40 countries. The models are used in over 160 U.S. airport studies involving more than $1.8 billion in airport noise compatibility grants, and recently provided the basis for an aircraft noise exposure prediction model for air tours in the Grand Canyon National Park.
- Released advanced version of a computer model that is used extensively by over 300 domestic and international users in airport air quality analyses and has won the EPA's highest endorsement.
- JPDO Environmental Integrated Product Team (E-IPT, now E-WG) instituted a framework for establishing national goals for aviation and the environment and completed a "gap analysis" of environmental R&D programs necessary to meet NextGen goals.
- Reported to Congress regarding a comprehensive national study of ways to reduce aircraft noise and emissions.

FY 2005:

- Developed a handbook on aviation emissions that serves as the definitive source on this evolving issue.
- Developed a first order approximation to help airports assess aircraft particulate emissions and demonstrate compliance with the National Environmental Policy Act and the Clean Air Act.
- Developed a novel methodology for assessing noise, local air quality emissions, and aviation climate impacts using a common currency.

FY 2004:

- Initiated a long-term, strategic effort to develop analytical tools to address the relationship between noise and emissions and different types of emissions. The long-term aim is a comprehensive approach to addressing all aspects of noise and emissions. The tools will facilitate better-informed decisions that can cost in excess of $10 billion to government and industry.
- Developed a modeling capability to produce annual inventories of aircraft greenhouse gas emissions and to assess aviation's forecasted global emissions.

FY 2003:

- Established the PARTNER COE to allow partnerships with universities, research institutions, and industry to conduct exploratory research to identify and better measure the issues and impacts associated with aircraft noise and aviation emissions, and generate improved solutions to deal with these problems.
- Demonstrated new Continuous Descent Arrival noise abatement procedures in collaboration with NASA, academia, manufacturers, and airline and airport operators.

FY 2009 MAJOR ACTIVITIES AND ANTICIPATED ACCOMPLISHMENTS:

Noise and Emissions Analyses and interrelationships

- Complete an annual assessment of noise exposure and fuel burn.
- Deliver Aviation Environmental Design Tool (AEDT) Version 2.0, including Environmental Design Space (EDS), capability for ICAO Committee on Aviation Environmental Protection (CAEP)/8 Application.
- Deliver Aviation Portfolio Management Tool (APMT) Version 2.0 for CAEP/8 Application.
- Develop alpha version of AEDT tool for local application.
- Assess noise and emissions for various technology, operational, and airspace enhancement scenarios.
- Demonstrate a new comprehensive approach to aviation environmental impact mitigation through a significant example problem.
- Continue upgrades to Integrated Noise Model (INM), Emissions and Dispersion Modeling System (EDMS), Modeling System For Assessing Global Noise Exposure (MAGENTA), and System For Assessing Aviation Global Emissions (SAGE) modules for incorporation into AEDT and to support existing customers as necessary.
- Develop business case and cost allocation for implementation of clean and quiet operational procedures.
- Work with candidate airports to identify opportunities to implement clean and quiet operational procedures.
- Explore provisions for clean and quiet procedure usage in airspace redesign projects.

Aircraft noise

- Promulgate new procedures and technical guidance for noise certification for aircraft (subsonic jet and large transport airplanes, small propeller airplanes, and rotorcraft) that are both harmonized and simplified.
- Recommend and develop widely accepted impact metrics within noise community on sleep disturbance, annoyance, speech interference and perceptible vibration.
- Investigate the role of aviation noise in combined transportation noise around airports and its impact to communities.
- Investigate how average Day-Night-Level (DNL) performs compared to other noise impact metrics;
- Complete Land Use metrics study and publish a report.
- Conduct a study to analyze the four elements of the Balanced Approach (technology to reduce noise at the source, land use planning and management, quieter operational procedures, and operational restrictions) to noise abatement and their relationships.
- Continue to assess potential benefits of using newly developed noise reduction technologies and operational procedures; identify technology and operational goals for long-term reduction of aircraft noise.
- Continue developing interactive website/software to communicate complex noise technical information in a manner suitable for public distribution (NoiseQuest) and complete educational component of NoiseQuest.
- Advance the sonic boom metric definition and continue to assess the applicability of existing noise metrics to sonic boom and determined annoyance of low boom waveforms to inform future decision-making regarding supersonic flight over land.
- With the "Aviation emissions activity," conduct two COE focused sessions at a national and an international conference.

Aviation emissions

- Continue to develop and publish procedures and technical guidance materials for aircraft engine exhaust emissions testing and certification that are internationally harmonized and simplified, taking into account modernization in measurement methodologies and advancements in technical understanding.
- Continue to develop and disseminate methodologies and procedures to quantify and assess the impact of Particulate Matter and Hazardous Air Pollutant emissions on the environment.
- Conduct analysis of actual aircraft engine emissions measurements to better understand the generation of emissions during engine start-up, ground idle and taxi operation, during aircraft ground roll immediately prior to takeoff, and under varying ambient conditions.
- Continue to:
    - Assess potential benefits of using newly developed engine emissions reduction technologies, monitor state of technology advancements against the established goals for long term reduction of aircraft engine NOx emissions, and initiate establishment of aircraft technology goals for long term reduction of fuel burn.
    - Assess potential benefits of optimized operational procedures to reduce emissions and fuel burn
    - Assess the atmospheric and health effects of aviation related emissions through the PARTNER COE.

  - Test and analyze particulate matter emissions from aircraft engines as identified under the PM Roadmap; establish databases of PM emissions from aircraft engines that can be used for trends assessment.
- Initiate effort required to plan an additional study to collect particulate matter and plume evolution/expansion data using light detection and ranging (LIDAR) technology that can be used to enhance dispersion analytical models embodied in our local air quality tools.
- Develop preliminary agreed upon methods to measure PM emissions from commercial aircraft engines, taking into account an assessment of the impact of PM emissions.
- Assess whether there are unique health effects associated with particulate matter emissions and hazardous air pollutants from aviation sources.
- Initiate assessment of uncertainty of impact of aviation on climate change with special emphasis on practical application of research results to aid the development of models to assess mitigation options.
- Initiate an assessment of the impacts of aviation on regional air quality including the effects of emissions attributable to aircraft climb and cruise activities.
- With the "Aircraft noise activity," conduct two COE focused sessions at a national and an international conference.

FY 2009 PROGRAM REQUEST:

In accordance with the National Environmental Policy Act, FAA must consider and mitigate the environmental consequences of its actions. The FAA will continue to work with NASA, the manufacturing industry, and international authorities to support the development and implementation of aircraft environmental certification regulations through proactive response to changes in airplane and engine technology, measurement/analysis technology, regulatory policy, and international regulatory initiatives.

FAA will continue to work with NASA in research efforts identifying noise and emissions reduction technologies that may enter the marketplace within the next 10-15 years. The agency will use these research findings to consider new environmental certification standards and procedures for the next generation of transport aircraft.

Ongoing Activities

Aerospace systems have historically been designed – and regulations for their certification and use have been written – as though aviation noise and various emissions had nothing to do with one another. However, aviation noise and emissions are highly interdependent phenomena. Future environmentally responsible aviation policy and rule making must be based on a new, interdisciplinary approach. Furthermore, this approach must be made as affordable as it is effective.

Existing analytical tools are inadequate to assess interdependencies between noise and emissions or analyze the cost/benefit of proposed actions. Accordingly, FAA is developing a robust new comprehensive framework of aviation environmental analytical tools and methodologies to perform these functions. The long-term aim is to provide a seamless, comprehensive set of tools to address all aspects of noise and emissions. The elements of this framework include:

- EDS capability to provide integrated analysis of noise and emissions at the aircraft level.
- AEDT comprises EDS and other integrated aviation noise and emissions modules – will provide integrated capability of generating interrelationships between noise and emissions and among emissions at the local and global levels.

- APMT comprises AEDT and other modules – will provide the common, transparent cost/benefit methodology needed to optimize national aviation policy in harmony with environmental policy.
- These AEDT and APMT tools will allow:
  - Government agencies to understand how proposed actions and policy decisions affect aviation noise and emissions.
  - Industry to understand how operational decisions affect proposed projects affecting aviation noise and emissions.
  - The public to understand how actions by government and industry affect aviation noise and emissions.

Anticipated benefits of this initiative include the ability to:

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

Other activities include:

- Continue activities through the COE to identify and measure better the issues and impacts associated with aircraft noise and aviation emissions, and generate improved solutions to deal with these problems.
- Continue updating and enhancing existing analytical tool modules (e.g., INM, EDMS, SAGE, MAGENTA), as necessary, to support existing customers and transition to AEDT.
- Support FAA role in the ICAO CAEP working groups for assessing the technological, scientific, operational, and economic aspects associated with maintaining international standards and recommended practices for aircraft noise and engine exhaust emissions.
- Continue efforts to maintain the currency of the regulation and technical guidance materials concerning aircraft noise and engine exhaust emissions certification requirements.

KEY FY 2009 MAJOR ACTIVITIES AND ANTICIPATED ACCOMPLISHMENTS:

Noise and Emissions Analyses and interrelationships

- Complete an annual assessment of noise exposure and fuel burn.
- Complete a significant example analysis to demonstrate the benefit of cost-benefit analyses.
- Deliver Aviation Environmental Design Tool (AEDT) Version 3.0 for CAEP/8 application.
- Deliver Aviation Portfolio Management Tool (APMT) Version 3.0 for CAEP/8 application.
- Deliver Environmental Design Tool Version 3.0, including validated vehicle library and demonstrated capability within AEDT framework for CAEP/8 application.
- Complete integrated system level analyses of NextGen scenarios and strategies (e.g., operations, technologies, policies, etc.).
- Continue upgrades to INM, EDMS, MAGENTA, and SAGE modules for incorporation into AEDT and to support existing customers as necessary.
- Continue working with candidate airports for appropriate implementation of continuous descent arrival (CDA).

- Develop tools to aid in demonstrating CDA procedures in high-density environment.

Aircraft noise

- Promulgate new procedures and technical guidance for noise certification for aircraft (subsonic jet and large transport airplanes, small propeller airplanes, and rotorcraft) that are both harmonized and simplified.
- Continue comprehensive noise annoyance survey.
- Assess potential health impacts of aircraft noise and investigate methodologies to incorporate these impacts in the APMT framework.
- Publish report on noise annoyance metrics, including new metric for supersonic aircraft.
- Complete peer review of noise annoyance data.
- Continue to develop guidance on land use best practices.
- Continue to assess potential global benefits of using newly-developed noise reduction technologies; identify technology goals for long term reduction of aircraft noise.
- Continue advancement of NoiseQuest website.
- With the "Aviation emissions activity," conduct two COE focused sessions at a national and an international conference.

Aviation emissions

- Continue to develop and publish:
    - Procedures and technical guidance materials for affordable engine exhaust emissions testing and certification that are both harmonized and simplified.
    - Develop and disseminate standards and methodologies to quantify and assess the impact of Particulate Matter (PM) and Hazardous Air Pollutants (HAPs) emissions in the aviation environment.
    - Assess potential global benefits of using newly developed emissions reduction technologies, and identify technology goals for long term reduction of aircraft engine emissions and fuel burn.
    - Advance best practices in aviation emissions PM and HAPs measurements.
    - Continue collecting PM and HAPs profiles and measurement data to improve and/or replace approximation methods and advance those data sources in models used to isolate sources, and identify aviation's contribution to impacts.
- Continue assessment of the relative effect of various emissions on climate forcing functions.
- • Continue comparison of detailed chemistry computations to aviation environmental tools approximations.
- Continue developing a model of near field plume evolution/expansion to feed local air quality models.
- Assess whether there are unique health impacts or other environmental effects, particularly for NextGen scenarios, associated with particulate matter emissions and hazardous air pollutants from aviation sources, with specific focus on the aircraft engine.
- Continue assessment of uncertainty of impact of aviation on climate change.
- Complete assessment of the impacts of aviation on local and regional air quality including the effects of emissions attributable to aircraft climb and cruise activities.
- Initiate development of guidance material related to dispersion, chemical and transport modeling (i.e., assessment of aviation-related air pollutant concentrations that effect local and regional air quality).

- Continue evaluation of the necessity for establishing standards pertaining to particulate matter emissions from aircraft engines.
- With the "Aircraft noise activity," conduct two COE focused sessions at a national and an international conference.

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2007)	$153,001
FY 2008 Appropriated	15,469
FY 2009 Request	15,608
Out-Year Planning Levels (FY 2010-2013)	61,418
Total	$245,496

Budget Authority ($000)	**FY 2005 Enacted**	**FY 2006 Enacted**	**FY 2007 Enacted**	**FY 2008 Enacted**	**FY 2009 Request**
Contracts:					
Aircraft Noise	1,164	1,366	1,367	1,359	13,172
Engine Emissions	467	1,596	1,766	1,600	0
Noise & Emissions Analyses	8,436	10,748	10,700	10,213	0
Personnel Costs	1,575	1,985	2,015	2,036	2,127
Other In-house Costs	153	145	170	261	309
Total	**11,795**	**15,840**	**16,018**	**15,469**	**15,608**

OMB Circular A-11, Conduct of Research and Development ($000)	**FY 2005 Enacted**	**FY 2006 Enacted**	**FY 2007 Enacted**	**FY 2008 Enacted**	**FY 2009 Request**
Basic	0	0	0	0	0
Applied	11,795	15,840	16,018	15,469	15,608
Development (includes prototypes)	0	0	0	0	0
Total	**11,795**	**15,840**	**16,018**	**15,469**	**15,608**

A13.a- Environment and Energy Product and Activities	FY 2009 Request ($000)	Program Schedule					
		FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013
091-016 Noise and Emissions Analysis							
Noise and Emissions Analysis	**$9,900**						
Develop architecture for noise/emissions modules communication		◆			◊	◊	
Develop model for assessing global exposure to noise from transport aircraft		◆			◊	◊	
Validate the methodologies used to assess aircraft noise exposure and impact (INM, AEM)		◆		◊			
Release INM updates			◊				
Enhance aircraft noise and emissions modeling for airspace management activities			◊		◊	◊	
Release EDMS updates		◆	◊				
Forecast future global emissions and complete updates to the SAGE model		◆					
Release screening model for airport air quality, version 1, and updates			◊				
Validate methodologies used to assess aviation emissions and their impact on air quality		◆		◊		◊	
Develop first-order approximation method for aircraft engine PM emissions		◆					
Publish handbook for airport air quality analysis and updates		◆	◊	◊	◊	◊	◊
Guidance document for estimating and reducing emissions from ground support equipment							
Resource and guidance materials, and assessment protocol concerning hazardous air pollutants		◆		◊		◊	
Develop AEDT		◆	◊	◊	◊	◊	◊
Release AEDT for local applications					◊		◊
Develop EDS		◆		◊		◊	
Develop APMT		◆		◊		◊	
Harmonize AEDT and APMT databases and code management protocols			◊		◊	◊	
Integrate cost and socioeconomic data			◊		◊	◊	◊
Aircraft Noise	**$1,572**						
Assess aircraft noise reduction strategies research		◆	◊	◊	◊	◊	◊
Assess land use practices and metrics		◆	◊	◊	◊	◊	◊
Publish Advisory Circular 36-4 (and updates)		◆		◊		◊	
Develop a new international noise standard for subsonic jets and large airplanes					◊		◊
Develop a new international noise standard for small props and helicopters				◊			
Apply methodologies used to assess aircraft noise exposure and impact (AEM)			◊	◊			
Prepare COE reports, findings, and other activities		◆	◊	◊	◊	◊	◊
Engine Emissions	**$1,700**						
Assess technological and scientific bases to support future ICAO engine emission standards		◆		◊		◊	
Develop alternative, simplified engine exhaust emissions certification test procedures		◆	◊		◊	◊	◊
Update Advisory Circular 34-1			◊		◊	◊	
Develop measurement/sampling protocol for PM emissions from aircraft engines		◆	◊		◊	◊	◊
Develop science/metrics and reduce uncertainties to assess impact of aviation on climate change			◊	◊			◊
Prepare COE reports, findings, and other activities		◆	◊	◊	◊	◊	◊
Personnel and Other In-House Costs	**$2,436**						
Total Budget Authority	**$15,608**	**$15,469**	**$15,608**	**$15,670**	**$15,467**	**$15,253**	**$15,028**

◆ - Activities Accomplished ◊ - Activities Planned

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

FAA Budget Appropriation	Budget Item	Program Title	Budget Request
R,E&D	**A13.b.**	**NextGen Environmental Research – Aircraft Technologies, Fuels, and Metrics**	**$16,050,000**

Supports FAA Strategic Goals: Greater Capacity.

Intended Outcomes: The NextGen Technologies, Fuels, and Metrics program helps achieve the NextGen goals to increase capacity by reducing significant community noise, local air quality emissions impacts in absolute terms and aviation greenhouse gas emissions impacts on the global climate. The program is focused on reducing current levels of aircraft noise, local air quality and greenhouse gas emissions and energy use and advancing alternative fuels for aviation use.

The Program specifically supports the following outcomes:

Demonstrate aircraft and engine technologies that reduce noise and local air quality and greenhouse gas emissions at the source to a developmental level that will allow quicker industry uptake of these new environmental technologies in order to produce a fleet that will operate more efficiently with less energy usage and permit expansion of airports in a manner consistent with the environmental goals of the NextGen plan.

Specific activities include developing and demonstrating:

- Certifiable aircraft technology that increases aircraft fuel efficiency by 25 percent relative to 1997 subsonic aircraft technology;
- Certifiable engine technology that reduces landing and takeoff cycle (LTO) nitrogen oxide emissions by 50 percent, without increasing other gaseous or particle emissions, over the ICAO standard adopted in 2004;
- Certifiable aircraft technology that reduces noise levels by 10 dB at each of the three certification points relative to 1997 subsonic jet aircraft technology; and
- Determination of the extent to which new engine and aircraft technologies may be used to retrofit or re-engine aircraft so as to increase the level of penetration into the commercial fleet.

Demonstrate alternative fuels for aviation to reduce emissions affecting local air quality and greenhouse gas emissions and increase energy supply security for NextGen.

Specific activities include developing and demonstrating:

- The feasibility of use of alternative fuels in aircraft systems, including successful demonstration and quantification of benefits; and
- Ensuring safety and devising transition strategies that enable “drop in” replacement for petroleum derived turbine engine fuels.

Determining the appropriate goals and metrics to manage NextGen aviation environmental impacts that are needed to support Environmental Management Systems (EMSs) and allow a three times capacity growth.

Specific activities include:

- Establish and implement metrics to better assess and control noise, air quality and climate impacts from anticipated NextGen commercial aircraft operations.
- Evaluate and establish required technology and operational goals and targets to mitigate the environmental impact of projected NextGen and support EMSs implementation.

Agency Outputs: The program is protecting the environment by reducing significant aviation environmental impacts associated with noise, emissions, global climate impact, and energy production. The program will advance and mature, collaboratively with industry, engine and airframe technologies to reduce aviation noise, local air quality and greenhouse gas emissions and energy use. It will also assess the feasibility of and developing alternative aviation fuels that could serve as “drop in” replacements for today’s petroleum derived turbine engine fuels. Ultimately the program will demonstrate advanced technologies and alternative fuels in integrated ground and flight demonstrations.

The program is also helping to achieve NextGen goals by developing metrics to define and measure significant aviation environmental impacts. The program will improve the fundamental understanding of aviation environmental health and welfare and climate impacts and translate impact into improved metrics that can be used to better assess and mitigate aviation’s contribution. This program will identify the gaps in scientific knowledge to support NextGen; focus research in areas that will reduce key uncertainties to levels that allow action; and develop metrics to enable sound analyses. Ultimately, the program will enable establishing goals and targets to support establishing dynamic EMSs to better manage and reduce aviation’s environmental impacts.

Research Goals:

- By FY 2009, establish consortium for Continuous Low Energy, Emissions and Noise (CLEEN) Technologies and award grants and contracts to conduct research.
- By FY 2009, complete detailed feasibility study, including economic feasibility, environmental impacts, and assessment of “drop in” potential for gas turbine alternative fuels.
- By FY 2010, complete system analyses and identify and pursue the development of first round engine and airframe technologies that will be the most effective at producing environmental benefits.
- By FY 2010, complete effort to experimentally measure environmental impacts of “drop in” alternative turbine engine fuels.
- BY FY 2010, initiate demonstration of CLEEN technologies in ground rig tests
- By 2010, estimate how projected NextGen operations-generated emissions and noise impact human health and welfare, and global climate and identify key uncertainties.
- By FY2010, establish the relationship between aircraft engine exhaust and the gaseous and particulate matter emissions that are deposited in the atmosphere.
- By FY2010, establish preliminary metrics and goals to guide CLEEN technology and alternative fuels development and support EMSs.
- By FY 2011, initiate effort to experimentally assess environmental impacts and benefits and costs of renewable alternative turbine engine fuels.
- By FY2011, complete assessment of aviation’s impact on climate change.
- By FY 2012, complete demonstration of CLEEN technologies in ground rig tests.
- By FY 2013, demonstrate airframe and engine technologies to reduce noise, emissions and fuel burn in integrated ground demonstrations for large and regional jets.
- By FY 2013, complete system analyses to identify the most promising CLEEN technologies for flight tests.
- By FY 2012, conduct significant demonstration of “drop in” alternative turbine engine fuels.
- By FY 2012, conduct renewable alternative turbine engine fuels safety, environmental and business case assessments.

- By FY 2013, complete assessment of “drop in” alterative turbine engine fuels and develop implementation plan.
- By FY2013, reduce key uncertainties of aviation impacts to levels that better inform appropriate action.
- By FY 2014, complete system analyses and identify and pursue the development of second round engine and airframe technologies that will be the most effective at producing environmental benefits.
- By FY 2014, demonstrate first round of CLEEN airframe and engine technologies to reduce noise, emissions and fuel burn in integrated flight demonstrations for large and regional jets.
- By FY2014, refine metrics that more accurately capture aviation emissions health and welfare and climate impact and goals to facilitate EMSs implementation.

Customer/Stakeholder Involvement: FAA works closely with other federal agencies, industry, academia, and international governments and organizations to design R&D efforts that can mitigate the environmental impact of aviation and explore alternative gas turbine fuels.

- NextGen -- FAA leads an Environmental Working Group (E-WG) responsible for leading environmental dimensions of the JPDO. The E-WG comprises FAA, NASA, the Environmental Protection Agency (EPA), DoD, Department of Commerce, Council on Environmental Quality, Department of the Interior, and Office of the Secretary of Transportation, as well as industry, academia, local government, and community groups. The efforts of the WG are centered on advancing the national vision and recommendations for aviation in the NextGen and in the congressionally mandated study on “Aviation and the Environment”, including advanced technology and alternative fuels development.
- Commercial Alternative Aviation Fuel Initiative (CAAFI) -- Concerns about rising fuel costs, energy supply security and the environmental effects of aviation are providing a significant stimulus to take a fresh look at the use of alternative fuels for aviation. To forge a way ahead, FAA founded the Commercial Aviation Alternative Fuels Initiative (CAAFI) together with Airports Council International-North America (ACI-NA), the Air Transport Association (ATA) and the Aerospace Industries Association (AIA). CAAFI is teaming with the DoD to leverage their substantial efforts advancing alternative fuels for military aviation– driven by energy security considerations. CAAFI is also working with other Federal agencies such as NASA.

R&D Partnerships: As does the Environment and Energy Research Program and other NextGen activities, the NextGen Aircraft Technologies, Fuels, and Metrics Program relies on a series of Memorandums of Agreement (MOA), to work closely with NASA and DoD. The FAA is also pursuing collaborative agreements with DoE, and EPA to leverage resources to address aviation’s environmental impact.

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

Accomplishments: This is a new effort to address the challenges of NextGen. However, relevant stakeholders have achieved significant accomplishments mitigating aviation’s environmental impact. The number of people exposed to significant noise levels was reduced by about 90 percent between 1975 and 2006. Today's aircraft are also 70 percent more fuel-efficient-per-passenger-mile than jet aircraft of the 1960s. Reduced fuel consumption has also led to a 90 percent reduction in carbon monoxide, smoke, and other aircraft emissions.

FY 2008 MAJOR ACTIVITIES AND ANTICIPATED ACCOMPLISHMENTS:

There were no activities in FY 2008 as this is an FY 2009 new initiative.

FY 2009 PROGRAM REQUEST:

Anticipated increases in air transportation demand will place significant environmental pressures on various segments of the NextGen. The primary environmental constraints on the capacity and flexibility of the NextGen could be community noise, local air quality, global climate impacts, and energy production and consumption. Environmental issues have constrained airport and airspace growth over the past decade. To ensure environmental impacts don't become a constraint on growth in NexGen, we need to accelerate introduction of quieter and cleaner technology in our fleets. Ninety percent of the environmental improvements (noise and emissions reductions) in the aviation system in the last 30 years have come from improved technology. Without a pipeline of near term (5-10 years) technology improvements, we cannot achieve the absolute reduction of significant noise and air quality impacts that we believe are necessary to enable NextGen growth. We need robust research and development to enable technology solutions to manage and mitigate environmental constraints. The goal is to have a fleet of quieter, cleaner aircraft that operate more efficiently with less energy.

We are currently facing larger research and development challenges at a time when we need to make larger technological leaps. Solutions that involve technology improvements in engines and airframes in a foreseeable timeframe require successful maturation and certification of new technologies within the next 5-10 years. This initiative establishes a world-class research consortium that can pursue technology goals to significantly reduce aviation noise, emissions, and fuel consumption. Establishing a world-class research consortium with industry- targeted on maturing technology- will help accelerate introduction of quieter and cleaner technology in our fleets so environmental issues do not become constraints.

The NextGen environmental goal is to reduce significant health and welfare impacts of aviation community noise and local air quality (namely NOx) emissions in absolute terms, notwithstanding growth. Although there is no quantitative goal for greenhouse gas emissions, the NextGen environmental goal does call for limiting or reducing the impact of aviation greenhouse gas emissions on global climate. There is a need to explore the appropriate metrics and system goals to establish significant impacts. There is also a need to develop a robust science-based understanding of impacts of NextGen aviation emissions on earth's climate and translate these impacts into improved metrics that can be used to better assess and mitigate aviation's contribution to climate change. These goals and metrics will enable Environmental Management Systems (EMSs) to mitigate impacts in a dynamic and cost-beneficial manner.

Elements of this initiative include:

- In collaboration with industry, mature noise, emissions and fuel burn reductions technologies (previously conceived by NASA and industry to Technology Readiness Levels (TRL) of 3-4) to levels (TRL 6) that enable industry to expedite introduction of these technologies into current and future products.
- Assess and advance the development of alternative "drop in" and renewable turbine fuels for aviation.
- Develop metrics to better assess and control noise, air quality and climate impacts from NextGen commercial aircraft operations and establish goals and targets to support EMSs implementation to mitigate impacts.

Ongoing Activities

This is a new activity.

KEY FY 2009 MAJOR ACTIVITIES AND ANTICIPATED ACCOMPLISHMENTS:

Noise, emissions and fuel burn reduction technologies maturation

- Establish consortium for Continuous Low Energy, Emissions and Noise (CLEEN) Technologies.
- Award grants and contracts to conduct research.
- Develop a detailed plan to achieve NextGen environmental goals.
- Identify promising noise, local air quality and greenhouse gas, and fuel burn reduction technologies for maturation.
- Conduct component level analyses for promising technologies to optimize environmental and fuel burn performance.
- Conduct detailed integrated system level analyses for large and regional jets to identify the most promising technologies for further maturation.
- Initiate design of demonstration experiments.

Alternative turbine engine fuels

- Complete detailed feasibility study, including economic feasibility of “drop in” alternative turbine engine fuels.
- Initiate planning for experimentally quantifying environmental impacts of “drop in” gas turbine fuels in commercial aircraft engines.
- Initiate efforts to explore the potential of renewable gas turbine fuels for commercial applications.

NextGen Environmental Metrics, Goals and Targets

- Initiate efforts to determine how projected NextGen operations-generated emissions and noise impact human health and welfare, and global climate and identify key uncertainties.
- Determine research efforts necessary to reduce key uncertainties and enhance models.
- Initiate comprehensive modeling efforts to establish the relationship between aviation engine exhaust and the gaseous and particulate matter emissions that are deposited in the atmosphere.
- Identify and assess potential metrics to quantify the climate related impacts of commercial aircraft operations.
- Initiate baseline analyses of potential climate response due to aviation emissions with quantified uncertainties, based on the best available science and modeling tools.

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2007)	$0
FY 2008 Appropriated	0
FY 2009 Request	16,050
Out-Year Planning Levels (FY 2010-2013)	79,802
Total	$95,852

Budget Authority ($000)	**FY 2005 Enacted**	**FY 2006 Enacted**	**FY 2007 Enacted**	**FY 2008 Enacted**	**FY 2009 Request**
Contracts:					
NextGen Environmental Research—Aicraft Technologies, Fuels and Metrics					15,829
Personnel Costs					221
Other In-house Costs					0
Total					**16,050**

OMB Circular A-11, Conduct of Research and Development ($000)	**FY 2005 Enacted**	**FY 2006 Enacted**	**FY 2007 Enacted**	**FY 2008 Enacted**	**FY 2009 Request**
Basic					0
Applied					16,050
Development (includes prototypes)					0
Total					**16,050**

A13.b.- NextGen Environmental Research—Aircraft Technologies, Fuels, and Metrics Product and Activities	FY 2009 Request ($000)	Program Schedule					
		FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013
111-150 NextGen Environmental Research							
Technology Maturation	**$11,329**						
Establish CLEEN Consortium			◊				
System Level Assessments			◊	◊	◊	◊	◊
Component Assessments				◊		◊	
Rig Tests – Round 1			◊		◊		
Rig Tests – Round 2						◊	
Integrated Ground Demonstrators					◊		◊
Flight Demonstrations						◊	◊
Prepare Annual Report			◊	◊	◊	◊	◊
Alternative Turbine Fuels	**$2,000**						
"Drop in" Fuels Feasibility Study			◊	◊			
Renewable Fuels Feasibility Study				◊		◊	
"Drop in" Fuels environmental Assessment			◊	◊			
Renewable Fuels Environmental Assessment				◊		◊	
"Drop in" Safety Assessment				◊		◊	◊
Transition Plans						◊	◊
Prepare Annual Report			◊	◊	◊	◊	◊
Metrics, Goals and Targets	**$2,500**						
Define potential metrics			◊	◊			
Evaluate metrics and models			◊	◊		◊	
Advance measurement approaches				◊		◊	
Climate impact assessments			◊	◊	◊		
Air Quality assessments				◊		◊	
Noise assessments				◊		◊	
Refine metrics				◊	◊	◊	
Assess efficacy of metrics				◊		◊	
Upgrade Assessment Models							◊
Publish Research Reports			◊	◊	◊	◊	◊
Personnel and Other In-House Costs	**$221**						
Total Budget Authority	**$16,050**	**$0**	**$16,050**	**$19,700**	**$20,368**	**$20,034**	**$19,700**

◆ - Activities Accomplished ◇ - Activities Planned

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

FAA Budget Appropriation	Budget Item	Program Title	Budget Request
R,E&D	**A14.a.**	**System Planning and Resource Management**	**$1,817,000**

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

Intended Outcomes: Demonstrate the value of working with international partners to leverage research programs and studies in order to improve safety and promote seamless operations worldwide. The ongoing activity will manage the FAA's R,E&D portfolio, meet the President's criteria for R&D, increase program efficiency, and maintain management and operating costs.

This activity produces the National Aviation Research Plan (NARP), an annual strategic plan for FAA R&D; administers the congressionally mandated R,E&D Advisory Committee (REDAC); conducts external program coordination; fosters future research opportunities; and provides program advocacy and outreach.

Agency Outputs: In FY 2009 FAA will:

- Publish the annual National Aviation Research Plan.
- Host two REDAC meetings and multiple subcommittee meetings. The Committee provides advice on and reviews plans for the annual FAA R&D budget, and produces periodic and special reports providing advice and recommendations to FAA on its R&D program.
- Support the NextGen initiative.
- Prepare the annual R,E&D budget submission.
- Manage the R,E&D portfolio.
- Coordinate research activities with NASA through FAA's R&D Field Offices.
- Investigate measures for the exchange of research information.

Research Goal:

- In FY 2009 through FY 2013, the FAA will maintain an R,E&D management workforce of no more than 10 percent of the total R,E&D workforce and will sustain the System Planning and Resource Management budget at two percent or less of the total R,E&D budget.
- Develop a strategic mapping for international collaboration.
- Identify a process to measure quality, timeliness, and value of collaboration.

Customer/Stakeholder Involvement: The REDAC reviews FAA research commitments annually and provides guidance for future R,E&D investments. The members of this committee and its associated subcommittees are subject matter experts drawn from various associations, user groups, corporations, government agencies, as well as universities and research centers. Their combined presence in the REDAC fulfills a congressional requirement for FAA R&D to be mindful of aviation community and stakeholder input.

R&D Partnerships: DOT, JPDO, NASA and other Federal Agencies, and EUROCONTROL.

Accomplishments: Program accomplishments include:

- Published the National Aviation Research Plan (February 2007) and submitted to Congress with The President's FY 2008 Budget.
- Managed two REDAC meetings and over twelve subcommittee meetings, which reviewed FAA's proposed FY 2009 R,E&D program.
- Developed the FY 2009 R,E&D budget submission.
- Supported the JPDO's NextGen activities.

- Met the research goal for R,E&D management workforce and funding for System Planning and Resource Management in FY 2007.

FY 2008 MAJOR ACTIVITIES AND ANTICIPATED ACCOMPLISHMENTS:

- Deliver the National Aviation Research Plan to Congress (February 2008) and submit to Congress with The President's FY 2009 Budget.
- Provide strategic direction for the FAA R,E&D program.
- Obtain REDAC guidance for the FY 2010 R,E&D Program.
- Obtain REDAC review of and recommendations for FY 2010 R,E&D Program.
- Developed the FY 2010 R,E&D budget submission.
- Coordinate R&D activities with NASA and other partners.
- Support NextGen activities.

FY 2009 PROGRAM REQUEST:

Ongoing Activities

FAA will continue supporting the work of the REDAC in its task to advise the Administrator on the R&D Program. In particular, it will seek the counsel and guidance of the committee for the FY 2011 program, review the proposed FY 2011 program prior to submission of the budget requirements to the DOT, and seek the committee's guidance during the execution of the R&D program. The agency will publish, as required by Congress, the National Aviation Research Plan and submit it to Congress concurrent with The FY 2010 President's Budget Request.

The program will review the President's R&D criteria, ensuring that the agency's R&D program remains viable and meets national priorities. It will also publish program activities and accomplishments, as well as foster external review of and encourage customer input to the R&D program.

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

New Initiatives

The new initiative starting in FY 2009 is to provide management for the NextGen R&D program. The purpose is to identify high value products being produced by the R&D program and to promote the use of these products globally, generating value in the international market.

In FY 2009 this initiative will investigate measures for the exchange of research information and begin to examine strategies and processes for international collaboration.

KEY FY 2009 MAJOR ACTIVITIES AND ANTICIPATED ACCOMPLISHMENTS:

- Deliver the National Aviation Research Plan to the Congress (February 2009) and submit to Congress with The President's FY 2010 Budget.
- Administer and facilitate REDAC activities by:
  - Obtaining REDAC recommendations on planned R,E&D investments for FY 2011.
  - Aiding the REDAC in its preparation of other reports, as requested by the Administrator.
- Prepare the FY 2011 R,E&D budget submission.
- Manage FAA's R&D portfolio.
- Support NextGen activities.
- Coordinate R&D activities with NASA and other partners.

- Investigate measures for the exchange of research information.
- Determine measures for the exchange of research information.

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2007)	$39,319
FY 2008 Appropriated	1,184
FY 2009 Request	1,817
Out-Year Planning Levels (FY 20010-2013)	7,546
Total	$49,866

Budget Authority ($000)	**FY 2005 Enacted**	**FY 2006 Enacted**	**FY 2007 Enacted**	**FY 2008 Enacted**	**FY 2009 Request**
Contracts:					
R,E&D Plans and Programs	455	1,143	1,192	1,075	1,648
Personnel Costs	53	46	39	37	98
Other In-house Costs	8	0	3	72	71
Total	**516**	**1,189**	**1,234**	**1,184**	**1,817**

OMB Circular A-11, Conduct of Research and Development ($000)	**FY 2005 Enacted**	**FY 2006 Enacted**	**FY 2007 Enacted**	**FY 2008 Enacted**	**FY 2009 Request**
Basic	0	0	0	0	0
Applied	516	1,189	1,234	1,184	1,817
Development (includes prototypes)	0	0	0	0	0
Total	**516**	**1,189**	**1,234**	**1,184**	**1,817**

A14a – System Planning and Resource Management Product and Activities	FY 2009 Request ($000)	Program Schedule					
		FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013
011-130 R,E&D Plans and Programs							
R,E&D Portfolio Development	**$225**						
Prepare guidance for budget formulation		◆	◊	◊	◊	◊	◊
Conduct R,E&D financial management		◆	◊	◊	◊	◊	◊
Prepare annual budget submissions		◆	◊	◊	◊	◊	◊
Congressionally Mandated	**$425**						
Publish National Aviation Research Plan (NARP)		◆	◊	◊	◊	◊	◊
Conduct REDAC Meetings		◆	◊	◊	◊	◊	◊
NASA Field Offices	**$350**	◆	◊	◊	◊	◊	◊
Research Collaborations (NextGen)	**$648**						
Determine measures for exchange of research information			◊	◊			
Develop a strategic mapping for international collaboration			◊	◊	◊	◊	
Identify a process to measure quality, timeliness, and value of collaboration			◊	◊	◊	◊	
Calculate values of collaboration					◊	◊	◊
Personnel and Other In-House Costs	**$169**						
Total Budget Authority	**$1,817**	**$1,184**	**$1,817**	**$2,136**	**$1,839**	**$1,803**	**$1,768**

◆ - Activities Accomplished ◇ - Activities Planned

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

FAA Budget Appropriation	Budget Item	Program Title	Budget Request
R,E&D	**A14.b.**	**William J. Hughes Technical Center Laboratory Facility**	**$3,536,000**

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

Intended Outcomes: FAA sustains research facilities located at the William J. Hughes Technical Center (WJHTC) in support of its R&D program goals. These facilities consist of the Research and Development Flight Program (Aircraft), Simulation facilities, and the Research and Development Human Factors Laboratory (RDHFL).

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

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

- Capacity and air traffic management technology.
- Communications, Navigation, And Surveillance.
- Operational Evolution Plan (OEP) concept validation.
- NextGen.
- Weather.
- Airport technology.
- Aircraft safety technology.
- Human Factors.
- Information Security.
- Environment and Energy.
- Automated Dependent Surveillance-Broadcast.
- Terminal Instrumentation Procedures (TERPS).
- Wide Area Augmentation System.

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

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

FY 2008 MAJOR ACTIVITIES AND ANTICIPATED ACCOMPLISHMENTS:

The following programs are supported by the laboratories:

- Runway Incursion.
- Information Security.

- Separation Standards.
- Wide Area Augmentation System (WAAS).
- TERPS.
- Satellite Communication.
- Data Link.
- Acquisition Human Factors.
- Delay Reduction.
- Dynamic Vertical Reduced Separation Minima (DRVSM).
- The OEP.
- Airspace Re-sectorization Studies.

FY 2009 PROGRAM REQUEST:

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

Ongoing Activities

- NextGen.
- Capacity Initiatives (Airspace, Procedures).
- Information Security.
- Satellite Communication and Navigation Programs.
- Separation Standards.
- Wide Area Augmentation System.
- TERPS.
- Runway Incursion.
- Aircraft Safety.
- Air Traffic Control/Airway Facilities Human Factors.
- OEP Concept Validation.
- DRVSM.

New Initiatives

No new initiatives are planned in FY 2009.

KEY FY 2009 MAJOR ACTIVITIES AND ANTICIPATED ACCOMPLISHMENTS:

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

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2007)	$103,475
FY 2008 Appropriated	3,415
FY 2009 Request	3,536
Out-Year Planning Levels (FY 2010-2013)	15,503
Total	$125,929

Budget Authority ($000)	**FY 2005 Enacted**	**FY 2006 Enacted**	**FY 2007 Enacted**	**FY 2008 Enacted**	**FY 2009 Request**
Contracts:					
WJHTC Laboratory Facility	983	572	779	667	684
Personnel Costs	2,293	2,712	2,584	2,642	2,672
Other In-house Costs	86	75	67	106	180
Total	**3,362**	**3,359**	**3,430**	**3,415**	**3,536**

OMB Circular A-11, Conduct of Research and Development ($000)	**FY 2005 Enacted**	**FY 2006 Enacted**	**FY 2007 Enacted**	**FY 2008 Enacted**	**FY 2009 Request**
Basic	0	0	0	0	0
Applied	3,362	3,359	3,430	3,415	3,536
Development (includes prototypes)	0	0	0	0	0
Total	**3,362**	**3,359**	**3,430**	**3,415**	**3,536**

A14.b – WJHTC Laboratory Facility Product and Activities	FY 2009 Request ($000)	Program Schedule FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013
011-140 WJHTC Laboratory Facility							
Simulation Facilities (Target Generator Facility, Cockpit Simulators)	**$54**						
Approach Procedures		◆	◇				
Next Generation Air Traffic System (NextGen)		◆	◇	◇	◇	◇	◇
Airspace Design		◆	◇	◇	◇	◇	◇
Operational Evolution Plan Concept Validation		◆	◇	◇	◇	◇	◇
Dynamic Vertical Reduced Separation Minima (DRVSM)		◆	◇	◇	◇	◇	◇
Research & Development Flight Program (Aircraft)	**$576**						
Satellite Communications and Navigation Programs		◆	◇	◇	◇	◇	◇
Separation Standards		◆	◇	◇	◇	◇	◇
Wide Area Augmentation System (WAAS).		◆	◇	◇	◇	◇	◇
TERPS		◆	◇	◇	◇	◇	◇
Aircraft Safety		◆	◇	◇	◇	◇	◇
Runway Incursion		◆	◇	◇	◇	◇	◇
Next Generation Air Transportation System (NextGen)							
Research and Development Human Factors Laboratory	**$54**						
Air Traffic Control Human Factors		◆	◇	◇	◇	◇	◇
Airway Facilities Human Factors		◆	◇	◇	◇	◇	◇
Operational Evolution Plan Concept Validation		◆	◇				
Personnel and Other In-House Costs	**$2,852**						
Total Budget Authority	**$3,536**	**$3,415**	**$3,536**	**$3,674**	**$3,804**	**$3,941**	**$4,084**

◆ - Activities Accomplished ◇ - Activities Planned

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

FAA Budget Appropriation	Budget Item	Program Title	Budget Request
ATO Capital	**1A01A**	**Runway Incursion Reduction**	**$10,000,000**

Supports FAA Strategic Goals: Increased Safety and Greater Capacity

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

The Program directly contributes to achieving Objective 3, “reduce the risk of runway incursions,” of the FAA’s Flight Plan 2008 –2012 strategic goal of Increased Safety.

Airports referred to in this program description include:

DFW Dallas/Ft. Worth International Airport

SAN San Diego International Airport

LGB Long Beach – Daugherty Field

GEG Spokane International, Washington

Agency Outputs:

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

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

Accomplishments:

- Developed and evaluated operation of Runway Status Lights (RWSL) at DFW and SAN.
- Developed RWSL, take-off hold lights (THL) enhancements.
- Completed engineering evaluation of Runway Intersection Lights (RILs) application at ORD.
- Installed two independent Low-Cost Surface Surveillance (LCSS), Systems at GEG.
- Evaluated operation of first LCSS system at GEG.

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

FY 2008 MAJOR ACTIVITIES AND ANTICIPATED ACCOMPLISHMENTS:

- Support implementation of RWSL Test Systems at three additional airports, ORD, BOS, LAX.

- Conduct operational user evaluation of LCGS, System at GEG.
- Complete the eFAROS field evaluation at DFW.
- Install RWSL airfield lighting equipment and conduct evaluation of RWSL for the east side of DFW Airport.
- Conducted initial investment analysis activity for LCGS program.
- Conduct RWSL engineering evaluation at additional airports.
- Initiate procurement action to support pilot LCGS program.

FY 2009 PROGRAM REQUEST:

The requested funding will allow the program to:

- Support implementation of RWSL at three additional airports.
- Complete installation of LCGS at one additional airport.
- Complete investment analysis activity for LCGS.

KEY FY 2009 MAJOR ACTIVITIES AND ANTICIPATED ACCOMPLISHMENTS:

- Complete installation of RWSL test system at one additional airport.
- Initiate RWSL Field operational evaluation at one additional airport.
- Award contract for LCGS Pilot procurement.
- Complete installation of LCGS product at additional “to be scheduled” airports.

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2007)	$60,735
FY 2008 Appropriated	8,000
FY 2009 Request	10,000
Out-Year Planning Levels (FY 2010-2013)	16,000
Total	$94,735

Budget Authority ($000)	**FY 2005 Enacted**	**FY 2006 Enacted**	**FY 2007 Enacted**	**FY 2008 Enacted**	**FY 2009 Request**
Contracts:					
Runway Incursion Reduction	9,027	6,440	8,000	8,000	10,000
Personnel Costs	0	0	0	0	0
Other In-house Costs	0	0	0	0	0
Total	**9,027**	**6,440**	**8,000**	**8,000**	**10,000**

OMB Circular A-11, Conduct of Research and Development ($000)	**FY 2005 Enacted**	**FY 2006 Enacted**	**FY 2007 Enacted**	**FY 2008 Enacted**	**FY 2009 Request**
Basic	0	0	0	0	0
Applied	0	0	0	0	0
Development (includes prototypes)	9,027	6,440	8,000	8,000	10,000
Total	**9,027**	**6,440**	**8,000**	**8,000**	**10,000**

1A01A - Runway Incursion Reduction Product and Activities	FY 2009 Request ($000)	Program Schedule					
		FY2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013
Runway Incursion Reduction	**$10,000**						
Runway Status Lights (RWSL)							
Conduct operational evaluations		◆	◊	◊			
eFaros Field Evaluation		◆	◊	◊			
Install lighting equip DFW East side		◆					
Conduct Eng Analysis at additional airports		◆	◊				
Install Test System at two add'l airport			◊				
Initiate Field OpEval at two add'l airport			◊				
Low-Cost Ground Surveillance (LCGS)							
Conduct Investment Analysis		◆	◊				
Initial procurement for Pilot program		◆					
Award contract for Pilot Program		◆	◊				
Complete install at three add'l airports by FY09			◊				
Cockpit Runway Safety Alerting							
Conduct Market Survey		◆	◊				
Total Budget Authority	**$10,000**	**$8,000**	**$10,000**	**$5,000**	**$5,000**	**$3,000**	**$3,000**

◆ - Activities Accomplished ◇ - Activities Planned

NOTES: OUT YEAR NUMBERS ARE FOR PLANNING PURPOSES ONLY. ACTUAL FUNDING NEEDS WILL BE DETERMINED THROUGH THE ANNUAL BUDGET PROCESS. IN THE ATO CAPITAL APPROPRIATIONS, PERSONNEL AND OTHER COSTS ARE BUDGETED IN ACTIVITY 5, NOT THE PROGRAM BUDGET LINE ITEM.

FAA Budget Appropriation	Budget Item	Program Title	Budget Request
ATO Capital	**1A01B**	**System Capacity, Planning and Improvement**	**$6,500,000**

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

Program Goals and Intended Outcomes: The System Capacity, Planning, and Improvements program identifies, analyzes, and evaluates system capacity enhancements for the National Airspace System (NAS). In addition to providing recommendations for airport improvements, procedural updates, and simulation studies, this program delivers performance measurement and executive dashboard systems, operations research to estimate NAS efficiency, and strategic planning to ensure that Agency goals are realized. These initiatives seek to develop long-term responses to capacity shortfalls that will increase system accessibility and flexibility.

Agency Outputs: The System Capacity, Planning and Improvement (SCPI) program strives to deliver high-quality, cost-effective services to meet the needs of its customers and the users of the air transportation system. A component of this program, the Performance Data Analysis and Reporting System (PDARS), captures real-time performance data at major operational facilities. Airport design studies will continue to provide problem identification and solution sets at specific targeted airports. Strategic Goals and related performance metrics required by the Air Traffic Organization (ATO), and captured through the organization's Strategic Management Process (SMP), will continue to provide a framework for assessing operational performance against Agency goals and targets. SCPI sponsors a wide range of tasks designed to measure, assess, and improve aviation capacity. The following programs are critical to the improvement of the aviation system:

Performance Data Analysis and Reporting System

- Supports the development of facility-level metrics that tie Agency goals to actions at the service delivery point and quantify specific outcomes. PDARS extracts radar data from the HOST, Automated Radar Terminal System (ARTS), and STARS computer systems. The system records and integrates flight plan and track data in an interactive database. The data can then be queried to establish outcome metrics such as time, distance, altitude, and reroutes, with the fidelity necessary to make meaningful distinctions between the performance of facilities (both en-route and terminal).

Performance Metrics Development

- Includes the planning, coordination, data collection, and implementation of performance measures used to assess NAS operations. These metrics are also included in the Agency's strategic planning documents and databases to determine whether or not the Agency is meeting its targets. Currently metrics have been developed to measure operational errors, runway incursions, on-time arrivals, delays, ground stop minutes, airport arrival efficiency rate, and airport arrival capacity. Forecasted metrics include the development of an indicator that effectively quantifies the impact of weather on NAS activity and the design of enroute, system predictability, terminal departure, and efficiency rate metrics.

ATO Strategic Management Process (SMP)

- Provides focus and alignment to successfully implement FAA Flight Plan and ATO initiatives and all activities necessary to achieve our objectives. The SMP is a structured system used to identify Strategic Goals and Objectives with related measures or metrics which are used to determine the ATO's progress in achieving these objectives. Performance metrics are the core of the SMP and are important both to senior management leading the

ATO, and employees in operational roles driving functional excellence in order to achieve Agency and ATO Goals and Objectives. SMP links effective measures across organizational tiers as those measures are cascaded to the field.

Airport Capacity Enhancement/Design Studies

- Investigates capacity and delay at major airports, both domestically and internationally. The FAA works with airports and other aviation industry stakeholders to conduct computer simulation and modeling studies aimed at improving the operating efficiency of airports. The outputs are in the form of recommendations that can include any of the following: new runways, taxiways, intersections, operating procedures, or terminals.

Operational Evolution Partnership (OEP) Performance Modeling

- Models the impact of OEP capabilities on the performance of the NAS. The OEP includes seven "solution sets" in the air traffic operations "domain," two in the airport development domain, and one in the aircraft and operator requirements domain. These solution sets are designed to maximize the capacity of the NAS over the next ten years, while ensuring the highest standards of safety. This activity will use fast-time models to analyze OEP improvements in NAS performance retrospectively, and project anticipated improvements in performance prospectively.

International Air Navigation Service Provider (ANSP) Benchmarking

- Working with the Civil Air Navigation Services Organization (CANSO), compares the operational and financial performance of the ATO to that of other ANSPs.

Customer/Stakeholder Involvement: The success of the FAA depends on effective capacity programs involving all elements of the Agency, its customers, and its stakeholders. Field experts from the affected disciplines – concerned airports, air carriers, aviation interest groups, and FAA regional and local facilities – collaborate on diversified airspace and airport capacity task forces and projects.

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

Accomplishments:

- Developed trajectory-based forecasts for use in DataComm Initial Investment Analysis.
- Developed Service Delivery Point (SDP) demand projections for terminal and en route.
- Completed deployment of PDARS to all TRACONs serving the 34 CONUS Operational Evolution Partnership (OEP) airports.
- Used the NAS Strategy Simulator (NSS) to analyze the impact of the proposed FAA reauthorization language, and Congressional alternatives, on Airport and Airway Trust Fund receipts.
- Developed a new systems dynamics model of North Atlantic operations in support of the ICAO North Atlantic (NAT) Economic and Financial Group (EFG).
- Developed an econometric model of NAT traffic.
- Completed and released the Future Airport Capacity Task (FACT) II report.
- Analyzed changes in excess fuel burn over the past seven years.
- Prepared the ATO FY 2008 Business Outlook.
- Developed an OEP "avoided delay" metric and prepared estimates of the expected value of this metric for the next 10 years.

- Completed a study of the economic impact of civil aviation on the U.S. economy.
- Performed a review of the ATO Strategy Map which identifies ATO Objectives in four pathways or areas of concentration. These four Pathways were updated and a new pathway with an employee focus was developed and populated with new Objectives and metrics.

R&D Partnerships:

Work with the National Center of Excellence for Aviation Operations Research (Nextor) and the Partnership for Air Transportation Noise and Emissions Reduction to study

- the causes and impacts of delay
- the economic cost of delay
- how to forecast future traffic, capacity, and environmental impacts of ATM inefficiencies
- strategies to increase capacity.

FY 2008 MAJOR ACTIVITIES AND ANTICIPATED ACCOMPLISHMENTS:

- Complete FACT II Next Steps Report.
- Develop software and hardware to allow integration of surface movement data (e.g., ASDE-X) with PDARS, and develop initial surface movement metrics. Establish PDARS connection to at least one facility providing such data.
- Prepare the 2009-2013 FAA Flight Plan.
- As part of the ATO Strategic Management Process:
- Identify data sources, collect baseline data, conduct gap analysis and establish performance targets for all ATO Service/Business Units Strategy Maps based on the updated FY08 ATO Strategy Map; and
- Facilitate the monthly review of performance metrics in all five Pathways and facilitate the review of these results with the COO and Executive Council monthly; and
- Maintain the web-based software application infrastructure to provide all ATO Service/ Business Units with centralized access to ATO and Service Unit cost and performance analysis, forecasting, reporting and initiative tracking capabilities.
- Complete initial round of OEP performance modeling, projecting NAS-wide performance benefits and environmental savings through 2018.

KEY FY 2009 MAJOR ACTIVITIES AND ANTICIPATED ACCOMPLISHMENTS:

- Complete PDARS installation at the remaining OEP airports that have surface surveillance systems.
- Integrate oceanic data into PDARS.
- As part of the ATO Strategic Management Process,:
- Facilitate the monthly review of performance metrics in all five Pathways and facilitate the review of these results with the COO and Executive Council monthly; and
- Maintain the web-based software application infrastructure to provide all ATO Service/ Business Units with centralized access to ATO and Service Unit cost and performance analysis, forecasting, reporting and initiative tracking capabilities; and
- Perform system and process modifications based on the general needs of stakeholders, dissemination of Strategic Management Process software application to remaining Service Units, communication of strategy management best practices; and

- Review and if deemed necessary, develop new measures to monitor and assess strategic objectives, strengthen existing metrics, validate continuing relevance of metrics on the ATO Strategy Map.
- Complete second round of OEP performance modeling, refining the FY 2008 projections and extending through 2019.

FY 2009 PROGRAM REQUEST:

The requested funding will support the Agency goals documented in the FAA Flight Plan by continuing to focus on maximizing airport capacity through improvements in runways, taxiways, navigational/guidance aids, and operational procedures that can result in increased capacity and reduced delays. The SCPI Program will effectively design data systems to measure and analyze operational performance for the assessment of system improvements. The program will also produce capacity studies and analyses to improve operational activity at the nation's most congested airports.

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2007)	$41,158
FY 2008 Appropriated	6,500
FY 2009 Request	6,500
Out-Year Planning Levels (FY 2010-2013)	20,000
Total	$80,158

Budget Authority ($000)	**FY 2005 Enacted**	**FY 2006 Enacted**	**FY 2007 Enacted**	**FY 2008 Enacted**	**FY 2009 Request**
Contracts:					
System Capacity, Planning and Improvement	3,968	6,435	5,500	6,500	6,500
Personnel Costs	0	0	0	0	0
Other In-house Costs	0	0	0	0	0
Total	**3,968**	**6,435**	**5,500**	**6,500**	**6,500**

OMB Circular A-11, Conduct of Research and Development ($000)	**FY 2005 Enacted**	**FY 2006 Enacted**	**FY 2007 Enacted**	**FY 2008 Enacted**	**FY 2009 Request**
Basic	0	0	0	0	0
Applied	0	0	0	0	0
Development (includes prototypes)	3,968	6,435	5,500	6,500	6,500
Total	**3,968**	**6,435**	**5,500**	**6,500**	**6,500**

1A01B - System Capacity, Planning and Improvement Product and Activities	FY 2009 Request ($000)	Program Schedule					
		FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013
System Capacity, Planning and Improvement	**$6,500**						
NAS Performance Measurement							
Prepare FAA Flight Plan		◆	◇	◇	◇	◇	◇
Update SMP Strategy Map		◆	◇	◇	◇	◇	◇
Integrate surface surveillance data into PDARS		◆	◇				
Integrate oceanic data into PDARS			◇				
Integrate Micro EARTS data into PDARS				◇			
Airport Development							
Complete FACT II Next Steps report		◆					
OEP Performance Modeling							
Estimate OEP impacts on NAS		◆	◇	◇	◇	◇	◇
Total Budget Authority	**$6,500**	**$6,500**	**$6,500**	**$6,500**	**$6,500**	**$6,500**	**$6,500**

◆ - Activities Accomplished ◇ - Activities Planned

NOTES: OUT YEAR NUMBERS ARE FOR PLANNING PURPOSES ONLY. ACTUAL FUNDING NEEDS WILL BE DETERMINED THROUGH THE ANNUAL BUDGET PROCESS. IN THE ATO CAPITAL APPROPRIATIONS, PERSONNEL AND OTHER COSTS ARE BUDGETED IN ACTIVITY 5, NOT THE PROGRAM BUDGET LINE ITEM.

FAA Budget Appropriation	Budget Item	Program Title	Budget Request
ATO Capital	**1A01C**	**Operations Concept Validation**	**$7,400,000**

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

Intended Outcomes: This project assesses the interaction of changing roles and responsibilities of NAS service providers and pilots, airspace changes, procedural changes and new mechanized systems for distributing weather, traffic and other flight related information. It tests the assumptions behind common situational awareness and distributed information processing. It provides the high-quality performance requirements needed to ensure that the next generation of National Airspace System (NAS) ground and airborne support systems succeed. This process assesses and redirects the tactical and strategic assumptions behind controller and pilot roles and responsibilities, and decision support tools in general – as well as requirements affecting information type, display and update rate – for the mutual benefit of the public and the aviation community. Associated with the changes in roles and responsibilities are opportunities for restructuring the services provided by air traffic control facilities to best support the re-aligned roles of humans in the NAS as enabled by new automation and communication capabilities.

Agency Outputs: This process of identifying and refining a valid operational structure for the next generation NAS requires the development of many planning documents and work products, including:

- Documentation of a validated overall concept, or "target system," for the future management and control of NAS operations – the documents are well-defined and understandable, and the validations are based on credible systems modeling and simulation.
- Detailed second-level operational descriptions of concept elements (e.g., flight planning, high altitude operations, capacity management) that can be used to develop detailed operational scenarios for concept validation and requirements generation.
- Requirements for the subsystems of the new target system – these integrated, configuration-managed research criteria are individually and collectively validated to provide a coherent, comprehensive framework to guide anticipated research and development activities;
- Top-level designs for the major new Air Traffic Management (ATM) capabilities associated with the modernized operational concept;
- Cost/benefit analyses to determine the feasibility of implementing the operational changes across the NAS;
- A risk-mitigation plan to guide development activities for new capabilities; and
- A human factors validation plan that provides a comprehensive roadmap of activities to ensure that new functionality will be operationally acceptable to flight crews and controllers.

Customer/Stakeholder Involvement: The RTCA Air Traffic Management Advisory Committee and Steering Group have been a strong external influence upon the FAA in many aspects of operational concept development and validation. The Agency working in conjunction with the JPDO also has conducted a detailed survey of major stakeholders to obtain their ranking of future concept sub-elements designed to support modernization. This level of stakeholder participation ensures that the evolving concept is fully mindful of aviation user community requirements – an essential prerequisite to validating the concept of a modern NAS based on a shared, integrated infrastructure.

Accomplishments: The vision for the modern NAS has been developed and published in the Government/Industry Operational Concept for Free Flight (released by the RTCA, August 1997), A Concept of Operations for the NAS Airspace System in 2005 (released by Air Traffic Services, September 1997), and the RTCA NAS Concept of Operations and Vision of Future Aviation (released by the RTCA, December 2002). More recently, JPDO has provided plans, concept of use and other documentation; these documents have provided guidance to the development of the NAS Architecture Version 6. Additional details appear in the appendices to the NAS Architecture document itself. Starting in FY 1999, this program initiated the following activities to ensure high standards of top-level design, risk-mitigation planning, and attention to the influence of human factors in arriving at a validation plan:

Operational concept development

- Developed concepts for NAS Common Reference model.
- Developed a framework for individual service enhancements to support the development of system-level requirements for modernization.
- Developed a NAS performance model for evaluating the impact of proposed concepts on operational performance, and quantitative measures and goals for mid-term concept capabilities.
- Developed Concept of Use for integrated Decision Support Tools in the 2003-2005 timeframe.

Concept validation

- Established a validation data repository for the reuse of experimental data and results.
- Developed a capability for the fast-time analysis of new concepts.
- Developed detailed scenarios of operational changes in support of architecture and research requirements.
- Validated user concepts including joint FAA/NASA human-in-the-loop simulations.
- Validated information requirements for flight object management.
- Analyzed concept of de-emphasizing geographic dependency when assigning airspace to facilities.

Concept system design

- Analyzed core factors related to a common trajectory model.
- Assessed controller workload in various U.S. traffic situations.
- Developed and analyzed the aircraft separation concept referred to as “three miles everywhere.”
- Evaluated the impact on cross-facility coordination of splitting front and back rooms, and centralizing the core automation functions apart from the controller facilities.

R&D Partnerships: This work directly relates to the objectives of the Next Generation Air Transportation System objectives advanced by the Joint Planning and Development Office. Work under this program is coordinated through the FAA/NASA Research Transition Teams to ensure NASA's efforts both complement and are integrated into the NAS Operational Concept.

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

FY 2008 MAJOR ACTIVITIES AND ANTICIPATED ACCOMPLISHMENTS:

Operational concept development

- Deliver detailed concept for end-to-end flight data management.
- Deliver detailed concept of operations for the evolution of Traffic Flow Management, including a functional and task analysis.
- Deliver an initial concept for flexible exchange of airspace across domains.
- Deliver initial concept for high altitude, generic airspace.
- Develop detailed concept for the use of data communications to support trajectory based operations.

Concept validation

- Conduct high-level concept validation for restructuring en route operations into a high airspace/low airspace split for productivity and training.
- Develop a standard for validating and verifying air traffic management concepts.

Concept system design

- Develop detailed system design requirements for the common trajectory service in the new en route automation system.
- Support the development of data communication requirements to support trajectory based operations and re-allocating functions between air navigation service providers, pilots and automation.

FY 2009 PROGRAM REQUEST:

The FY 2009 request continues to evolve the NAS operations concept. From its initial broad perspective and early validation emphasis, the concept work is focusing more specifically on internal investigations of opportunities for increased productivity, and on reducing the influence of geographic location in the process of delegating responsibilities for controlling particular airspace.

Further demonstration and validation are required to show whether this concept can support the integration of the entire NAS infrastructure, with all airspace definitions, within the proposed En Route Automation Modernization methodology. The validation process investigates all opportunities to exploit the potential productivity and flexibility benefits offered by changes in technology and communications.

KEY FY 2009 MAJOR ACTIVITIES AND ANTICIPATED ACCOMPLISHMENTS:

Operational concept development

- Develop a NAS operational concept that covers flight planning through flight execution and integrates the capabilities of the Operational Evolution Partnership.
- Deliver detailed, second-level concept for high altitude, generic airspace along with detailed information flows.
- Deliver detailed concept for unlimited dynamic resectorization.
- Deliver detailed concept for flexible use of terminal airspace.

Concept validation

- Continue to populate the Validation Data Repository to capture all FAA activities and results associated with concept and concept-of-use validation.
- Conduct validation of alternative concepts for delegation for separation authority.

- Conduct analysis of alternative concepts for provision of tower services at airports of various complexity and traffic levels.
- Conduct validation of Traffic Flow Management evolution.
- Conduct human-in-the-loop analysis of high/low airspace split on training requirements for sector controllers along with the information needs and systems requirements.

Concept system design

- Extend closed-loop system dynamic modeling of decisions and demand dynamics related to scheduling and management of aircraft
- Leverage human factors research work and operational concept validation experimentation to define the information type, update rate, and display requirements needed to support agreed-to operational improvements of the NAS Concept of Operations through 2017.
- Develop display and decision support requirements for implementation of multi-sector planner position.
- Roles and Responsibility changes to support the initial phase of flexible staffing.

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2007)	$21,838
FY 2008 Appropriated	3,000
FY 2009 Request	7,400
Out-Year Planning Levels (FY 2009-2012)	30,000
Total	$65,238

Budget Authority ($000)	**FY 2005 Enacted**	**FY 2006 Enacted**	**FY 2007 Enacted**	**FY 2008 Request**	**FY 2009 Request**
Contracts:					
Operations Concept Validation	2,000	2,970	3,000	3,000	7,400
Personnel Costs	0	0	0	0	0
Other In-house Costs	0	0	0	0	0
Total	**2,000**	**2,970**	**3,000**	**3,000**	**7,400**

OMB Circular A-11, Conduct of Research and Development ($000)	**FY 2005 Enacted**	**FY 2006 Enacted**	**FY 2007 Enacted**	**FY 2008 Request**	**FY 2009 Request**
Basic	0	0	0	0	0
Applied	0	0	0	0	0
Development (includes prototypes)	2,000	2,970	3,000	3,000	7,400
Total	**2,000**	**2,970**	**3,000**	**3,000**	**7,400**

1A01C - Operations Concept Validation Product and Activities	FY 2009 Request ($000)	Program Schedule					
		FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013
Operations Concept Validation	$7,400						
Operational Concept Development							
End-end flight data management		◆	◊	◊			
High altitude, generic airspace		◆	◊	◊	◊		
Flexible & dynamic airspace re-sectorization		◆	◊	◊	◊		
Concepts of operations for the evolution of Traffic Flow Management		◆	◊	◊			
Develop end-end midterm NAS operational concept		◆	◊	◊			
Concept Validation							
Validation Data Repository and metrics		◆	◊	◊	◊	◊	
High/low airspace split		◆	◊	◊	◊		
Concept validation/verification standard		◆	◊				
Delegation for separation authority			◊	◊	◊	◊	◊
Traffic Flow Management evolution			◊	◊	◊	◊	◊
Multi-sector Planner		◆	◊	◊	◊	◊	
Provision of Tower Services			◊	◊	◊	◊	◊
Concept System Design							
System dynamic modeling of decisions and demand dynamics related to scheduling and management of aircraft			◊	◊	◊	◊	◊
Requirements needed to support agreed-to operational improvements of the NAS Concept of Operations through 2017 (e.g., common trajectory service, data communications)			◊	◊	◊	◊	◊
Multi-sector planner requirements		◆	◊	◊	◊	◊	◊
RTCA							
Develop Aviation Community inputs to MASPS, MOPS and Integrated Plans to Support Future Concepts and Modernization		◆	◊	◊	◊	◊	◊
Total Budget Authority	$7,400	$3,000	$7,400	$8,000	$8,000	$8,000	$6,000

◆ - Activities Accomplished ◇ - Activities Planned

NOTES: OUT YEAR NUMBERS ARE FOR PLANNING PURPOSES ONLY. ACTUAL FUNDING NEEDS WILL BE DETERMINED THROUGH THE ANNUAL BUDGET PROCESS. IN THE ATO CAPITAL APPROPRIATIONS, PERSONNEL AND OTHER COSTS ARE BUDGETED IN ACTIVITY 5, NOT THE PROGRAM BUDGET LINE ITEM.

FAA Budget Appropriation	Budget Item	Program Title	Budget Request
ATO Capital	**1A01D**	**NAS Weather Requirements**	**$1,000,000**

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

Intended Outcomes: Weather has a significant impact on safety and efficiency and affects activities across all domains. Weather accounts for approximately 65 percent of all delays and avoidable weather delays are estimated to cost airlines, air cargo operators and other users approximately $4 billion annually. Weather is a contributing or causal factor in over 20 percent of all accidents (and in very near 90 percent of general aviation accidents) and almost 25 percent of fatal accidents. Accidents and injuries from icing and turbulence alone cost approximately $300 million per year.

FAA's Air Traffic Organization, Operations Planning, Aviation Weather Office, Weather Policy and Requirements Group manages aviation weather requirements at the NAS level and aims to minimize the negative impacts of weather on NAS operations by increasing operational predictability during weather events (particularly during winter weather and convective weather situations). The Weather Policy and Requirements Group attempts to decrease avoidable weather delays plus reduce accidents caused by weather. The staff does this principally by managing aviation weather policy and standards, representing FAA in the Joint Program Development Office (JPDO) Weather Integrated Planning Team and managing the research and development weather portfolio.

This budget line item provides an established but flexible means for FAA to direct attention and resources to ensure the most effective technical strategies are being pursued to ensure the Agency's mission of providing a safe, secure and efficient aerospace system. The thrust of the program is to develop aviation weather policy, standards and metrics, including developing operational weather policies, developing and implementing surface and airborne observation service standards, promoting Next Generation Air Transportation System (NextGen) practices at the International Civil Aeronautical Organization (ICAO) and develop system performance metrics related to weather for efficiency and capability.

The second major part of this program is to represent FAA in the JPDO Weather IPT. The Weather Policy and Requirements Group is committed to aligning the FAA and NextGen weather architectures by establishing policy that addresses issues and development of the finalized NextGen structure.

The Weather Policy and Requirements Group also manages the weather portfolio and in doing so, develops the weather segment of a corporate mission analysis and develops a Concept and Requirements Definition (CRD) for weather, develops aviation weather research requirements and manages the transition of weather R&D into operation.

Deliverables supported by the NAS Requirements line are to develop a capability to measure the impact of any improvement in, access to or integration of, weather information into decision support tools on the operational performance of the NAS; develop a weather capabilities roadmap for NextGen weather; obtain agreements on a policies and standards that will ultimately become an ICAO standard; continue to conduct the technology transfer program, and establish a firm foundation for a focused R&D budget that is focused on NextGen weather priorities

Agency Outputs: This line item enables:

- Development of a reliable technique to measure avoidable weather delays as subset of overall weather delays.

- Definition of ICAO requirements for quality management, identification of responsibilities in developing and operating a baseline verification program, including scope, costs, and timelines.
- Continued work on weather capabilities roadmap.
- Obtaining agreement between U.S. and the European Organization for the Safety of Air Navigation (EUROCONTROL) on a common weather exchange model.
- Completion of a plan to complete flight deck display standards for meteorological information.
- Establishment of a policy on allocating costs for NextGen investments and on-operations, the role of the commercial sector in providing aviation weather, and approaches to assure the quality and utility of end-use weather information.
- Establishment of a mechanism to effectively coordinate the development of future weather information and utilization of currently available weather information.

Customer/Stakeholder Involvement:

This program's customers and stakeholders include:

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

Accomplishments:

The following summarizes major accomplishments to date:

- Updated aviation weather roadmap to integrate NextGen weather concepts
- Defined Single Authoritative Source of weather information for NextGen Air Traffic Management.
- Completed Operational Suitability and Environmental Description (OSED) for Weather and Aeronautical Information Data Link via joint RTCA/EUROCAE special committee.
- Prepared Reduce Weather Impact (RWI) OEP Solution Set.
- Initiated FAA NextGen Aviation Weather Strategic Plan (FY2008-2025)
- Initiated NextGen Weather Evaluation Capability Plan.
- Completed technology transfer into NAS operations of several new R&D products.
- Transferred other products into the final R&D phase.
    - Developed and tested a safety risk assessment process for R&D products before being implemented on Government platforms.

- Represented U.S. aviation interest at ICAO to minimize operating costs for U.S. carriers.
- Provided requirements of service as contracting state to support the operation of Washington World Area Forecast Center and Anchorage/Washington Volcanic Ash Advisory Centers.

Partnerships:

FAA's Air Traffic Organization, Operations Planning, Aviation Weather Office, Weather Policy and Requirements Group partners with the Agency's Aviation Weather Research program, other Air Traffic Organization offices, Flight Standards, Aircraft Certification, and NWS offices as a part of the technology transfer process. The office partners with the Flight Standards and NWS personnel on a full range of aviation weather development activities. The office partners with the Joint Program Development Office (JPDO) to align FAA and NextGen weather architecture and address public/private roles and responsibilities for efficient sourcing. In the international arena, the office closely partners with ICAO and its contracting members.

FY 2008 MAJOR ACTIVITIES AND ANTICIPATED ACCOMPLISHMENTS:

- Develop a reliable technique to measure avoidable weather delays as subset of overall weather delays.
- Define a program plan to produce a baseline of the quality of U.S. aviation weather information and the on-going measurements of product.
- Populate a weather capabilities roadmap with information the current weather systems architecture roadmap and information contained in the JPDO enterprise architecture document.
- Develop, obtain agreement on and complete an agreement that defines a common weather exchange model for use by JPDO agencies, EUROCONTROL and ultimately becomes an ICAO standard.
- Research, assess, develop and obtain agreement on potential display standards for meteorological information on flight deck displays.
    - Develop plan to align FAA with NextGen policies to optimize government and commercial vendor's roles in observations, forecasting, and dissemination.
    - Assess and develop display standards for commercial vendors' use of weather information from the digital database and a means to verify the accuracy of weather information obtained from the database.

FY 2009 PROGRAM REQUEST:

The requested funding will allow the program to continue to focus on enhanced safety, enhanced efficiency and international leadership. Specific areas will include continued activities associated with aviation weather policy and standards, FAA representation to the JPDO Weather IPT and managing the research and development weather portfolio.

KEY FY 2009 MAJOR ACTIVITIES AND ANTICIPATED ACCOMPLISHMENTS:

- Continue to develop a weather capabilities roadmap that aligns FAA and JPDO goals.
- Continue to develop and obtain agreement on display standards for meteorological information on flight deck displays.
- Continue to develop a plan to align FAA with NextGen policies to optimize government and commercial vendor's roles in observations, forecasting, and dissemination.
- Continue to develop users' needs analyses, simulations, and performance requirements and integrate ATO, NextGen and AVS requirements.
- Develop various Concept and Requirements Definition (CRD) for weather.

- Develop NextGen Network Enable Weather Requirements.
- Continue to manage the Weather Portfolio Investment Management Plan.

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2007)	$11,978
FY 2008 Appropriated	1,000
FY 2009 Request	1,000
Out-Year Planning Levels (FY 2010-2013)	7,300
Total	$21,278

Budget Authority ($000)	**FY 2005 Enacted**	**FY 2006 Enacted**	**FY 2007 Enacted**	**FY 2008 Enacted**	**FY 2009 Request**
Contracts:					
NAS Weather Requirements	1,488	790	800	1,000	1,000
Personnel Costs	0	0	0	0	0
Other In-house Costs	0	0	0	0	0
Total	**1,488**	**790**	**800**	**1,000**	**1,000**

OMB Circular A-11, Conduct of Research and Development ($000)	**FY 2005 Enacted**	**FY 2006 Enacted**	**FY 2007 Enacted**	**FY 2008 Enacted**	**FY 2009 Request**
Basic	0	0	0	0	0
Applied	0	0	0	0	0
Development (includes prototypes)	1,488	790	800	1,000	1,000
Total	**1,488**	**790**	**800**	**1,000**	**1,000**

1A01D - NAS Weather Requirements Product and Activities	FY 2009 Request ($000)	Program Schedule FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013
NAS Requirements (Office of Weather Policy and Standards, NAS Weather Office, ATO-P)	$1,000						
Weather Policy and Standards							
Establish policy to allocate costs for NextGen investments and on-going operations		◆	◊	◊			
Establish policy for role of commercial sector in providing aviation weather		◆	◊	◊	◊	◊	
Establish policy to assure the quality and utility of end-use weather information		◆	◊	◊	◊	◊	
Assess, develop display standards for commercial vendors' use of weather information		◆	◊	◊	◊		
Develop standards for flight deck displays of meteorological information		◆	◊	◊	◊		
ICAO							
Complete agreement to define common weather exchange model for use by JPDO agencies, EUROCONTROL.		◆	◊	◊	◊		
FAA Flight Plan Initiative							
Develop technique to measure avoidable weather delays		◆	◊	◊			
Develop concept for a set of metrics that would evaluate the effectiveness of weather information on performance of the NAS in operationally significant weather		◆	◊	◊			
Aviation Weather Requirements Development							
Populate weather capabilities roadmap with current and JPDO documents.		◆	◊	◊			
Develop plan to align FAA with NextGen policies to optimize government and commercial vendors roles in observations, forecasting, and dissemination.		◆	◊	◊	◊		
Total Budget Authority	**$1,000**	**$1,000**	**$1,000**	**$1,000**	**$1,000**	**$1,000**	**$3,300**

◆ - Activities Accomplished ◊ - Activities Planned

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FAA Budget Appropriation	Budget Item	Program Title	Budget Request
ATO Capital	**1A01E**	**Airspace Management Laboratory**	**$4,000,000**

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

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

To aid the ATO in achieving its mission, the Airspace and AIM Laboratory ("Laboratory") provides value to our customers by managing our aeronautical information (AI) chain to supply accurate, high integrity, and timely information that supports safe and efficient air traffic operations. The Laboratory develops advanced decision support tools, databases and information management systems to enable facility-level and national management of the FAA's national airspace system resources. In addition, the Laboratory develops new capabilities that make it easier for FAA customers to operate safely and efficiently in the NAS.

Major categories of activities carried out by the Laboratory include:

- Demonstrating and developing new capabilities to improve the collection, processing and distribution of NAS resources that air traffic control and pilots depend upon to operate safely and efficiently. Efforts in this area include: 1) determining if proposed towers and obstructions pose a hazard to air traffic, 2) evaluating terrain and obstacles to determine the lowest permissible flight level, 3) improving FAA aeronautical data collection processes such as digital management of airport data and 4) supporting new concepts for creating and distributing dynamic aeronautical information (e.g., advisories, NOTAM, temporary flight restrictions, and special use airspace (SUA))
- Developing information systems, decision support tools and advanced geo-spatial capabilities to collect, manage and analyze air traffic control operational data such as flight information, flight plans, airspace utilization and navigation structures. These Laboratory products allow the FAA lines of business to evaluate performance metrics, determine fee for service charges (both international over-flights and domestic), and estimate airspace and Air Traffic Control (ATC) benefits from new technologies (e.g., the Next Generation Air Transportation System (NextGen) being managed by the Joint Planning and Development Office (JPDO)).
- Streamlining input, storage and output for FAA AIM systems to ensure the FAA has a single source of high quality aeronautical data on navigation aids, airspace, communication systems, routes and procedures. The aeronautical information is used to create customer products such as charts and publications as well as internal FAA products such as NAS modernization/improvement plans, environmental analyses and infrastructure data needed to run the FAA ATC systems (e.g., Host Computer System (HCS), En Route Automation Modernization (ERAM), Standard Terminal Automation Replacement System (STARS), and Automated Radar Terminal System (ARTS)).

Customer/Stakeholder Involvement: The Airspace and AIM Laboratory focuses on providing new capabilities that enable FAA and external customers, such as air carriers, airfreight, and general aviation to operating more safely and efficiently. The Laboratory directly supports the missions of Finance and Cost Accounting, the Office of Financial Services, the Office of Aviation Policy, and the Operational Evolution Plan with performance metrics. Products and tools produced by the lab are continually used by several lines of business throughout the agency, including several ATO organizations like System Operations – Airspace and AIM, System Architecture and Investment Analysis, System Capacity, Air Traffic Planning and Procedures, En Route, Terminal and Air Traffic System Management. The Laboratory also has provided ongoing support for many NAS improvement projects such as field staffing analyses, airspace management, and noise analyses.

Highlights of Airspace and Aeronautical Laboratory Accomplishments:

Air Traffic Operational Data Information System

- Developed ATC operational data repository to collect, quality check and distribute high fidelity air traffic operational data. This system includes daily calculations of NAS performance metrics calculations and supports local, regional and NAS improvement planning. The system enables international over-flight fee collection and is used to evaluate domestic user fee collection scenarios.
    - Made over 4 years of high fidelity traffic data available to laboratory customers for analysis, performance metrics and user fee calculations.
    - Developed and deployed a new daily performance metric system designed to provide the field with feedback through next day performance metrics.
    - Began implementing automation processes to assist with fee for service collections – both international overflights and possible domestic user fees.

Aeronautical Information Management

- Implemented new technology to capture Airport Layout Plan information electronically from airport operators. The systems automate airport survey and airport layout plan collection and processing. Results of this activity will streamline airport arrival and departure procedure development and improve FAA's ability to manage airport improvements.
- Completed research, engineering and outreach to develop international standards for encoding and distributing aeronautical information in coordination with EUROCONTROL. Resulting Aeronautical Information Exchange Model (AIXM) has become a de facto ICAO standard for use in aeronautical information exchange. AIXM is a contributor to effective digital distribution of aeronautical information such as information distribution in SWIM and NextGen. The adoption of this standard will lead to cost savings in aeronautical data collection, management and distribution as well as safety improvements resulting from enhanced data quality.

Obstruction Evaluation and Airport Airspace Analysis

- Deployed new obstruction evaluation capabilities allowing proposed obstructions to be submitted digitally. Continued to automate additional evaluation criteria that enable the FAA to respond with decisions more quickly while ensuring a higher degree of safety for air traffic operations.
    - Deployed national infrastructure to support paperless processing of obstruction evaluation cases.
    - Deployed a new interface allowing proponents to submit proposed obstructions electronically.
    - Began integrating the National Flight Procedures obstruction evaluation processes into the paperless obstruction evaluation system.

Minimum IFR Altitude (MIA) and Minimum Vector Altitude (MVA) Evaluation

- Developed and fielded initial capabilities to automate the design and evaluation of Minimum Instrument Flight Rules (IFR) Altitude (MIA) and Minimum Vector Altitude (MVA) areas for the En Route and Terminal environments. The system identifies the lowest altitudes that air traffic control can safely vector aircraft. Initial field evaluations indicate that analysis errors have been virtually eliminated.

- Fielded new capabilities in the Sector Design and Analysis Tool (SDAT) to provide field facilities with initial capabilities to automate MIA/MVA area design and evaluation.
- Completed initial evaluation of all FAA ARTCCs and initiate review of terminal facility MVA charts.

Airspace System Issue Identification and Operations Research

- Supported FAA offices with performance analysis, NAS modernization analysis and benefits analysis.
- Calculated and reported on facility utilization rates using historical and current air traffic.
- Worked with FAA and TSA to provide traffic statistics and charts to support security exercises that strength the FAA's preparedness.

FY 2008 MAJOR ACTIVITIES AND ANTICIPATED ACCOMPLISHMENTS:

- Providing analytical, decision support and operations research support to the FAA lines of business and external customers.
- Complete Minimum Vector Altitude evaluations for major terminal areas using the automation process developed by SDAT.
- Provide end-to-end digital data for FAA Minimum IFR Altitude and Minimum Vector Altitude data.
- Develop new capabilities to provide standards-based (e.g., AIXM) digital aeronautical information to internal customers, external governmental customers and other external customers by enabling the FAA NASR system to communicate using AIXM.
- Release aeronautical information standard, AIXM, jointly with EUROCONTROL. Continue managing the worldwide adoption of AIXM.
- Integrating airport layout plan and survey data into FAA's aeronautical information system repository.
- Supporting fee for service calculations and delivering additional performance metrics capabilities to the field and national FAA lines of business.
- Develop business processes, workflow and data exchange mechanisms to support fully digital Special Use Airspace management from airspace creation through its use in an operational environment.

KEY FY 2009 MAJOR ACTIVITIES AND ANTICIPATED ACCOMPLISHMENTS:

- Automate obstruction evaluation by ensuring Minimum Vector Altitude and Minimum IFR Altitude areas are not penetrated by proposed obstacles.
- Automate obstruction evaluation by ensuring terminal procedures are not affected by proposed obstacles.
- Enhance AIXM data standard to become a global solution to aeronautical information exchange including exchange of dynamic aeronautical data (including NOTAM and Special Use Airspace). Work with international community and International Civil Aviation Organization (ICAO) to adopt AIXM as a standard.
- Develop transformation engines to support new digital NASR products and fully integrate electronic surveys and electronic airport layout plans into FAA's aeronautical information system (NASR).

- Complete internationalization of NASR.
- In coordination with the SWIM program begin implementing digital approach to Special Use Airspace lifecycle management.
- Working with the international community and ICAO deliver a global AIM Modernization concept and develop architectures and roadmaps to harmonize FAA AIM modernization to the global roadmap.

FY 2009 PROGRAM REQUEST:

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

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2007)	$26,991
FY 2008 Appropriated	4,000
FY 2009 Request	4,000
Out-Year Planning Levels (FY 2010-2013)	16,000
Total	$50,991

Budget Authority ($000)	**FY 2005 Enacted**	**FY 2006 Enacted**	**FY 2007 Enacted**	**FY 2008 Enacted**	**FY 2009 Request**
Contracts:					
Airspace Management Laboratory	0	6,930	4,000	4,000	4,000
Personnel Costs	0	0	0	0	0
Other In-house Costs	0	0	0	0	0
Total	**0**	**6,930**	**4,000**	**4,000**	**4,000**

OMB Circular A-11, Conduct of Research and Development ($000)	**FY 2005 Enacted**	**FY 2006 Enacted**	**FY 2007 Enacted**	**FY 2008 Enacted**	**FY 2009 Request**
Basic	0	0	0	0	0
Applied	0	0	0	0	0
Development (includes prototypes)	0	6,930	4,000	4,000	4,000
Total	**0**	**6,930**	**4,000**	**4,000**	**4,000**

1A01E - Airspace Management Laboratory Product and Activities	FY 2009 Request ($000)	Program Schedule					
		FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013
Airspace Management	**$4,000**						
Analyze, Deploy, and Enhance Air Traffic Data and Metrics Products and Projects							
Enhance and augment ATC data collection and distribution system		◆	◊	◊	◊	◊	◊
Deliver high fidelity next-day performance metrics for field use		◆	◊	◊	◊	◊	◊
Provide analytical and operations research support to internal and external customers, including analysis supporting fee for service		◆	◊	◊	◊	◊	◊
Analyze, Enhance, and Support Analysis and Decision Support Tools							
Deliver airspace office automation capabilities, including minimum vector altitude and minimum IRF altitude capabilities		◆	◊	◊			
Integrate terminal procedures and MVA/MIA components of obstruction evaluation into the obstruction evaluation workflow system		◆	◊	◊	◊	◊	
Aeronautical Information Management							
Create fully integrated aeronautical information management system							
Automate and standardize aeronautical data inputs		◆	◊	◊	◊	◊	◊
Develop transformation engines to automate aeronautical data products and provide digital data access to internal and external clients		◆	◊	◊	◊	◊	◊
Implement process improvement strategies to improve end-to-end data integrity, timeliness and quality		◆	◊	◊	◊	◊	◊
Integrate international aeronautical data standards and processes with SWIM and other FAA modernization initiatives		◆	◊	◊	◊	◊	◊
In coordination with the SWIM program begin implementing digital approach to Special Use Airspace lifecycle management.			◊	◊	◊		
Support development and deployment of international standard for aeronautical information (AIXM) as well as global architect concepts for AIM Modernization		◆	◊	◊	◊	◊	◊
Total Budget Authority	**$4,000**	**$4,000**	**$4,000**	**$4,000**	**$4,000**	**$4,000**	**$4,000**

◆ - Activities Accomplished ◇ - Activities Planned

NOTES: OUT YEAR NUMBERS ARE FOR PLANNING PURPOSES ONLY. ACTUAL FUNDING NEEDS WILL BE DETERMINED THROUGH THE ANNUAL BUDGET PROCESS. IN THE ATO CAPITAL APPROPRIATIONS, PERSONNEL AND OTHER COSTS ARE BUDGETED IN ACTIVITY 5, NOT THE PROGRAM BUDGET LINE ITEM.

FAA Budget Appropriation	Budget Item	Program Title	Budget Request
ATO Capital	**1A01F**	**Airspace Redesign**	**$3,000,000**

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

FAA Air Traffic Control Facilities Cited in This Program Description:

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

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

- Increases system capacity and efficiency by removing as many airspace constraints as possible;
- Manages complexity and congestion without continuously increasing sector splitting and growth in the number of sectors;
- Increases flexibility and predictability for the benefit of air traffic controllers and aviation system users;
- Balances the access needs of the diverse set of aviation system users;
- Maintains the highest levels of system safety and security; and
- Reduces expected delays and inefficient routing over the next ten years in major metropolitan areas.

Agency Outputs: The Airspace Management Program serves as the FAA's primary effort to modernize the nation's airspace. The purpose of this national initiative is to review, redesign and restructure airspace. The program includes:

- Regional Optimization and Redesign projects involve airspace changes that are targeted at local problem, but can have larger system-wide impacts. These projects can be smaller in scale, utilizing available resources, or can be larger in scale, encompassing multiple facilities that cross several Service Areas or FAA Regions.
- National High Altitude and Oceanic Redesign are national level efforts that apply state-of-art design techniques in systematic way. These projects specifically leverage national automation and procedural enhancements. High Altitude Airspace Management has been a mechanism for influencing future infrastructure system requirements and the introduction of

advanced concepts into airspace design. Oceanic Redesign capitalizes on the oceanic infrastructure and automation improvements across all oceanic and offshore facilities.

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

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

- Las Vegas Redesign & Phoenix/Northwest 2000 – redesigned terminal/en route airspace and random navigation/area navigation (RNAV) procedures.
- Honolulu Redesign – improved departure coordination procedures for flights; reduced departure times.
- Great Lakes Integrated Design Plan – implemented new routes and improved procedures; reduced delays and restrictions.
- Choke Points – implemented new sectors and route changes; reduced delays, miles in trail, and other restrictions.
- High Altitude Redesign Phase 1 Initial – improved information about Special Use Airspace (SUA) availability and usage, implemented waypoints to circumnavigate SUA supporting improved flight planning information; reduced flying distance around SUA.
- Oakland Oceanic Gateway – created new oceanic route access points; allowed Pacific bound aircraft to achieve desired altitudes quicker, saving fuel and time.
- Denver South – created new routings for Denver satellite airports; reduced complexity.
- Anchorage Center Redesign – created an oceanic specialty, added a new sector, and revised other sector boundaries; improved controller workload balance.
- ZHU/ZMA/ZJX Boundary Realignment – revised the boundaries that divide control of Gulf airspace; improved safety for Gulf flights.
- High Altitude Redesign Phase 1 – instituted non-restrictive routing, Navigational Reference System, and Q-Routes.
- Denver Redesign – developed Ski Country procedures; better-managed delays and demand at key airports.
- NY/NJ/PHL Redesign – instituted "Dual Modena" departure routes; increased departure throughput, reduced departure restrictions, and reduced taxi-out delays.
- Atlantic Oceanic Redesign – instituted Coded Caribbean Routes; reduced coordination and communication errors, increased use of shorter distance access routes, and saved 11-35 miles for flights from Philadelphia and Boston to the Caribbean.
- ZME 5th Area Redesign and ZKC East End – realigned sectors; balanced workload and reduce complexity.
- HAATS Airspace and DFW RNAV – instituted new RNAV departures for DFW; tripled arrivals for IAH and expected to increase throughput.

- LAS Redesign – re-instituted RNAV procedures; reduced flight distances.
- Bay to Basin Redesign and ZAB Redesign – instituted new sectors in ZLA and ZAB; reduced restrictions upon LAS and PHX.
- Southern CA Redesign (LAX Departure Optimization) – instituted new departure routes; allowed for more fuel efficient departures and reduced the number of leveled-off departures by over 70 percent.
- Northern California Terminal Airspace Redesign – realigned airspace between NCT and ZOA; reduced FAA operational costs and reduced flight distances for customers.
- Florida Airspace Optimization – added new sectors and routes; reduced delays and restrictions in the busy east coast corridor.
- Central California Terminal Airspace – realigned en route airspace from Los Angeles center to Santa Barbara TRACON, providing enhanced service to general aviation customers in central California.
- Southern CA Redesign (LAX Arrival Optimization) – instituted new arrival routes; allowed for more fuel efficient arrival altitudes into LAX.
- High Altitude Redesign Expansion Q-Routes – implemented remaining RNAV Q-routes for the southwest and southeast, expanding number of routes available to customers.
- Airspace for New Runways – implement airspace changes to support new runways, specifically Minneapolis, Cincinnati, St. Louis, Atlanta, adding new capacity and efficiency to the system.
- Midwest Airspace Enhancement – large scale redesign of terminal and en route airspace to reduce complexity in the busy Great Lakes Corridor and to leverage previous runways built in Cleveland and Detroit.
- Northern California Airspace Redesign (Dual Arrival Routes and Sector 33 Split) – en route airspace was realigned to add a new sector and to support improvements in arrival throughput at the Bay area airports.
- NY/NJ/PHL Metropolitan Area Airspace Redesign – published Final Environmental Impact Statement (FEIS) in August 2007 and signed Record of Decision (ROD) in September 2007
- Chicago Airspace Project – completed Stage 1, with new eastbound departure routes and supporting sectorization and airspace realignment changes

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

FY 2007 MAJOR ACTIVITIES AND ANTICIPATED ACCOMPLISHMENTS:

- NY/NJ/PHL Metropolitan Airspace Redesign – initial implementation of elements of Stage 1, including dispersal headings for departures at Newark, Kennedy, and Philadelphia
- Houston Area Air Traffic System (HAATS) Airspace – completion of Environmental Assessment, including public meetings, implementation of HAATS Phase 3A
- Chicago Airspace Project – implementation of departure portion of CAP Stage 2, including new southbound departure routes
- Northern California Redesign (ZOA) – completion of sectorization for Three Tier Redesign

FY 2008 PROGRAM REQUEST:

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

- Regional optimization and redesign: includes NY/NJ/PHL Metropolitan Airspace Redesign, Chicago Airspace Project, Houston Area Air Traffic System Airspace, and Western Corridor Airspace.
- National High Altitude Airspace Management and Oceanic Redesign: includes redesign of airspace above Flight Level 290 and work in all oceanic (New York, Oakland, and Anchorage) airspace and offshore airspace. Also includes alignment of airspace planning with future facility planning.

KEY FY 2008 MAJOR ACTIVITIES AND ANTICIPATED ACCOMPLISHMENTS:

- NY/NJ/PHL Metropolitan Area Airspace Redesign (initial phases).
- Chicago Airspace Project (additional airspace changes for new runway).
- Houston Area Air Traffic System (HAATS) Airspace.
- Southern California Redesign (environmental analysis initiated)
- Western Corridor Airspace (including Southern Nevada Airspace)
- Airspace for new runways in Seattle and Washington DC metro areas

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2007)	$2,800
FY 2008 Appropriated	5,000
FY 2009 Request	3,000
Out-Year Planning Levels (FY 2010-2013)	12,000
Total	$22,800

Budget Authority ($000)	FY 2005 Enacted	FY 2006 Enacted	FY 2007 Enacted	FY 2008 Enacted	FY 2009 Request
Contracts:					
Airspace Redesign	0	0	2,800	5,000	3,000
Personnel Costs	0	0	0	0	0
Other In-house Costs	0	0	0	0	0
Total	**0**	**0**	**2,800**	**5,000**	**3,000**

OMB Circular A-11, Conduct of Research and Development ($000)	FY 2005 Enacted	FY 2006 Enacted	FY 2007 Enacted	FY 2008 Enacted	FY 2009 Request
Basic	0	0	0	0	0
Applied	0	0	0	0	0
Development (includes prototypes)	0	0	2,800	5,000	3,000
Total	**0**	**0**	**2,800**	**5,000**	**3,000**

1A01F - Airspace Redesign Product and Activities	FY 2009 Request ($000)	Program Schedule					
		FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013
Airspace Design							
Equipment and other ATO Capital expenditures to support Airspace Management Program projects	**$3,000**	◆					
Develop/Initiate regional optimization and redesign			◊	◊	◊	◊	◊
Develop/Initiate high altitude and oceanic redesign			◊	◊	◊	◊	◊
Total Budget Authority	**$3,000**	**$5,000**	**$3,000**	**$3,000**	**$3,000**	**$3,000**	**$3,000**

◆ - Activities Accomplished ◇ - Activities Planned

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FAA Budget Appropriation	Budget Item	Program Title	Budget Request
ATO Capital	**1A01I**	**Wind Profiling and Weather Research - Juneau**	**$1,100,000**

Supports FAA Strategic Goals: Increased Safety and Greater Capacity.

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

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

JAWS is currently undergoing a Business Case development and analysis of end-state system alternatives, to identify the cost to the FAA and benefits of the system to the Juneau, Alaska aviation community. Four identified alternatives are being investigated: 1) allow Alaska Airlines to own and operate the JAWS system, 2a) FAA to continue to develop the JAWS system without the alert algorithms, 2b) a contractor to continue to develop the JAWS system without the alert algorithms, and 3) FAA to continue to develop JAWS with the alert algorithms. Alternative 3 is the preferred alternative; although, cost and benefit data are still being collected and a decision of Alternative has yet to be determined by the Executive Committee. FY 2008 key activities are based on the preferred alternative.

Agency Outputs: The JAWS program generates turbulence advisories and wind information, which is used by commercial and general aviation pilots in the Juneau area. Commercial/Part 121 pilots (in particular, Alaska Airlines compliance with an FAA Flight Standards required Operational Specification), general aviation/Part 135 pilots, and general operating and flight rules/Part 91 users. The pilots rely on the wind information generated by JAWS for safer forecasts and to allow, when applicable, RNP procedures to be used.

Customer/Stakeholder Involvement: Customers include the Automated Flight Service Station (AFSS)/General Aviation pilots, the National Weather Service (NWS) and the Juneau area air taxi services. Alaska Airlines is the principal stakeholder.

Accomplishments:

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

R&D Partnerships:

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

FY 2008 MAJOR ACTIVITIES AND ANTICIPATED ACCOMPLISHMENTS:

The currently identified $4.0 million will allow for the operations and maintenance of the current prototype system and complete installation and checkout of the end-state system.

- Maintain the JAWS operational prototype in Juneau.
- Complete an Operational Evaluation Report of the prototype system.
- Develop the end-state JAWS on a COTS hardware platform (funds permitting).
- Complete safety mitigation efforts at the JAWS mountaintop anemometer sites and the three wind profiler sites.
- Continue to install the end-state JAWS system to allow for operational testing (funds permitting).
- Address security concerns of JAWS prototype system (funds permitting).

FY 2009 PROGRAM REQUEST:

The requested funding of $1.1 will allow the program to maintain and operate the current prototype system, as well as continue into the completion process of the JAWS end-state system.

KEY FY 2009 MAJOR ACTIVITIES AND ANTICIPATED ACCOMPLISHMENTS:

- Continue to maintain operation of the JAWS prototype.
- Complete any security issues pertaining to the prototype.
- Complete development of the JAWS end-state system.
- Perform any follow-up safety issues at Profiler sites.
- Complete system testing, certification and commissioning of the end-state system.

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2007)	$27,200
FY 2008 Appropriated	4,000
FY 2009 Request	1,100
Out-Year Planning Levels (FY 2010-2013)	0
Total	$32,300

Budget Authority ($000)	**FY 2005 Enacted**	**FY 2006 Enacted**	**FY 2007 Enacted**	**FY 2008 Enacted**	**FY 2009 Request**
Contracts:					
Wind Profiling and Weather Research Juneau	4,861	3,130	1,100	4,000	1,100
Personnel Costs	0	0	0	0	0
Other In-house Costs	0	0	0	0	0
Total	**4,861**	**3,130**	**1,100**	**4,000**	**1,100**

OMB Circular A-11, Conduct of Research and Development ($000)	**FY 2005 Enacted**	**FY 2006 Enacted**	**FY 2007 Enacted**	**FY 2008 Enacted**	**FY 2009 Request**
Basic	0	0	0	0	0
Applied	0	0	0	0	0
Development (includes prototypes)	4,861	3,130	1,100	4,000	1,100
Total	**4,861**	**3,130**	**1,100**	**4,000**	**1,100**

Wind Profiling and Weather Research - Juneau Product and Activities	FY 2009 Request ($000)	Program Schedule					
		FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013
Juneau Airport Wind System	**$1,1000**						
Facilities and Equipment (F&E)							
Operations and maintenance of the current prototype system		◆					
Maintain the JAWS operational prototype in Juneau		◆					
Develop the end-state JAWS on a COTS hardware platform (funds permitting).		◆					
Complete safety mitigation efforts at the JAWS mountaintop anemometer sites and wind profiler sites.		◆					
Continue to install the end-state JAWS system to allow for operational testing (funds permitting).		◆					
Address security concerns of JAWS prototype system (funds permitting).		◆					
Operations and Maintenance (O&M)							
Continue to maintain operation of the JAWS prototype.			◊				
Complete any security issues pertaining to the prototype.			◊				
Complete development of the JAWS end-state system.			◊				
Perform any follow-up safety issues at Profiler sites.			◊				
Install and commission the JAWS end-state system.			◊				
Total Budget Authority	**$1,100**	**$4,000**	**$1,100**	**$0**	**$0**	**$0**	**$0**

◆ - Activities Accomplished ◇ - Activities Planned

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FAA Budget Appropriation	Budget Item	Program Title	Budget Request
ATO Capital	**1A08**	**NextGen Demonstrations and Infrastructure Development**	**$28,000,000**

FAA Strategic Goal: Greater Capacity – Increase reliability and on-time performance of scheduled carriers.

The FAA has identified this program as a "Transformational" program for NextGen.

Description of Problem: The Joint Planning and Development Office (JPDO) is the steward of NextGen. Over the past year, the JPDO developed a NextGen Concept of Operations (ConOps) and an initial Enterprise Architecture. These documents establish a framework for the future based on today's best information. These documents defined two major concepts NextGen will develop: Four Dimension Trajectory Based Operations and Performance-Based Air Traffic Management (PATM).

Four Dimension Trajectory Based Operations — The four dimensions measure latitude, longitude, altitude and time. A set of systems would collect and disseminate 4D data to provide complete situational awareness to pilots, controllers and air traffic managers. The goal is to allow flights to find their best route, rather than restrict them to controlled paths.

Air Traffic Management —FAA currently controls air traffic in the NAS using defined flight paths and airspace restrictions that do not take full advantage of the capabilities of an aircraft or its systems. NextGen would transition FAA to a more collaborative environment where pilots and FAA managers would work together to tailor an aircraft's route for optimum safety and efficiency.

Beyond defining these initial concepts, JPDO, with its many partners, must test and mature these concepts and the technologies that support them. This investment prepares partner agencies to make investment decisions and deploy new capabilities.

FY 2008 was the first year JPDO requested funding for demonstrations and infrastructure development activities to test central NextGen concepts. The results will be used to identify early implementation opportunities, refine longer-term objectives, and if results dictate, eliminate certain concepts from further consideration.

Description of Solution: For FY 2009, $28,000,000 is requested to fund the following activities:

1. **International Air Traffic Interoperability** – This demonstration is designed to help the FAA promote safe, affordable and rapidly implemented innovations into Air Traffic Management (ATM). This effort, known as the Atlantic Interoperability Initiative to Reduce Emissions (AIRE), will use commercial aircraft along oceanic routes to demonstrate and accelerate Airline and Air Navigation Service Providers (ANSP) efficiency improvements using existing systems and technologies. The flight trials development stage will include system architecture, design, hardware and software development (where applicable), procedures development, simulations, component and subsystem testing and certification, and system checkout. Flight trial execution could include scripted flight tests, limited operational testing and extended operational evaluations with revenue aircraft. The AIRE program contributes directly to NextGen concepts and supports international collaboration, avoids overlap, and will "deconflict" activities with national and international organizations (FAA, DOD, EC, Eurocontrol, SESAR, ICAO, ANSP, Airlines, and industry partners). Further, this international interoperability air traffic demonstration and development initiative will assist the international communities and the FAA in validating 4D Trajectory Based Operations (TBO) and Performance-based Air Traffic Management (PATM) alternatives.

2. High Density Airport (HDA) Capacity and Efficiency Improvement Project – This demonstration will serve as the first transition step to TBO. This concept attempts to take advantage of existing ground technologies and functionality while leveraging airborne navigational capabilities that already exist on most commercial production and many in-service airplanes. Trajectory Based Management (TBM) will be accomplished using fully defined 3D paths to ensure aircraft sequencing and spacing (path stretching using dog-legs or offsets). The 3D paths permit a more orderly and predictable traffic patterns and use path clearances rather than the conventional speed, altitude, and heading clearances to manage aircraft spacing. This technique has the potential to reduce controller workload and allow the airplane to precisely follow a continuous path using the accuracy of Required Navigation Performance (RNP) operations. Execution of the demonstration will include data collection from real operations to show benefits in capacity, environmental (noise, computed emissions), and fuel efficiency. Site selection will require deployment of ATM ground automation prototypes to functionally support 3D path operations. The automation tools include the Center TRACON Automation System Traffic Management Advisor (CTAS TMA) and the En Route Descent Advisor (EDA).

3. Unmanned Aircraft Systems (UAS) 4D Trajectory Based Demonstration – This demonstration has two objectives. The first objective will utilize the advanced capabilities of the UAS community to serve as a testbed for exploring future 4D trajectory based concepts. The second objective examines potential concepts for the wide-spread integration of UAS into the future NextGen environment. Today's generation of UAS offer a perfect testbed for "trajectory based" concept validation, in that they basically fly 4DT profiles today and are equipped with toolsets (data-link, GPS) needed for 4D. Use of the UAS community will allow the FAA to evaluate planned 4D automation toolsets, which will be evolving in the next few years. More importantly to the DoD community, these demonstrations will provide a platform for validation of RTCA SC-203 UAS performance requirements now under development. This validation will provide the FAA confidence in the safety case for UAS, and allow the FAA to transition the Minimum Aviation System Performance Standards (MASPS) documents into guidance material such as Advisory Circulars and Technical Standard Orders (TSO).

4. Virtual Tower (Staffed and Autonomous) – The Virtual Tower (VT) program will demonstrate and validate the potential of emerging alternative approaches to performing local and ground air traffic control tower operations for other than the current Airport Traffic Control Tower (ATCT). Projected growth in air traffic and the high cost of building, sustaining and replacing air traffic control towers necessitate the development and evaluation of new concepts that do not require the construction of a new tower or its co-location within or immediately adjacent to the airport property. Such a concept is envisioned and outlined in the JPDO's NextGen ConOps. The ConOps outlines a future air traffic system in which tower ANSP services are provided from remote locations, thus not requiring the ANSP to be physically present in a tower in or near the airport property. The Virtual tower demonstrations will be at field sites (medium to low density airports) that have yet to be determined. The field site selection for virtual towers (both staffed and autonomous) is expected to occur in FY.

5. JPDO Program Management – The JPDO's oversight of NextGen requires approximately $18 million annually in support from the FAA. Prior to FY 2008, the entire amount was requested through the Research, Engineering, and Development appropriation. Beginning in FY 2008, as a few programs move toward implementation, there is a rationale for requesting part of the funding through the ATO Capital appropriation. A detailed description of the program management request can be found in the RE&D budget request.

Benefits: These demonstration and early implementation initiatives will provide JPDO and its partner agencies critical information to refine operating concepts and tools, including the following:

1. International Air Traffic Interoperability. The expected benefits are proof-of-concept and working prototypes for an operational environment with flight profile predictability and efficiency on long-duration international flights, where fuel burn optimization is a prime concern. This activity will demonstrate the benefits of flexibility in a four-dimensionally managed environment through en route flexibility; demonstrate exchange of operational data between aircraft operators and air traffic service providers for informed decision making in near real-time to increase productivity; and demonstrate efficient transition from the oceanic/en route phase of flight to the domestic/en route and offshore descent phases of flight to increase transition area efficiency and productivity.

2. High Density Airport (HDA) Capacity and Efficiency Improvement Project. This demonstration will show enhanced airspace use to accommodate the expected demand. It links two important activities: time based metering and procedures that reduce separation minima (RNAV/RNP) to more fully and efficiently utilize every landing opportunity at the airport runway. The demonstration will also test whether or not the FAA can increase capacity without additional staffing.

3. Unmanned Aircraft Systems (UAS) 4D Trajectory Based Demonstration. Initially, UAS will be used as surrogate transportation aircraft in this demonstration. The results of these tasks will allow for early implementation of trajectory management flight planning capabilities for all aircraft operating in the NAS. Significant benefits can be realized in airspace designated for high performance aircraft through problem identification and resolution earlier in the process, workload spread more evenly, and more effective management of airspace.

4. Virtual Tower (Staffed and Autonomous). The near-term goal and expected benefits are a proof-of-concept and working prototype for a Staffed Virtual Tower (SVT). The longer-term goal will be the Autonomous Virtual Tower (AVT). Both systems will support the projected growth in air traffic by providing additional options for providing ATCT services at airports not currently served, and potentially lower man-power costs. Further, these systems offer a potential reduction in the higher cost of building, maintaining and replacing ATCTs throughout the NAS.

FY 2008 MAJOR ACTIVITIES AND ANTICIPATED ACCOMPLISHMENTS:

- Conduct Tailored Arrival (TA) demonstration at San Francisco International Airport (SFO).
- Conduct a collaborative surface management demonstration at Memphis International Airport (MEM).
- Conduct an Oceanic TBO demonstration, using manual procedures, to identify optimal flight profiles.
- Conduct metrics evaluation throughout FY08 to determine the amount of jet fuel and emissions being reduced by the AIRE partnership demonstrations.

FY 2009 PROGRAM REQUEST:

The requested funding will allow the program to:

- Expand demonstrations to include AIRE European partners.

- Apply lessons learned during the FY08 demonstrations for future planning.

KEY FY 2009 MAJOR ACTIVITIES AND ANTICIPATED ACCOMPLISHMENTS:

- Conduct flight demonstrations and simulations to develop conflict detection and resolution.
- Develop the ability to generate and issue advisories to non-equipped aircraft.
- Integrate en route descent advisor (EDA) functionality into the Miami International Airport (MIA) demonstration.

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2007)	$0
FY 2008 Appropriated	20,000
FY 2009 Request	28,000
Out-Year Planning Levels (FY 2010-2013)	120,000
Total	$168,000

Budget Authority ($000)	**FY 2005 Enacted**	**FY 2006 Enacted**	**FY 2007 Enacted**	**FY 2008 Enacted**	**FY 2009 Request**
Contracts:					
NextGen Demonstrations and Infrastructure Development				20,000	28,000
Personnel Costs				0	0
Other In-house Costs				0	0
Total				**20,000**	**28,000**

OMB Circular A-11, Conduct of Research and Development ($000)	**FY 2005 Enacted**	**FY 2006 Enacted**	**FY 2007 Enacted**	**FY 2008 Enacted**	**FY 2009 Request**
Basic				0	0
Applied				0	0
Development (includes prototypes)				20,000	28,000
Total				**20,000**	**28,000**

1A08 – NextGen Demonstrations and Infrastructure Development Product and Activities	FY 2009 Request ($000)	Program Schedule					
		FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013
NextGen Demonstrations and Infrastructure Development	**$28,000**						
International Air Traffic Interoperability							
Conduct an Oceanic Trajectory Based Operation (TBO) demonstration, using manual procedures, to identify optimal flight profiles for aircraft traversing the Atlantic in order to assess the potential requirements for future automation upgrades.			◊	◊			
Conduct an Oceanic Trajectory Based Operation (TBO) demonstration, using automation, to assess the potential requirements for future automation upgrades.					◊	◊	◊
Demonstrate Continuous Descent Arrivals (CDAs) at various airports to build upon previous work conducted during trials.		♦	◊	◊			
Formulate global requirements and business case for Tailored Arrivals.				◊	◊	◊	
Conduct metrics evaluation throughout FY08 to determine the amount of jet fuel and reduced emissions through the efforts of the AIRE partnership demonstrations.		♦	◊	◊	◊		
Develop initial requirements, procedures and standards for integrated surface operations.		♦	◊	◊			
High Density Airport (HDA) Capacity and Efficiency Improvement Project							
Conduct a High Density Tailored Arrival (TA) at MIA.			◊				
Use fully defined 3D paths to achieve sequencing and spacing trials			◊	◊			
Demonstrate efficient transition from the oceanic / en route phase of flight to the domestic / en route and offshore descent phases of flight			◊	◊	◊		
Unmanned Aircraft Systems (UAS) 4D Trajectory Based Demonstration							
Utilize UAS community as a test bed for the exploration of future 4D trajectory based concepts			◊				
Conduct a demonstration of UAS for validation of RTCA SC-203 performance requirements.			◊				
Virtual Tower			◊	◊	◊	◊	◊
JPDO Program Management		♦	◊	◊	◊	◊	◊
Total Budget Authority	**$28,000**	**$20,000**	**$28,000**	**$30,000**	**$30,000**	**$30,000**	**$30,000**

♦ - Activities Accomplished ◊ - Activities Planned

NOTES: OUT YEAR NUMBERS ARE FOR PLANNING PURPOSES ONLY. ACTUAL FUNDING NEEDS WILL BE DETERMINED THROUGH THE ANNUAL BUDGET PROCESS. IN THE ATO CAPITAL APPROPRIATIONS, PERSONNEL AND OTHER COSTS ARE BUDGETED IN ACTIVITY 5, NOT THE PROGRAM BUDGET LINE ITEM.

FAA Budget Appropriation	Budget Item	Program Title	Budget Request
ATO Capital	1A09A	NextGen - Air Traffic Control/Technical Operations Human Factors – Controller Efficiency	$3,800,000

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

Supports FAA R&D Goal: High-quality teams and individuals.

Intended Outcomes: By 2015, demonstrate improvements in air traffic service provider (ATSP) efficiency (e.g., greater number of aircraft, fewer delays) and effectiveness (e.g., fewer operational errors) through the automation and standardization of operations, procedures, and information

Research will examine the roles of ATSPs and maintainers to ensure safe operations at increased capacity levels and how those roles are best supported by allocation of functions between human operators and automation. The concepts being proposed by the JPDO indicate the roles and responsibilities of ATSPs may change significantly if there is increased reliance on automation for conflict monitoring and if separation functions migrate to the aircraft flight deck. This research will support further development of JPDO concepts of operation and the Operational Evolution Partnership (OEP) solution sets by addressing human-system integration and human performance issues, such as:

- Deciding the appropriate role of the ATSP relative to the automation when trajectory based operations are routinely used in the en route cruise regime.
- Develop integrated workstations that enable the delivery of services throughout the NAS using the concepts in the Operational Evolution Partnership and JPDO Concept of Operations.
- Managing the assignment of roles and responsibilities among the actors in the future NAS (pilots, ATSP, dispatchers, traffic flow coordinators, etc.).
- Ensuring that there is unambiguous transfer of separation responsibility between ground and flight deck elements of the system as aircraft make the transition between different types of airspace.
- Effectively using automation to aid the ATSP in conformance monitoring during trajectory based operations
- Providing the characteristics of usable merging and spacing tools in high density airspace for tailored approaches to increase capacity and reduce environmental impact.
- Making appropriate use of automation to aid the service provider in airspace segments where there are variable separation criteria.
- Avoiding the design of automated systems that are “brittle” and leave the service provider with inadequate clues regarding automation failures.
- Preparing for degraded system modes so that safety can be maintained under abnormal and off-normal conditions.
- Enhancing the response of the NAS to weather disruptions using collaborative air traffic management techniques to accommodate operator preferences.
- Managing risk associated with human errors as human operators interact in new or novel ways with automation that alters traditional relationship between actors in the air traffic system and between those actors and various automated system elements.
- Determining what ATSP training is needed to assure adequate understanding of functions and limitations of automation and decision aids.

Agency Outputs: The Air Traffic Control/Technical Operations Human Factors Research Program provides leadership and products to motivate the evolution of the NAS to assure that the human component of the system will reliably perform to meet the needs of the flying public.

Outputs include:

- Design concepts for en route, terminal and tower workstations for increasing the efficiency and effectiveness of the workforce.
- Assessments of candidate decision support tools, advanced technologies, and associated procedures, demonstrating a specified human-in-the-loop performance level or safety benefit.
- Transitions to more effective problem solving in the ATO safety culture, using procedure changes, processes, and reporting systems, to achieve intended safety benchmarks, moving the ATO toward a Just Culture.
- Accelerate the development of training and selection procedures to transform the workforce into a new generation of service providers who can manage traffic flows in a highly automated system.

Research Goals:

Demonstrate 160 percent ATSP efficiency (Air Traffic Control/ Technical Operations Human Factors)

- By 2009, determine the appropriate use of digital communications to reduce ATSP workload in the terminal area including data entry requirements and workload benefits.
- By 2009, define initial requirements for merging and spacing tools to support continuous descent approach to reduce ATSP workload and environmental impact in the terminal area.

Demonstrate 230 percent ATSP efficiency (Air Traffic Control/ Technical Operations Human Factors)

- By 2013, define the new role for the ATSP that is more strategic in nature in the en route and terminal domains.
- By 2013, demonstrate common situational awareness between flight operators and ATSP to enable collaborative air traffic management.
- By 2013, define procedural requirements for ATSPs to manage and introduce change into the four dimensional (position plus time) dynamic environment.

Customer/Stakeholder Involvement: The ATC/TO Human Factors research program coordinates research priorities with its internal FAA sponsoring organizations and the JPDO.

- *Advanced Air Traffic Systems Requirements Group* – operational personnel and systems developers from the En Route and Terminal Service units as well as System Engineering in Operations Planning coordinates NextGen research requirements for measuring human factors benefits and impacts of proposed technologies to ATSPs, traffic management specialists, and maintainers.
- *Individual and Team Performance Requirements Group* – The Safety, En Route, Terminal, System Operations, Technical Operations and System Engineering functions participate to identify human performance research needs involving safety culture, human error hazard identification, age, operational errors, runway incursion prevention, and employee attitudes. The Safety Integrated Product Team of the JPDO participated in this requirements group.
- *Technical Operations Research Group* – The Technical Operations, En Route, and Terminal service areas recommend research for operation and maintenance of the NAS infrastructure including specification of displays, controls, and maintainability features of ATC systems.

- *Personnel Selection Research Group* – Human Resources, Workforce Services, Workforce Development, and the financial services groups address personnel selection and retention including the ability to successfully screen applicants for ATSP positions, and the need to reduce training cost and time.

R&D Partnerships:

- Collaborative research with NASA on its aerospace systems and air portal projects includes the identification of human factors research issues in the NextGen as technology brings changes to air traffic management.
- Collaboration with EUROCONTROL includes participation in semi-annual Air Traffic Management (ATM) Seminars and participation in ATM Safety Research symposiums.
- Program personnel represent the agency in the Normal Operations Safety Survey Study Group of the International Civil Aviation Organization.
- Grants will be used with universities to address NextGen human factors issues.

Accomplishments: This is a new program starting in FY 2009.

FY 2009 PROGRAM REQUEST:

The program will accelerate and expand research addressing human performance issues in NextGen concepts.

Initiate Trajectory Based Operations (TBO)

- Defining concepts, decision support tools, and procedures for integrating TBO capabilities into ATSP workstations to ensure improvements in ATSP efficiency.
- Evaluating midterm workstation enhancements to ensure benefits intended from integration of data communications and NextGen operational concepts (e.g., limited self separation, variable separation criteria, merging and spacing, and continuous descent approach) are realized.

Increase Arrivals/Departures at High Density Airports

- Determine information requirements necessary to manage advanced operations such as self-spacing, merging, spacing, and passing in en route airspace.
- Assessing the potential for human error in human-automation interaction and developing guidance supporting error tolerance and recovery.
- Identifying the potential human error modes when various actors in the NextGen system communicate and carry out new roles and responsibilities.

Increase Flexibility in the Terminal Environment

- Determine how to integrate traffic flow and contingency management information into the terminal service provider workstation.
- Develop methods to display aircraft equipage differences to service providers in the terminal environment to enable the appropriate level of service.

Improve Collaborative Air Traffic Management (CATM)

- Perform human factors analyses of the CATM concept to determine the optimum communications and decision paths for negotiating access to NAS resources and stating preferences.

Reduce Weather Impact

- Specify the human factors characteristics of decision support tools that will be used in strategic and tactical decision making by members of the air traffic community when adverse weather has an impact on NAS capacity or safety of flight.

Transform Facilities

- Develop integrated staffed virtual tower workstations that enable the provision of essential air traffic services at airports that experience an increase in traffic levels without the need for construction of a traditional tower.

KEY FY 2009 MAJOR ACTIVITIES AND ANTICIPATED ACCOMPLISHMENTS:

Demonstrate a 166 percent air traffic ATSP efficiency using an advanced workstation integrating NextGen concepts, capabilities, and procedures.

Initiate Trajectory Based Operations

- Define a preliminary set of roles and responsibilities for the actors in the NextGen NAS when interacting with anticipated automated functions to achieve the expected performance levels.
- Conduct a high fidelity simulation to assess efficiency from integrating NextGen concepts, capabilities, and procedures.

Increase Arrivals/Departures at High Density Airports

- Define ATSP information requirements for merging and spacing operations and continuous descent approach in the terminal area.
- Assess system performance requirements to recover from ATSP data entry errors.
- Assess types and modes of human error in operations for merging and spacing and continuous descent approach.

Increase Flexibility in the Terminal Environment

- Model ATSP workload benefits from digital data link for mixed equipage aircraft in the terminal area.

Improve Collaborative Air Traffic Management

- Develop initial collaborative ATM requirements, ensuring information and communication flows support common situational awareness for ATSPs, pilots, and in the future NAS.

Reduce Weather Impact

- Assess improved weather displays in the en route domain.

Transform Facilities

- Perform initial simulations to assess the benefits of integrated tower workstations
- Perform initial human factors analyses to define requirements for displays that replace the traditional out-the-window view.

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2007)	$0
FY 2008 Request	0
FY 2009 Request	3,800
Out-Year Planning Levels (FY 2010-2013)	46,800
Total	$50,600

Budget Authority ($000)	**FY 2005 Enacted**	**FY 2006 Enacted**	**FY 2007 Enacted**	**FY 2008 Enacted**	**FY 2009 Request**
Contracts:					
NextGen - Air Traffic Control/Technical Operations					3,800
Human Factors – Controller Efficiency					
Personnel Costs					0
Other In-house Costs					0
Total					**3,800**

OMB Circular A-11, Conduct of Research and Development ($000)	**FY 2005 Enacted**	**FY 2006 Enacted**	**FY 2007 Enacted**	**FY 2008 Enacted**	**FY 2009 Request**
Basic					0
Applied					0
Development (includes prototypes)					3,800
Total					**3,800**

1A09A – Air Traffic Control/Technical Operations Human Factors – Controller Efficiency Product and Activities	FY 2009 Request ($000)	Program Schedule					
		FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013
Air Traffic Control/Technical Operations Human Factors – Controller Efficiency	$3,800						
Trajectory Based Operations			◆	◊	◊	◊	◊
High Density Airports			◆	◊	◊	◊	◊
Flexibility in the Terminal Environment			◆	◊	◊	◊	◊
Collaborative Air Traffic Management			◆	◊	◊	◊	◊
Reduce Weather Impact			◆	◊	◊	◊	◊
Transform Facilities			◆	◊	◊	◊	◊
Total Budget Authority	$3,800		$3,800	$11,700	$11,700	$11,700	$11,700

◆ - Activities Accomplished ◇ - Activities Planned

NOTES: OUT YEAR NUMBERS ARE FOR PLANNING PURPOSES ONLY. ACTUAL FUNDING NEEDS WILL BE DETERMINED THROUGH THE ANNUAL BUDGET PROCESS. IN THE ATO CAPITAL APPROPRIATIONS, PERSONNEL AND OTHER COSTS ARE BUDGETED IN ACTIVITY 5, NOT THE PROGRAM BUDGET LINE ITEM.

FAA Budget Appropriation	Budget Item	Program Title	Budget Request
ATO Capital	**1A09B**	**NextGen - Air Traffic Control/Technical Operations Human Factors – Air/Ground Integration**	**$2,900,000**

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

Supports FAA R&D Goal: Human Centered Design.

Intended Outcomes: By 2016, demonstrate that operations (e.g., day and night, all weather), procedures, and information can be standard and predictable at an acceptable level of risk of human error for users (e.g., pilots, air traffic service providers (ATSP), dispatchers, airlines, passengers) at all types of airports and for all aircraft.

Integration of air and ground capabilities poses challenges for pilots and ATSPs. A core human factors issue is ensuring that safety in the NAS is maintained. As the NAS moves toward a more automated system and roles and responsibilities of pilots and ATSPs begin to change, intent information as well as positive information on delegation of authority must be clear and unambiguous. This changing environment requires a close examination of new types of human error modes to manage safety risk in the human factors domain.

Both the air and ground sides of the aviation system need to share intent information. The concept of trajectory management implies that a flight plan will become a performance contract that meets the user's needs, will be executed by the flight deck and protected by the air traffic system. There are multiple parameters in aviation such as weather, unanticipated traffic, sudden denial of airspace, emergencies, and a myriad of other factors that will require close monitoring. Even a simple factor such as aircraft ground speed may become a managed factor to meet trajectory expectations that must be balanced by other concerns such as fuel consumption and schedules.

Training of ATSPs, pilots, and dispatchers can be designed to ensure adequate understanding of functions and limitations of automation and decision aids important to ensuring efficiency and effectiveness in different ATSP roles and positions.

The knowledge base for understanding and defining effective roles for pilots, dispatchers, and ATSPs in next generation systems and how those roles are best supported by allocation of functions between human operators and automation is framed relative to the Operational Improvements envisioned in NextGen.

A system approach to air-ground integration needs to address how to transition from current operations to new concepts taking into account changes in responsibilities and liabilities. Interoperability of air and ground decision support tools necessitates synchronization of conflict probe look-ahead times, 4-D intent information, and alerting functions for CDTI and Precision Runway Monitor for closely spaced parallel approaches. Pilots and ATSPs need a shared understanding of how procedures change during transitions across different types of airspace (e.g., from a self-separation regime to shared separation to traditional ground-based separation environments). Procedures may also change relative to mixed equipage and aircraft types (such as Very Light Jets) and how air and ground systems will communicate and display aircraft capabilities.

Agency Outputs: The Air Traffic Control/Technical Operations Human Factors Research Program addresses the ATSP side of the air-ground integration challenge. Through use of modeling, simulation, and demonstration the program assesses interoperability of tools, develops guidance, identify human-system safety risk and verifies procedures for ensuring efficient and effective human system integration in transitions of NextGen capabilities.

Outputs include:

- Define the changes in roles and responsibilities, between pilots, dispatchers, and ATSPs and between humans and automation, required to implement NextGen and ensure safety of the NAS.
- Develop and apply error management strategies, mitigate risk factors, and reduce automation-related errors.
- Develop and apply formal human-system risk management methods and tools.
- Demonstrate improved weather displays that provide accurate and timely graphical weather information in the en route and terminal domain
- Demonstrate the application of a framework for using part task simulations, high fidelity simulations, and full mission demonstrations to assess interoperability of air and ground systems
- Demonstrate the application of a simulation and demonstration roadmap laying out incremental objectives, simulation requirements, assumptions, and risks for assessing integration of ATSP tools, including for weather and wake separation
- Demonstrate the transition of self-separation responsibility to pilots
- Define and develop human performance modeling and simulation activities to assess human and system performance requirements for design and operation of aircraft and air traffic management systems.

Research Goals: In concert with the Flightdeck Human Factors NextGen white sheet on air-ground integration,

- by 2011, identify changes in ATSP procedures to support pilot separation responsibility when using cockpit display of traffic information.
- by 2012, identify ATSP requirements for use of probabilistic weather information in en route terminal, tower, and system operation domains.
- by 2012, demonstrate ATSP use of NextGen concepts, capabilities and procedures supporting transition of self separation responsibility to pilots.
- by 2013, develop a transition plan addressing changes in ATSP roles and responsibilities for different regimes of airborne separation responsibility.
- by 2014, demonstrate ATSP procedures in use of workstation tools for weather and wake separation including mixed equipage and variable spacing.
- by 2014, demonstrate integration of air and ground functional capabilities.
- by 2016, conduct a full mission demonstration using a distributed simulation architecture showing integrated NextGen air and ground capabilities for ATSP efficiency pilot separation responsibility.

Customer/Stakeholder Involvement: The ATC/TO Human Factors research program coordinates research priorities with its internal FAA sponsoring organizations and the JPDO. Through the advanced air traffic system requirements group, operational personnel and systems developers from the En Route, Terminal, and System Operations service units will coordinate NextGen research requirements. Included in this are plans for high fidelity simulations and full mission demonstrations. This collaboration ensures mitigating potential risks in transitions of NextGen concepts, capabilities, and procedures with baseline systems.

R&D Partnerships:

Collaborative research with NASA on its aerospace systems and air portal projects includes the identification of human factors research issues in the NextGen as technology brings changes to air traffic management. Complex full mission demonstrations using a distributed simulation architecture will leverage NASA cockpit and ATM simulation facilities and other resources.

Grants will be used with universities to address NextGen human factors issues.

Coordination on research issues and plans with ATM industry stakeholders.

Accomplishments: This is a new program starting in FY 2009.

FY 2009 PROGRAM REQUEST:

- The program will assess human centered design issues in use of ATM and airborne NextGen concepts, capabilities, and procedures leading to a full mission demonstration in 2015.
- Roles and Responsibilities
- Defining a preliminary set of roles and responsibilities for the actors in the NextGen NAS based on OEP Solution Sets and identifying potential for new operator errors associated with these changes
- Determining appropriate functional allocation between operators and automation under various operational conditions using NextGen use cases and planned operational scenarios
- Conducting human factors analysis supporting safety management associated with the changes of roles and responsibilities and allocation of function
- Developing a human factors transition plan identifying changes in ATSP roles and procedures associated with delegation of separation responsibility to the pilot.

Human System Integration

- Developing NextGen human performance modeling environment including ATSPs, pilots, and airline personnel
- Developing methods to assure a common workstation view of current and projected aircraft performance

Integrated Demonstrations

- Defining requirements for use of probabilistic weather information.
- Assessing ATSP human performance measures related to NextGen concepts, capabilities, and procedures
- Assessing ATSP procedures for weather and wake separation using decision support tools

KEY FY 2009 MAJOR ACTIVITIES AND ANTICIPATED ACCOMPLISHMENTS:

Roles and Responsibilities

- Defining a preliminary set of roles and responsibilities for the actors in the NextGen NAS when interacting with anticipated automated functions to achieve the expected performance levels.
- Determining appropriate functional allocation between operators and automation under various operational conditions using NextGen use cases and planned operational scenarios
- Identifying potential areas for increased operator error associated with NextGen changes in operator roles and responsibilities
- Completing preliminary human factors analysis supporting safety management associated with the changes of roles and responsibilities and allocation of function

- Developing Human Performance Perspective of Integrated Risk Picture (IRP)
- Developing and applying risk management techniques to understand and predict human error vulnerabilities and hazards
- Developing a human factors transition plan identifying changes in ATSP roles and procedures associated with delegation of separation responsibility to the pilot.

Human System Integration

- Developing human performance modeling environment to assess NextGen air-ground integration human performance issues
- Developing methods to integrate conformance monitoring alerts for automated trajectories into the workstations to assure that the air and ground components have a common view of current and projected aircraft performance.

Integrated Demonstrations

- Defining en route ATSP requirements for use of probabilistic weather information.
- Assessing ATSP workload and situational awareness and use of NextGen concepts, capabilities, and procedures for different regimes of airborne separation responsibility using distributed simulations.
- Assessing ATSP procedures for weather and wake separation addressing interoperability of decision support tools and mitigation of human error risks using full mission demonstrations.

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2007)	$0
FY 2008 Request	0
FY 2009 Request	2,900
Out-Year Planning Levels (FY 2010-2013)	30,800
Total	$33,700

Budget Authority ($000)	**FY 2005 Enacted**	**FY 2006 Enacted**	**FY 2007 Enacted**	**FY 2008 Request**	**FY 2009 Request**
Contracts:					
Air Traffic Control/Technical Operations Human Factors – Air/Ground Integration					2,900
Personnel Costs					0
Other In-house Costs					0
Total					**7,700**

OMB Circular A-11, Conduct of Research and Development ($000)	**FY 2005 Enacted**	**FY 2006 Enacted**	**FY 2007 Enacted**	**FY 2008 Request**	**FY 2009 Request**
Basic					0
Applied					0
Development (includes prototypes)					2,900
Total					**2,900**

1A09B – Air Traffic Control/Technical Operations Human Factors – Air/Ground Integration Product and Activities	FY 2009 Request ($000)	Program Schedule					
		FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013
Air Traffic Control/Technical Operations Human Factors – Air/Ground Integration	**$2,900**						
Roles and Responsibilities							
Define potential new operator errors stemming from new roles and responsibilities			◆	◊	◊	◊	
Determine appropriate function allocation between operators and automation			◆	◊	◊		
Conduct human factors safety analyses for changing roles and responsibilities			◆	◊	◊	◊	
Develop a transition plan to implement pilot separation			◆	◊			
Human System Integration							
Develop NextGen human performance modeling			◆	◊	◊	◊	◊
Develop methods to assure a common view of current and projected aircraft performance			◆	◊	◊		
Integrated Demonstrations							
Define en route ATSP requirements for use of probabilistic weather information			◆	◊	◊	◊	
Assess ATSP workload and situational awareness and use of NextGen concepts			◆	◊	◊	◊	◊
Assess ATSP procedures for weather and wake separation			◆	◊	◊		
Total Budget Authority	**$2,900**		**$2,900**	**$7,700**	**$7,700**	**$7,700**	**$7,700**

◆ - Activities Accomplished ◇ - Activities Planned

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FAA Budget Appropriation	Budget Item	Program Title	Budget Request
ATO Capital	**1A09C, 1A09D**	**NextGen - Environment and Energy – Advanced Noise and Emission Reduction, Validation Modeling**	**$7,000**

Supports FAA Strategic Goals: Increased Safety and Greater Capacity.

Intended Outcomes: The Advanced Noise and Emissions Reduction and Validation Modeling program helps achieve the Next Generation Air Transportation System (NextGen) goal to increase capacity threefold while reducing significant environmental impacts in absolute terms.

The program will explore advanced operational procedures to enable absolute reduction of significant aviation environmental impacts and establishing the benefits and costs for adopting these new procedures. The program will also develop and advance analytical tools and metrics to implement Environmental Management Systems (EMSs) to manage and mitigate NextGen environmental impacts. The analytical efforts are providing sufficient knowledge of climate change effects of aviation to enable assessing the impacts of various means to mitigate these effects.

The program is also focused on assessing National Airspace System (NAS) infrastructure impacts of Continuous Low Energy, Emissions and Noise (CLEEN) technologies and alternative fuels developed under the Research, Engineering and Development program (RE&D) and establishing and advancing any NAS adaptation required to implement and benefit from these technologies and fuels.

The Program specifically supports the following outcomes:

Identify and explore how advances in Communication, Navigation and Surveillance technology can be leveraged in the short- to medium-term to further optimize advanced aircraft arrival and departure, surface and enroute procedures to reduce noise, fuel burn and emissions. Develop airspace analytical tools for aviation noise and emissions impacts, and analysis of costs/benefits of mitigation techniques. Design, develop and demonstrate implementation of EMS approaches to dynamically manage environmental impacts on the NAS in the most efficient and effective manner possible.

Specific activities include:

- Explore advanced aircraft arrival, departure and surface operations to reduce emissions, fuel burn and noise
- Advance noise, local air quality and climate impacts metrics to quantify and manage the impacts of operations associated with NextGen
- Develop decision support tools to dynamically manage environmental impacts via EMSs
- Conduct validation modeling of mitigation approaches
- Develop decision support tools to assess the benefits and costs and aid in the implementation of clean and quiet procedures in the NAS
- Determine and develop NAS infrastructure adaptation necessary to adopt new environmental technologies and advanced fuels.

Assess impacts of adopting new aircraft environmental technologies and advanced fuels for the NAS infrastructure and advance any NAS adaptation necessary to benefit from these technologies.

Specific activities include:

- Assess the impacts of new aircraft technologies and alternative fuels on the NAS
- Identify and develop any new elements of NAS infrastructure required to support the operation of new aircraft and alternative fuel technologies
- Demonstrate flight and ground integration of new CLEEN technologies and alternative fuels in the NAS

Agency Outputs: The program is protecting the environment by reducing significant aviation environmental impacts associated with noise, emissions, and global climate impact. The program will explore, collaboratively with industry and academia, advanced operational procedures that mitigate NextGen environmental impact while satisfying safety requirements. The program will support the design, development and implementation of EMSs that will allow adapting environmental protection to the dynamic needs of the NAS. In addition, the program will establish the benefits and costs for adopting new procedures and practices and develop decision support tools that can be introduced into the NAS in the short and medium term to enable better planning and decisions. Finally, the program will also establish and advance any NAS infrastructure adaptation required to support the operation of new aircraft technologies and alternative fuels.

Research Goals:

- By FY 2009, explore environmental control algorithms for ground, terminal area, and enroute advanced operational procedure to reduce emissions and noise
- By FY 2010, evaluate impacts of CLEEN technologies on NAS infrastructure integration
- By FY 2010, evaluate benefits of alternative fuels on NAS infrastructure integration
- By FY 2011, conduct demonstration of environmental control algorithms for advanced ground, terminal area, and enroute operational procedures to reduce emissions and noise
- By FY 2012, conduct significant demonstration of CLEEN mitigation technologies integration into the NAS
- By FY 2012, conduct significant demonstration of alternative fuels integration into the NAS
- By FY 2013, define standards, policy and procedures for environmental control logic for use in automated EMSs
- By FY 2013, define standards, policy and procedures for CLEEN technologies integration into the NAS
- By FY 2013, define standards, policy and procedures for alternative fuels integration into the NAS

Customer/Stakeholder Involvement: The FAA works closely with other federal agencies, industry, academia, and international governments and organizations to design R&D efforts that can advance understanding of aviation environmental health and welfare impacts.

- NextGen -- FAA is leading an Environmental Working Group (EWG) responsible for all environmental dimensions of the JPDO. The EWG comprises FAA, NASA, the Environmental Protection Agency (EPA), DoD, Department of Commerce, Council on Environmental Quality, Department of the Interior, and Office of the Secretary of Transportation, as well as industry, academia, local government, and community groups. The efforts of the EWG are centered on advancing the national vision and recommendations for aviation in the NextGen and in the congressionally mandated study on “Aviation and the Environment”, including advanced operational procedures, aircraft technologies and alternative fuels development.

R&D Partnerships: As does the Environment and Energy Research Program and other NextGen activities, the Advanced Noise and Emissions Reduction and Validation Modeling program relies on a series of Memorandums of Agreement (MOA), to work closely with NASA. In FY 2005, FAA signed an MOA with DoD to pursue joint activities to understand and mitigate aviation noise and emissions. The FAA is also pursuing collaborative agreements with DoE, and EPA to leverage resources to address aviation’s environmental impact.

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

Accomplishments: This is a new effort to address the challenges of NextGen. However, relevant stakeholders have achieved significant accomplishments mitigating aviation’s environmental impact. The number of people exposed to significant noise levels was reduced by about 90% between 1975 and 2006. Today's aircraft are also 70 percent more fuel-efficient-per-passenger-mile than jet aircraft of the 1960s. Reduced fuel consumption has also led to a 90 percent reduction in carbon monoxide, smoke, and other aircraft emissions.

FY 2008 MAJOR ACTIVITIES AND ANTICIPATED ACCOMPLISHMENTS:

There were no activities in FY 2008 as this is an FY 2009 new initiative.

FY 2009 PROGRAM REQUEST:

NextGen has adopted environmental goals to reduce significant noise and air quality impacts in absolute terms, to enhance fuel efficiency, to limit or reduce greenhouse gases. The growth enabled by NextGen increases environmental impacts 150-200% - even in the near term. The ATO Capital environmental investments enable delivering the NextGen noise goal of reducing the number of people exposed to noise each year by 4% and improving fuel efficiency by at least 1% per year. Future environmentally responsible aviation environmental mitigation must be based on a new, interdisciplinary approach that addresses the relationship between noise and emissions and different types of emissions, and provides the cost-benefit analysis capability necessary for data-driven decision making.

This effort will identify and explore how advances in Communication, Navigation and Surveillance technology can be leveraged in the short- to medium-term to explore advanced air and ground operations to reduce fuel burn, noise and emissions.

The FAA is developing a robust new comprehensive framework of aviation environmental analytical tools and methodologies under the RE&D program to develop integrated noise and emissions models. This effort will build upon the RE&D investment that is developing the fundamental modules of such models to develop computer models to assess environmental impacts of NAS changes and controls to enable environmental management systems to actively mitigate noise and emissions. The effort will allow developing a the regional versions of our analyses tools in the next 3-5 years to help guide NextGen environmental activities (for example right now we are unable to assess the impact of three time growth at a level beyond a rough order of magnitude; this is inadequate to make decisions that cost millions in infrastructure development) and support the development of robust EMSs. We would also conduct the validation and verification required to make these tools acceptable for environmental impact assessments and EMS implementation.

Finally, this effort seeks to assess the impacts of new aircraft technologies and alternative fuels on the NAS and establish and advance any NAS adaptation required to implement and benefit from environmentally beneficial technologies.

Elements of this initiative include:

- Explore operational procedures to mitigate NextGen environmental impacts
- Develop metrics and models to implement NAS Environmental Management Systems to reduce NextGen environmental impacts
- Establish the impacts of CLEEN aircraft technologies and alternative fuels on the NAS infrastructure and advance any changes required to adopt these aircraft technologies and fuels

Ongoing Activities

This is a new activity.

KEY FY 2009 MAJOR ACTIVITIES AND ANTICIPATED ACCOMPLISHMENTS:

Advanced Operational Procedures

- Explore advanced algorithms and approaches for enroute operations that reduce climate impacts
- Explore advanced algorithms and approaches for surface operations that reduce emissions
- Explore advanced algorithms and approaches for terminal procedures that optimize noise and air quality emissions reductions

Environmental Management System

- Define existing and planned environmental mitigation methods to counter NAS constraints (today and for NexGen)
- Modify the Aviation Environmental Design Tool (AEDT) to enable evaluating environmental impact for regional airspace needs and support EMSs
- Apply metrics for health and climate impacts to develop a sample NAS EMSs and define benefits of mitigation actions

CLEEN and Alternative Fuels and NAS Infrastructure Integration

- Evaluate potential benefits of CLEEN aircraft technologies on the NAS
- Evaluate potential benefits of aviation alternative fuels on the NAS
- Analyze new aircraft types (e.g., aircraft featuring CLEEN technologies, VLJ, UAV, SBJ) environmental impacts and assess approaches to optimize environmental performance

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2007)	$0
FY 2008 Appropriated	0
FY 2009 Request	7,000
Out-Year Planning Levels (FY 2010-2013)	80,000
Total	$87,000

Budget Authority ($000)	**FY 2005 Enacted**	**FY 2006 Enacted**	**FY 2007 Enacted**	**FY 2008 Enacted**	**FY 2009 Request**
Contracts:					
Operational Procedures Explorations/EMSs models and metrics					4,500
CLEEN/Alternative Fuels NAS impacts					2,500
Personnel					0
Other In-house Costs					0
Total					**7,000**

OMB Circular A-11, Conduct of Research and Development ($000)	**FY 2005 Enacted**	**FY 2006 Enacted**	**FY 2007 Enacted**	**FY 2008 Enacted**	**FY 2009 Request**
Basic					0
Applied					0
Development (includes prototypes)					7,000
Total					**7,000**

1A09C,D - Environment and Energy Product and Activities	FY 2009 Request ($000)	Program Schedule					
		FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013
Operational Procedure Exploration/EMS Models and Metrics	**$4,500**						
Assess efficacy of metrics			◊		◊		◊
EMSs development			◊		◊		◊
EMSs demonstration				◊		◊	◊
Validation modeling				◊	◊	◊	◊
Control Algorithm Development			◊		◊		
Procedures Exploration			◊		◊		◊
Benefit/Cost Assessment				◊	◊	◊	◊
Publish Research Reports				◊	◊	◊	◊
NAS Impacts of CLEEN/Alternative Fuels	**$2,500**						
Impacts assessment			◊		◊		◊
CLEEN technologies integration demonstrations				◊	◊		◊
Alternative Fuels integration demonstrations					◊		◊
Validation Modeling				◊	◊	◊	◊
Publish Research Results				◊	◊	◊	◊
Total Budget Authority	**$7,000**		**$7,000**	**$20,000**	**$20,000**	**$20,000**	**$20,000**

◆ - Activities Accomplished ◇ - Activities Planned

NOTES: OUT YEAR NUMBERS ARE FOR PLANNING PURPOSES ONLY. ACTUAL FUNDING NEEDS WILL BE DETERMINED THROUGH THE ANNUAL BUDGET PROCESS. IN THE ATO CAPITAL APPROPRIATIONS, PERSONNEL AND OTHER COSTS ARE BUDGETED IN ACTIVITY 5, NOT THE PROGRAM BUDGET LINE ITEM.

FAA Budget Appropriation	Budget Item	Program Title	Budget Request
ATO Capital	**1A09E**	**NextGen - New ATM Requirement**	**$5,400,000**

Supports FAA Strategic Goal: Greater Capacity

Intended Outcomes: The ATM Requirement Program addresses FAA's goal for capacity and the DOT Reduced Congestion Strategic Objective to "Advance accessible, efficient, inter-modal transportation for the movement of people and goods." It also supports the FAA's National Aviation Research Plan goal for "Fast, Flexible and Efficient" which supports development of a system that safely and quickly moves anyone and anything, anywhere, anytime on schedules that meet customer needs. It fits within the Air Traffic Organization's pathway 4, "Ensure Viable Future" which has the goal to assure a sustainable and affordable Air Transportation System for the future. Furthermore, this program fits the NextGen goal of expanding capacity by satisfying future growth in demand (up to three times capacity) as well as reducing transit time.

The program will include research and development for new procedures and technologies both on the ground and in the air to increase efficiency of the NAS. Program outcomes include:

- Procedures, technologies, and tools to support trajectory-based operations in transitional airspace, such as between oceanic and domestic en route, as well as all airspace to outer markers (approach and departure).

Agency Outputs: The program will address several of the NextGen solution sets while aligning with the FAA Enterprise Architecture and will concentrate on final research and development activities to prepare capabilities to be transitioned into the NAS. These solution sets include the following: Trajectory Based Operations; High Density Arrivals/Departures and Airports; Flexible Terminal and Airports; Collaborative Air Traffic Management; and Networked Facilities. Research activities may contribute to more than one of these solution sets. Where appropriate, activities will be coordinated with MITRE and/or NASA to complete any required final research and development to transition their products into the NAS. Also as appropriate, these activities move into final development and implementation upon successful completion of Joint Resource Council 2-B level decisions.

Research Goals:

Trajectory Based Operations

Enable strategic planning and execution of flight trajectories throughout the airspace for equipped aircraft. This will require performance-based separation management, performance-based trajectory management operations and decision support tools, flight object information exchange, and airspace support.

- By 2010, conduct tradeoff studies to determine approaches to future air-ground data communications requirements implementing flexible airspace management
- By 2012, develop requirements for development, negotiations and exchange standards trajectories
- By 2012, determine conflict resolution approaches using aircraft intent data
- By 2013, develop draft procedures and tools for 3-mile horizontal separation everywhere

High Density Arrivals/Departures and Airports

Using trajectory-based terminal operations and flow management, reduce spacing between aircraft. This will require implementation of high density corridors with reduced separation matching aircraft in transition to airport arrival capacity, enhanced surface technologies, parallel runway operations with reduced lateral separation, digital taxi clearance and conformance, expansion of terminal separation procedures throughout arrival and departure airspace. Higher performance navigation and communication capabilities will be necessary.

- By 2011, determine requirements for TCAS "8.0" to continue to provide effective collision risk safety net in an environment of closely space parallel RNP route form top-of-descent to the runway approaches for parallel runway operations with spacing down to 750 feet
- By 2012, determine procedures and technologies to support parallel runway operations with spacing down to 750 feet in IMC.
- By 2013, demonstrate the ability to define and "certify" RNAV/RNP procedures with exchange to flight deck via data messaging
- By 2013, develop concepts for surface traffic management with conformance monitoring

Flexible Terminal and Airports

Dynamically manage airspace and surface operations with appropriately equipped aircraft, as opposed to the static way of managing airspace today, to provide greater capacity, efficiency, and safety. Will be applicable to lower density terminal areas and either trajectory-based or classic operations can be conducted. This dynamic management will require changes to procedures for low or zero visibility conditions, as well as, related decision support tools for both air and ground applications.

- By 2010, conduct tradeoff studies to determine approaches to future air-ground and ground-ground data communications requirements implementing flexible terminal management
- By 2011, determine system requirements for separation in low-visibility on the airport surface.
- By 2012, determine mixed equipage trajectory-based routes for RNAV/RNP and continuous descent (CDA) operations
- By 2013, define automated virtual tower options and alternative mechanisms

Collaborative Air Traffic Management

Optimize capacity to balance demand by strategic and tactical interactions with air traffic managers and flight operators. Requires shared data communication among pilots, dispatchers, and controllers and decision support tools for both air and ground applications. This includes developing a software assurance standard for integrating the air ground applications safely.

- By 2011, develop software assurance standard for integration of air and ground decision support systems
- By 2013, test initial concepts in partial collaborative decision making application

Customer/Stakeholder Involvement: The program addresses the needs of the FAA Air Traffic Organization (ATO) and works with the FAA Aviation Safety organization to ensure new procedures and solutions are safe and that the airports and air routes targeted for their implementation are those with critical needs to reduce air traffic delays and air route congestion thus providing more capacity. The program works with controllers, airlines, and pilots to include user recommendations and ensure that training and implementation issues are addressed in the program's research from the start.

Customers:

- Pilots
- Air navigation service provider personnel
- Air carrier operations

- Airport operations

Stakeholders:

- Joint Planning and Development Office
- Commercial pilot unions
- FAA air navigation service provider unions
- Other ICAO air navigation service providers
- Avionics and Aircraft manufacturers

R&D Partnerships: In addition to maintaining its partnership with FAA's Aviation Safety organization, this research program will accomplish its work via working relationships with industry, academia, and other government agencies. The coordination and tasking are accomplished through joint planning/reviews, contracts and interagency agreements with the program's potential partners:

- Volpe National Transportation Center
- MITRE/Center for Advanced Aviation and Systems Development (CAASD)
- NASA Ames, Glenn, and Langley Research Centers
- EUROCONTROL and associated research organizations

FY 2009 PROGRAM REQUEST:

NextGen Initiative

In FY09, FAA must begin developing the capabilities needed to make required capabilities supportive of NextGen solution sets. These capabilities are highly dependent on technologies that accurately predict the location and intent of aircraft and provide this information to other pilots and controllers. Some of the aspects of the NextGen Concept of Operations depend upon the aircraft as a participant in efficient, safe air traffic management. These capabilities also rely on procedures that keep traffic flowing smoothly in all weather and visibility conditions. The NextGen research initiative will result in enhanced methods of determining safe separation while optimizing capacity, for all flight regimes and all aircraft.

KEY FY 2009 MAJOR ACTIVITIES AND ANTICIPATED ACCOMPLISHMENTS:

Trajectory Based Operations

- Complete the investigation of compatibility of prototyped L-Band components with existing systems in the L-band particularly with regard to the onboard co-site interference and agree on the overall design characteristics;
- Evaluate and validate the performance of the proposed solution in the relevant environments through trials and testbed development; and
- Considering the design trade-offs, propose the appropriate L-Band solution for input to a global aeronautical standardization activity.

High Density Arrivals/Departures and Airports

- Determine compatibility of ground-based elements with airborne elements when using new High Density trajectory based procedures
- Determine TCAS effectiveness in the NextGen environment and define requirements for improved performance

Flexible Terminal and Airports

- Identify the portions of the IEEE 802.16e C-band standard best suited for airport surface wireless mobile communications and propose an aviation specific standard to appropriate standardization bodies;
- Evaluate and validate the performance of the aviation specific standard to support wireless mobile communications networks operating in the relevant airport surface environments through trials and testbed development; and
- Develop a channelization methodology for allocation of safety and regularity of flight services in the band to accommodate a range of airport classes, configurations and operational requirements.

Collaborative Air Traffic Management

- Conduct analysis of approaches/methodologies for software assurance of complex air-ground systems.
- Initiate development of a coordinated airborne and ground software assurance standard to support Air-Ground operational integrity.

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2007)	$0
FY 2008 Appropriation	0
FY 2009 Request	5,400
Out-Year Planning Levels (FY 2010-2013)	116,500
Total	$121,900

Budget Authority ($000)	FY 2005 Enacted	FY 2006 Enacted	FY 2007 Enacted	FY 2008 Enacted	FY 2009 Request
Contracts	0	0	0	0	0
New ATM Requirement					5,400
Personnel Costs	0	0	0	0	0
Other In-house Costs	0	0	0	0	0
Total					**5,400**

OMB Circular A-11, Conduct of Research and Development ($000)	FY 2005 Enacted	FY 2006 Enacted	FY 2007 Enacted	FY 2008 Enacted	FY 2009 Request
Basic	0	0	0	0	0
Applied	0	0	0	0	0
Development (includes prototypes)	0	0	0	0	5,400
Total					**5,400**

1A13(5) – New ATM Requirement Product and Activities	FY 2009 Request ($000)	Program Schedule					
		FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013
New ATM Requirement	**$5,400**						
Trajectory Based Operations							
Future international frequency standards L-band			◊	◊	◊		
Approaches for implementing flexible airspace management				◊	◊		
Requirements for interactive flight planning				◊	◊	◊	
Conflict resolution approaches using aircraft intent data				◊	◊	◊	◊
Draft procedures and tools for 3-mile horizontal separation everywhere					◊	◊	◊
High Density Arrivals/Departures and Airports							
TCAS 8.0 analysis and requirements			◊	◊	◊		
Surface management CNS technologies identification				◊			
Optimize runway assignments				◊	◊	◊	
Data messaging for flow and taxi assignments					◊	◊	◊
Flexible Terminal and Airports							
Surface CNS technologies C-Band			◊	◊	◊		
System requirements for surface separation in low-visibility				◊	◊		
Procedures and technologies for additional closely spaced parallel runways in IMC				◊	◊	◊	
Mixed equipage trajectory-based routes and CDA					◊	◊	◊
Automated virtual tower options						◊	◊
Collaborative Air Traffic Management							
Efficient and safe certification methods of complex software systems			◊	◊	◊	◊	
Real time integrated decision making information				◊			
Shared data concepts				◊	◊		
Shared data decision support tools					◊	◊	
Networked Facilities							
Enhancement of laboratory facilities and capabilities				◊	◊		
Common procedures for disparate facilities				◊	◊		
ATM information sharing strategies and means				◊	◊		
CNS and timing alternatives and needs				◊	◊	◊	
Dynamic allocation of demand to ATM facilities					◊	◊	◊
NAS-wide applicable procedures for networked facilities						◊	◊
Total Budget Authority	**$5,400**	**$0**	**$5,400**	**$27,500**	**$27,900**	**$29,200**	**$31,900**

◆ - Activities Accomplished ◇ - Activities Planned

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FAA Budget Appropriation	Budget Item	Program Title	Budget Request
ATO Capital	**1A09F**	**NextGen - Operations Concept Validation – Validation Modeling**	**$4,000,000**

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

Intended Outcomes: The Operations Concept Validation Program addresses the FAA's goal for capacity and the DOT Reduced Congestion Strategic Objective to "Advance accessible, efficient, inter-modal transportation for the movement of people and goods." It also supports the FAA's National Aviation Research Plan goal for a "Fast, Flexible and Efficient" system that safely and quickly moves anyone and anything, anywhere, anytime on schedules that meet customer needs. The program supports these goals by developing and validating future end-to-end (flight planning through arrival) operational concepts with special emphasis on researching changes in roles and responsibilities between the FAA and airspace users (e.g., pilots and airlines), as well as the role of the human versus systems, that will increase capacity and improve efficiency and throughput. It fits within the Air Traffic Organization's pathway 4, "Ensure Viable Future" to assure a sustainable and affordable Air Transportation System for the future by developing future operational concepts that will decrease workload and increase reliance on automation for routine tasking, and new procedures both on the ground and in the air to increase efficiency of the NAS. Furthermore, this program works toward developing operational methods that will meet the NextGen goal of expanding capacity by satisfying future growth in demand (up to three times capacity) as well as reducing transit time (reduce gate-to-gate transit times by 30 percent and increasing on-time arrival rate to 95 percent.).

Agency Outputs: The research will identify and validate changes to current air traffic management operations that will foster increased system capacity, efficiency, and throughput. The validated operational concept will identify system level requirements, airspace changes, and procedural changes that will need to be implemented in order to realize the capacity gains afforded by implementation of the concepts. Where appropriate, activities will be coordinated with MITRE and/or NASA to complete any required final research and development to transition their products into the NAS.

Research Goals:

The operational research goal is to meet the capacity objectives:

- 2011: Demonstrate capacity increase to 166% current levels.
- 2013: Demonstrate capacity increase to 230% current levels.
- 2016: Demonstrate capacity increase to 300% current levels.

The research goal is to ensure that the NextGen transformation, as identified in the NextGen concept, is supported by detailed and validated operational concepts to ensure concept feasibility, ensure that the proposed benefits can be achieved, and to understand the human factors implications of the concepts. Additionally, concept validation is intended to drive high standards of top-level design and risk-mitigation planning. In particular, the research goals include the following:

Operational concept development

- Develop 2nd level concepts for individual service enhancements and service domains to support the specification of system-level operational needs for NextGen investments.

- By FY 2009, develop an end-to-end NAS operational concept for the mid-term (2017) that integrates NextGen systems and capabilities across solution sets.
- By FY 2011, develop an end-to-end NAS operational concept for the far-term (2025) that integrates NextGen systems and capabilities across solution sets.

Concept validation

- By FY 2009 develop detailed scenarios of operational changes in support of architecture and research requirements for the mid-term.
- By FY 2011 develop detailed scenarios of operational changes in support of architecture and research requirements for the far-term.
- Validate the concepts through detailed analyses including analytical modeling, fast-time simulations, and human-in-the-loop simulations and demonstrations. These activities will be done on an interactive and part-task basis with initial task validation results completed in FY 2010 and additional task validations completed throughout the life of the program.

Customer/Stakeholder Involvement: The Radio Technical Commission for Aeronautics (RTCA) Free Flight Steering Committee, the FAA's R,E&D Advisory Committee, the White House Commission on Aviation Safety and Security, and numerous other members of the aviation community have called for the development and validation of a Concept of Operations for modernizing the NAS. This concept must be consistent with the JPDO's concept for NextGen, and its impact on the FAA's ATO, including transition steps, must be identified and validated.

Operational concept development and validation will utilize an iterative work group approach with members representing each of the FAA ATO Operational Service Units and representatives from the airspace user community, including pilots and flight operations centers. The work group approach will present an initial concept or scenario and elicit feedback from impacted stakeholders. This feedback will be incorporated into future versions of the concept that will be reviewed by stakeholders. Concept validation activities employing human-in-the-loop simulation will utilize participants with experience in the task being validated. The Program will identify the precise mechanism for obtaining stakeholder participation as part of the FY 2008 activities. It is currently envisioned that this participation will be through the Next Generation Air Transportation System Institute.

R&D Partnerships: This program is encouraged by the JPDO to ensure the FAA's research and development activities support the evolution to NextGen. Participation of the JPDO assures that the Operational Concept activities reflect user community needs, and assures that identified improvements are evaluated for operational impacts on NAS users and FAA service providers.

The concept development and concept validation effort described here is also coordinated with the European community via agreements with EUROCONTROL and the European Commission on SESAR. This cooperation ensures that unique solutions and transitions are not developed in different quadrants of the globe, a situation which would impose an undue burden on all carriers and manufacturers participating in the global airspace system.

FY 2009 PROGRAM REQUEST:

The FY 2009 request expands the NextGen Operational Concept into an integrated and detailed end-to-end concept of operations for the mid-term (2017) for each phase of the operation from pre-flight planning to post flight analysis. Stakeholder input will be solicited throughout the concept development process to ensure that implementation of the concept is achievable. Details for the mid-term concept will include narrative descriptions, task lists, and operational scenarios to be used across all concept validation activities.

In addition, planning work will begin on validation of the mid-term concept with the actual validation taking place in subsequent years. The validation process investigates all opportunities to exploit the potential productivity and flexibility benefits offered by changes in technology and communications. These opportunities include automating legacy information requirements for local knowledge and turning to performance based procedures for infrastructure and customer cost efficiencies. The validation activities also will measure the capacity gains afforded by implementation of concept elements.

Activities will also begin to develop the far-term (2025) operational concept.

KEY FY 2009 MAJOR ACTIVITIES AND ANTICIPATED ACCOMPLISHMENTS:

Operational concept development

- Develop the initial end-to-end mid-term (2017) concept of operation narrative
- Develop the initial end-to-end mid-term (2017) concept of operations detailed task list descriptions
- Begin development of the initial end-to-end far-term (2025) concept of operations narrative
- Begin development of the initial end-to-end far-term (2025) concept of operations detailed task descriptions
- Identify research issues pertaining to roles and responsibilities between airspace users and the FAA associated with the mid-term concept and begin plans to study these topics to resolve the issues
- Examine the integration of four dimensional trajectories (4DT) across operational environments (e.g., terminal, traffic flow management, and en route operations) to determine the level of accuracy needed in each phase of flight
- Begin development of a detailed operational concept for surface traffic management

Concept validation

- Develop detailed operational scenarios to support mid-term concept validation activities
- Begin development of traffic scenarios to be used for both fast time and real time simulations that will validate the mid-term operational concept
- Initiate planning activities to perform human-in-the-loop and fast-time simulations to validate the mid-term concept with particular emphasis on roles and responsibilities
- Upgrade laboratories used for concept validation activities in order to support experiments on the future use of data communications between the air traffic control system and aircraft

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2007)	$0
FY 2008 Appropriation	0
FY 2009 Request	15,000
Out-Year Planning Levels (FY 2010-2013)	60,000
Total	$75,000

Budget Authority ($000)	**FY 2005 Enacted**	**FY 2006 Enacted**	**FY 2007 Enacted**	**FY 2008 Enacted**	**FY 2009 Request**
Contracts	0	0	0	0	0
Operations Concept Validation – Validation					4,000
Personnel Costs	0	0	0	0	0
Other In-house Costs	0	0	0	0	0
Total					**4,000**

OMB Circular A-11, Conduct of Research and Development ($000)	**FY 2005 Enacted**	**FY 2006 Enacted**	**FY 2007 Enacted**	**FY 2008 Enacted**	**FY 2009 Request**
Basic	0	0	0	0	0
Applied	0	0	0	0	
Development (includes prototypes)	0	0	0	0	4,000
Total					**4,000**

1A09F - NextGen - Operations Concept Validation – Validation Modeling Product and Activities	FY 2009 Request ($000)	Program Schedule					
		FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013
Operations Concept Validation – Validation Modeling	**$4,000**						
Concept Development							
End-to-end mid-term (2017) concept of operation narrative			◊				
End-to-end mid-term (2017) concept detailed task list descriptions			◊				
End-to-end far-term (2025) concept of operations narrative			◊	◊	◊		
End-to-end far-term (2025) concept detailed task descriptions			◊	◊	◊		
Identify mid-term research issues pertaining to roles and responsibilities between airspace users and the FAA			◊				
Integration of 4DT across operational environments			◊	◊			
Operational concept for surface traffic management			◊	◊			
Concept Validation							
Detailed operational scenarios to support mid-term concept validation			◊				
Traffic scenarios to validate the mid-term operational concept			◊	◊	◊		
Simulations to validate the mid-term concept			◊	◊	◊		
Upgrade laboratories			◊	◊	◊		
Detailed operational scenarios to support far-term concept validation				◊	◊	◊	
Traffic scenarios to validate the far-term operational concept				◊	◊	◊	
Simulations to validate the far-term concept					◊	◊	◊
Total Budget Authority	**$4,000**	**$0**	**$4,000**	**$15,000**	**$15,000**	**$15,000**	**$15,000**

◆ - Activities Accomplished ◇ - Activities Planned

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FAA Budget Appropriation	Budget Item	Program Title	Budget Request
ATO Capital	**1A09G**	**NextGen - System Safety Management Transformation**	**$16,300,000**

Support FAA Strategic Goals: Increased Safety, International Leadership

Intended Outcomes: By 2015 understand economic implementation and operational impact of system alternatives. This will be done by encouraging and participating in global safety practices to ensure the safety of the traveling public and cargo. A cutting-edge operational data analysis capability will be developed that identifies safety issues. This research will promote expansion of the U.S. capability to meet national and international safety goals and objectives with less oversight of individual carriers. Understand which alternatives are most likely to decrease accidents rates as air traffic increases 3 times current levels.

Agency Outputs: The program will develop an infrastructure that enables the free sharing of de-identified, safety information that is derived from various government and industry sources in a protected, aggregated manner. This will be accomplished through the following transformation directions:

- Develop a comprehensive, cooperative approach to safety across the system-of-systems at the national level.
- Develop a comprehensive set of safety management principles and practices to establish a common framework for the aviation community:
- Ensure an evolution of present certification, testing, and inspection of individual system elements to comprehensive approvals of operators' and manufacturers' safety management programs:
- Promote safety through training, sharing of safety data, and dissemination of lessons learned
- Establish a non-punitive reporting system, relieving concerns about corrective action processes.

Research Goals: The approach includes developing the information analysis and sharing system to support the FAA and NextGen safety initiatives; generating guidelines and shared capabilities to help stakeholders successfully implement their own safety management systems; and modeling activities to help measure progress toward achieving FAA goals.

- 2009: Evaluate current protection and assurance models and potential conflicts with privacy and consumer advocacy groups.
- 2011: Develop proof of concept for NextGen including a prototype to implement on a trial basis with selected participants that involve a cross-section of air service providers.
- 2012: Validate the Net Enabled Operations (NEO) Architecture proof-of-concept for the sharing of aviation safety information among JPDO member agencies, participants, and stakeholders.
- 2013: Complete the Aviation Safety Information Analysis and Sharing (ASIAS) pre-implementation activities, including concept definition, with other JPDO member agencies, participants, and stakeholders.
- 2014: Demonstrate a National Level System Safety Assessment capability that will proactively identify emerging risk across the NextGen.

Customer/Stakeholder Involvement: Stakeholders are integral participants in the research effort by providing subject matter experts in the areas of safety, operations and maintenance. In addition, stakeholders will share their data, processes, resources and tools with other participating stakeholders.

Stakeholders include, but are not limited to the following:

- Other government organizations, within and outside the JPDO
- Aerospace manufacturers
- Aerospace repair stations and maintenance organizations
- Air traffic service providers (civilian and military)
- Local and state governments (port authorities, funding offices)
- Aerospace industry associations
- Private, commercial, government, and military operators
- International airworthiness authorities
- Providers of other aviation products (e.g., ARINC, contract towers, weather service providers, Jeppesen)

R&D Partnerships:

R&D Partnerships have not been established yet but may include academia, government and foreign research and government organizations.

Accomplishments:

The following are planning activities that have been completed by the JPDO, activities that have provided support to this effort.

- 2004 Next Generation Air Transportation System Integrated Plan
- 2006 Progress Report to the Next Generation Air Traffic System Integrated Plan
- 2007 Safety Management System National Standard
- 2007 Initial Safety Culture Improvement Plan
- 2007 Safety IPT Program Plan that integrates planning and research activities
- 2007 Proposed ASIAS (Aviation Safety Information Analysis and Sharing) Environment Concept of Operations
- 2007 ASIAS Related Implementation Guidance Material

Although this budget request is a new start in FY 2009, this research will be leveraging the ongoing program Aviation Safety Risk Analysis/System Safety Management (A11.h). The scope of the ASIAS initiative being developed within that Program using RE&D funds is for near term research initiatives. The log-term goal of the ASIAS effort is to reduce the number of aviation accidents and incidents by developing a secure, safety information and analysis system that provides access to numerous databases, maintains their currency, enables interoperability across their different formats, provides the ability to identify future threats, conducts a causal analysis of those threats, and recommends solutions.

FY 2008 MAJOR ACTIVITIES AND ANTICIPATED ACCOMPLISHMENTS:

New start for FY 2009.

FY 2009 PROGRAM REQUEST:

New start for FY 2009.

KEY FY 2009 MAJOR ACTIVITIES AND ANTICIPATED ACCOMPLISHMENTS:

Safety Management Systems

- Develop selected prototype solutions based on National SMS requirements for management of safety risk of hazards that cross multiple agencies and users of the air transportation system.

Aviation Safety Information Analysis and Sharing (ASIAS)

- Develop enhanced ASIAS Concept of Operations (ConOps) document to include NextGen member agency aviation safety information needs, expanding upon the existing ASIAS ConOps.
- Baseline the enhanced ASIAS, include information on infrastructure, data/information protection policies, information access policies, procedures, equipment, tools, processes, data architectures, resources and budgets, building upon existing ASIAS baseline.
- Perform analysis to identify any gaps between the existing ASIAS baseline and the enhanced ASIAS ConOps.
- Develop interim implementation plan using expanded ASIAS ConOps and the results of the gap analysis. The interim plan will be used by JPDO member agencies to communicate required ASIAS implementation activities.
- Using existing ASIAS ConOps and baseline and gap analysis products expand existing ASIAS environment enterprise architecture (AEEA) to meet Federal Enterprise Architecture (FEA) requirements. Develop and expand AEEA Framework and Standards documentation.
- Develop and expand a FEA-ASIAS reference model that describes how department and agency participants use their enterprise architectures to connect to the ASIAS environment. The AEEA Framework will be communicated to departments and agencies through OMB's Federal Transition Framework (FTF).
- Conduct the ASIAS policy research to support the development of ConOps for all future enhancements of ASIAS, as needed.

Safety Risk Management

- Evaluate NextGen processes, components, and their relationships and rules to identify characteristics of the air transportation system which should be assessed for risk (complexity, dynamic, etc)

System Safety Assessment

- Develop prognostic safety assessment methods for systems and operations
- Baseline risk assessment for system-wide risks associated with current operations in (1) terminal area airspace, (2) transition airspace, or (3) enroute airspace
- Conduct initial safety assessments of proposed concepts, algorithms, and technologies to indicate the relative safety impacts with respect to the baseline system
- Proof of concept demonstration of an assessment process, including data collection, risk baseline calculation, system impact assessment, development of a risk analysis function and application to a limited set of new NextGen technologies and procedures
- Estimate the change in safety risk resulting from new NextGen concepts emerging from the seven solution sets described in the Operational Evolution Partnership (OEP).

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2007)	$0
FY 2008 Appropriation	0
FY 2009 Request	16,300
Out-Year Planning Levels (FY 2010-2013)	78,400
Total	$94,700

Budget Authority ($000)	**FY 2005 Enacted**	**FY 2006 Enacted**	**FY 2007 Enacted**	**FY 2008 Enacted**	**FY 2009 Request**
Contracts					
System Safety Management Transformation	0	0	0	0	16,300
Personnel Costs	0	0	0	0	0
Other In-house Costs	0	0	0	0	0
Total	**0**	**0**	**0**	**0**	**16,300**

OMB Circular A-11, Conduct of Research and Development ($000)	**FY 2005 Enacted**	**FY 2006 Enacted**	**FY 2007 Enacted**	**FY 2008 Enacted**	**FY 2009 Request**
Basic	0	0	0	0	0
Applied	0	0	0	0	0
Development (includes prototypes)	0	0	0	0	16,300
Total	**0**	**0**	**0**	**0**	**16,300**

1A09G - NextGen - System Safety Management Transformation Product and Activities	FY 2009 Request ($000)	Program Schedule					
		FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013
System Safety Management Transformation	$16,300						
Safety Management Systems							
Develop selected prototype solutions based on National SMS requirement			◆	◊	◊	◊	
ASIAS							
Develop ASIAS ConOps, with expanded scope			◆				
Baseline expanded scope of ASIAS			◆				
Conduct gap analysis			◆				
Develop ASIAS Implementation Plan			◆				
Develop ASIAS Enterprise Architecture			◆	◊	◊	◊	
Conduct ASIAS Policy Research			◆	◊			
Develop and validate ASIAS Training Curriculum				◊	◊	◊	◊
Further expand scope of ASAIS and develop ConOps, baseline, gap analysis, and implementation plans, as appropriate				◊	◊	◊	◊
System Risk Management							
Identify characteristics of the NAS which should be assessed for risk			◆	◊			
Determine requirements for NextGen prognostic risk assessment and risk management tools			◆	◊	◊		
System Safety Assessments							
Develop prognostic safety assessment methods for systems and operations			◆	◊			
Baseline risk assessment for system-wide risks for current operations			◆	◊	◊		
Conduct initial safety assessments of proposed concepts, algorithms, and technologies			◆	◊	◊		
Proof of concept demonstration of an assessment process on new NextGen technologies and procedures			◆	◊	◊		
Develop predictive, conceptual-level, safety assessment method for complex systems				◊	◊		
Estimate the change in safety risk resulting for changes in 7 OEP solution sets				◊	◊	◊	◊
Operational Safety Assessments							
Complete an Operational Safety Assessment (OSA) of NextGen				◊	◊	◊	◊
Total Budget Authority:	$16,300	$0	$16,300	$19,000	$19,700	$19,700	$20,000

◆ - Activities Accomplished ◇ - Activities Planned

NOTES: OUT YEAR NUMBERS ARE FOR PLANNING PURPOSES ONLY. ACTUAL FUNDING NEEDS WILL BE DETERMINED THROUGH THE ANNUAL BUDGET PROCESS. IN THE ATO CAPITAL APPROPRIATIONS, PERSONNEL AND OTHER COSTS ARE BUDGETED IN ACTIVITY 5, NOT THE PROGRAM BUDGET LINE ITEM.

FAA Budget Appropriation	Budget Item	Program Title	Budget Request
ATO Capital	**1A09H**	**NextGen - Wake Turbulence – Re-categorization**	**$2,000,000**

Supports FAA Strategic Goal: Greater Capacity

Supports FAA R&D Goal: Fast, Flexible, and Efficient

Intended Outcomes: The Wake Turbulence Program (WTP) addresses FAA's goal for capacity and the DOT Reduced Congestion Strategic Objective to "Advance accessible, efficient, inter-modal transportation for the movement of people and goods." In FY09, the WTP will address the broader research agenda required to progress to the envisioned Next Generation Air Transportation System (NextGen) and associated dynamic spacing between aircraft. Redefining (based on enhanced understanding of aircraft generated wake turbulence and its transport/demise) the basis for the air navigation service provider's (ANSP) required minimum spacing between aircraft to mitigate the effects of wake turbulence – is a major first step towards the NextGen efficient use of our nation's airspace. The Wake Re-Categorization initiative of the WTP will provide the analysis, experimentation, and validation activities necessary to replace today's safe but capacity inefficient procedures for separating aircraft to insure wake turbulence mitigation. The work will be conducted cooperatively with EUROCONTROL and the Joint Aviation Authorities and will result in global changes to the ANSP wake turbulence mitigation procedures. Initiative outcomes include:

- Current 6 weight categories and safe separation distances adjusted to account for fleet mix changes since the last re-categorization effort in the early 1990s
- Increased capability to safely place more aircraft in the same volume of airspace – resulting in ability to meet increased demand for air travel.
- Increased opportunity and flexibility for safe pair-wise maneuvering between aircraft within airspace and other system constraints

Agency Outputs: The Wake Turbulence Program will use applied research to develop the enhanced methods of defining wake safe separations between aircraft. Previously used methods will be reviewed and refined. Current wake characterization models will be enhanced to allow experimentation with the use various aircraft design parameters as mechanisms for defining the strength and longevity of aircraft produced wake vortices. Results of the modeling efforts will be validated through field measurements. Wake encounter models will be developed, validated and integrated into aircraft simulators. Separation standards will be refined based on field data, analysis and Pilot-in-the-loop simulations. Wake mitigation separation procedures developed for use by the ANSP will be evaluated using scenario based simulations to include human-in-the-loop simulations to insure usability and safe operations. Work will also include the development of the safety risk management documentation necessary for the implementation of the revised ANSP wake mitigation separation procedures.

Research Goals:

- By 2009 refine the boundaries of the current 6 weight categories for the National Airspace System (NAS) fleet mix and define automation requirements to support those modifications
- By 2011, determine optimal set of aircraft flight characteristics and weather parameters for use in setting wake separation minimums.
- By 2013, complete development of ANSP wake separation standards that better utilize aircraft flight characteristics and information concerning surrounding weather conditions.
- By 2016, develop the algorithms that will be used in the ANSP and flight deck automation systems for setting dynamic wake separation minimum for each pair of aircraft.

Customer/Stakeholder Involvement: The Wake Re-categorization Initiative addresses the needs of the FAA Air Traffic Organization (ATO) and works with the FAA Aviation Safety organization to ensure new procedures and solutions are safe for implementation both by the ANSP and for the flight deck. The program works with aircraft manufacturers, controllers, airlines, and pilots to include user recommendations, ensure an open safety assessment process and a shared understanding of the results of the safety assessments and ensuring training and implementation issues are addressed in the initiative's research from the start.

Customers:

- Pilots
- Air navigation service provider personnel
- Air carrier operations
- Airport operations
- Aircraft manufacturers

Stakeholders:

- Joint Planning and Development Office
- Commercial pilot unions
- FAA air navigation service provider unions
- Other ICAO air navigation service providers
- Aircraft manufacturer associations
- General aviation associations

R&D Partnerships: In addition to maintaining its partnership with FAA's Aviation Safety organization, this research initiative will accomplish its research agenda via working relationships with industry, academia, and other government agencies. The coordination and tasking are accomplished through joint planning/reviews, contracts and interagency agreements with the program's partners:

- Volpe National Transportation Center
- MITRE/Center for Advanced Aviation and Systems Development (CAASD)
- NASA Ames and Langley Research Centers
- EUROCONTROL and associated research organizations
- Massachusetts Institute of Technology's Lincoln Laboratory

Accomplishments: The following represent major accomplishments of the Wake Re-categorization Initiative:

- FY2007 – Second international meeting - Developed strategy for accomplishing the re-categorization work
- FY2006 – First international meeting – reviewed history of wake separation standards setting and various potential approaches to accomplishing re-categorization.
- FY 2006 – Completion of a two year effort to determine required wake separation minimums for the A-380 and similar sized aircraft.
- FY 2004-2006 – Utilized wake turbulence data collected from ground based and aircraft based prototype pulsed LIDAR systems, along with wake turbulence transit and demise models for characterizing the wake generated by the A-380 aircraft in relation to the wake generated by the 747-400 aircraft.

FY 2008 MAJOR ACTIVITIES AND ANTICIPATED ACCOMPLISHMENTS:

- Develop the plans and organization structure to accomplish the Wake Re-categorization Initiative.
- Begin assembling the wake transport and decay data bases – data collected over the previous eight years – and develop techniques for relating the data to various weather conditions and aircraft flight parameters.
- Evaluate existing wake models to determine needed enhancements for accomplishing the Wake Re-categorization initiative.

FY 2009 PROGRAM REQUEST:

In FY09, FAA must continue developing the capabilities needed to enable separation requirements supportive of NextGen shared separation and dynamic spacing super density operations. The Wake Re-categorization Initiative addresses the existing wake separation standards and seeks to determine if these static standards can be safely modified to allow more aircraft in the same volume of airspace. It is one component in the overall effort to apply technology to achieve the envisioned NextGen number of aircraft operations in the NAS.

KEY FY 2009 MAJOR ACTIVITIES AND ANTICIPATED ACCOMPLISHMENTS:

- Enhance analysis tools (to include effects of wake encounter) for evaluating alternative methods of defining safe wake separations between various types of aircraft.
- Conduct experiments, analyses and aviation community forums to vet potential methods for determining safe wake separations between various types of aircraft
- Develop an approach for evaluating the safety risks associated with the potential methods for determining safe wake separations between various groups of aircraft (i.e. Jumbo, Heavy, Large, Small, Very Small)
- Develop human-in-the-loop ANSP and Flight Deck simulations to evaluate usability of a proposed wake and collision risk separation minimum
- Develop potential methods for defining the minimum safe wake separations between aircraft, beginning with the more general groupings of aircraft types and progressing (subsequent years) with defining how minimum separations could be set for individual pairing of aircraft.
- Conduct analyses to link wake transport and decay characteristics to aircraft flight and surrounding weather parameters.

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2007)	$0
FY 2008 Request	0
FY 2009 Request	2,000
Out-Year Planning Levels (FY 2010-2013)	8,000
Total	$10,000

Budget Authority ($000)	FY 2005 Enacted	FY 2006 Enacted	FY 2007 Enacted	FY 2008 Enacted	FY 2009 Request
Contracts:					
Wake Turbulence	0	0	0	0	2,000
Personnel Costs	0	0	0	0	0
Other In-house Costs	0	0	0	0	0
Total	**0**	**0**	**0**	**0**	**2,000**

OMB Circular A-11, Conduct of Research and Development ($000)	FY 2005 Enacted	FY 2006 Enacted	FY 2007 Request	FY 2008 Enacted	FY 2009 Request
Basic	0	0	0	0	0
Applied	0	0	0	0	0
Development (includes prototypes)	0	0	0	0	2,000
Total	**0**	**0**	**0**	**0**	**2,000**

1A09H - NextGen - Wake Turbulence – Re-categorization Product and Activities	FY 2009 Request ($000)	Program Schedule					
		FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013
Wake Turbulence – Re-categorization	**$2,000**						
Development of enhanced analysis tools (to include effects of wake encounter) for evaluating alternative methods of defining safe wake separations between various types of aircraft.			◊	◊			
Conduct experiments/analyses and aviation community forums to vet potential methods for determining safe wake separations between various types of aircraft			◊	◊	◊	◊	◊
Develop an approach and evaluate system-wide safety risk associated with enhanced method for determining required wake separation between different types of aircraft.			◊	◊	◊	◊	◊
Develop and conduct human-in-the-loop (ANSP & Flight Deck) simulations for usability evaluations of alternative methods of defining safe wake separation between various categories of aircraft.			◊	◊		◊	◊
Develop enhanced method of determining safe wake separations between various types of aircraft.			◊	◊	◊		
Generate information to support use of aircraft design parameters to define required wake separations.			◊	◊	◊	◊	◊
Personnel and Other In-House Costs							
Total Budget Authority	**$2,000**	**$0**	**$2,000**	**$2,000**	**$2,000**	**$2,000**	**$2,000**

◆ - Activities Accomplished ◇ - Activities Planned

NOTES: OUT YEAR NUMBERS ARE FOR PLANNING PURPOSES ONLY. ACTUAL FUNDING NEEDS WILL BE DETERMINED THROUGH THE ANNUAL BUDGET PROCESS. IN THE ATO CAPITAL APPROPRIATIONS, PERSONNEL AND OTHER COSTS ARE BUDGETED IN ACTIVITY 5, NOT THE PROGRAM BUDGET LINE ITEM.

FAA Budget Appropriation	Budget Item	Program Title	Budget Request
ATO Capital	**4A09A**	**Center for Advanced Aviation Systems Development (CAASD)**	**$28,728,000**

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

Program Goals and Intended Outcomes: The FAA applies knowledge and expertise developed at the Center for Advanced Aviation System Development (CAASD) to produce a safer, more efficient global air transportation system. Studies performed at CAASD comprise an essential component of FAA research, systems engineering, and technical analyses. CAASD, a Federally Funded research and development Center (FFRDC), is operated under a Sponsoring Agreement with the MITRE Corporation.

Agency Outputs: CAASD research and development identifies and tests new concepts and technologies for the National Airspace System (NAS) in the areas of aviation safety, performance-based navigation, airspace design, and traffic flow management that impact worldwide standards and applications. CAASD produces detailed reports and briefings on subjects across the entire spectrum of their work program. CAASD also develops sophisticated models and prototypes to test concepts and/or systems proposed for use in the management and control of air traffic. Presently, some of these new products are helping to shape a Next Generation Air Transportation System (NextGen) that will be safer, more efficient, and more readily available.

Customer/Stakeholder Involvement: The FAA responds to a constant challenge to increase safety in the nation's civil aviation system while increasing capacity and efficiency. CAASD is playing an instrumental role in the achievement of the NextGen goals and objectives, providing key operational and technological inputs based on its many years of research and analysis in areas such as Air Traffic Management (ATM), communications, navigation, and surveillance operations/capabilities. CAASD contributes directly to the goals and activities of the RTCA Air Traffic Advisory Committee, which is the principal forum to bring industry, aircraft operators, and FAA representatives together to define the operational needs and to identify an affordable NAS Architecture capable of satisfying those needs. Additionally, CAASD efforts contribute to the FAA's global aviation goals and the goals of the International Civil Aviation Organization (ICAO) through international aviation standards development activities.

Accomplishments: CAASD has supported the following accomplishments:

- Conducted Controller HITL experiments at Palm Beach and Las Vegas TRACONs to obtain feedback on near-term terminal spacing and merging tools and mid-term controller alerting tools based on higher traffic levels and extensive use of Performance-Based Navigation (PBN) terminal routes.
- Developed a concept for the integration of RNAV and RNP procedures with Traffic Flow Management (TFM) and other functional capabilities to increase overall system benefits and movement toward performance-based NAS and NextGen goals. Performed simulations that couple RNAV and RNP with TFM to illustrate increases in user benefits and reduce controller workload per flight hour.
- Developed and documented a system concept for all-weather super density operations. The concept identifies the airports and metropolitan areas where super density operations will be needed, documents the operational limitations associated with these locations, and identifies potential means for overcoming these limitations. Operational performance improvements were analyzed using simulation models of metropolitan areas, and documented in open publications.

- Developed and executed two pilot and controller Human-in-the-loop (HITL) simulations that continued to mature the merging and spacing concept, influenced equipment design, illuminated problem areas, and supported initial benefits projections. Simulation results supported FAA certification and the expected operational approval, which will allow the FAA and the airline to start realizing initial benefits.
- Developed initial cross-domain NAS operational and system evolution plans and requirements for transitioning to Performance-Based Air Traffic Management concepts that are intended to enhance FAA controller productivity and improve service to users. Provided operational feasibility and validation analysis of candidate productivity-enhancing capabilities for the terminal domain, including extended evaluations of terminal concepts and end-to-end concept demonstrations. Conducted initial analyses of the safety of the proposed system and of aircraft intent data necessary to support the proposed system.
- Developed a foundation for net-enabled Traffic Flow Management (TFM) core services, and advanced TFM visualization tools using service-oriented architecture technologies. Developed a laboratory prototype of a net-enabled service registry providing descriptions and means of discovery for net-enabled services. Performed demonstrations to evaluate the suitability of these technologies for use in laboratory simulations and (ultimately) system use in the field.
- Provided technical and system engineering analysis of UAS operations concerning detect, sense and avoid concepts, air-ground communications requirements, and national and international standards for development and operation, resulting in integrated guidance to commercial and U.S. government operators of UASs.
- Developed operational concepts for using ADS-B technology to maintain traffic flows during weather events, including integration with a performance-based ATM environment.
- Analyzed technical and operational issues related to the FAA's evolution to System Wide Information Management (SWIM) capability, with emphasis on defining weather applications and dissemination capabilities.
- Completed the capacity analysis of the Future Airport Capacity Task (FACT) 2 airports and performed NAS-wide analysis to determine airports which will need more capacity to meet anticipated demand.

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

- Air Force Research Laboratory (UAS collision avoidance technology);
- Cargo Airlines Association, Embry-Riddle Aeronautical University (research on ADS-B and its use for situational awareness [traffic and weather information in the cockpit] and self-spacing);
- Commercial industry (collaboration in support of development of a UAT Beacon Radio for UAS);
- Embry Riddle Aeronautical University, Lockheed-Martin, NASA Ames & Langley, FAA Technical Center, UPS, Boeing, Federal Express, Crown Consulting, and Raytheon (development of the AviationSimNet standard for distributed Air Traffic Management simulation);
- EUROCONTROL (future ATM research information exchange and flight object interoperability proposed standard);
- George Mason University, Interdisciplinary Center for Economic Science (economic analyses);

- Joint University Program (research on National Airspace System capacity and NextGen concepts);
- Massachusetts Institute of Technology, Engineering Systems Division (developing tools & techniques for enterprise systems engineering);
- Massachusetts Institute of Technology, International Center for Air Transportation (UAS and National Airspace System capacity research);
- MIT Lincoln Laboratory (wake turbulence mitigation, safety analyses, UAS, and Traffic Flow Management under weather uncertainty);
- NASA Ames (continuous descent arrivals and merging & spacing concepts);
- NASA Langley (wake vortex and surface issues - capacity improvement);
- The National Center of Excellence for Aviation Operations Research (NEXTOR) (National Airspace System capacity analyses and operations research);
- New Mexico State University Physical Sciences Laboratory (research on UAS operations in the NAS);
- Santa Fe Institute (research on complexity and complex systems engineering);
- United Parcel Service (research on techniques for merging and spacing);
- University of North Dakota (research on ground radar surveillance of UAS);
- Virginia Polytechnic Institute and State University (system capacity analysis & modeling); and
- The Volpe National Transportation Systems Center (operational evaluation of Air Traffic Management research topics).

In addition, CAASD has collaborative relationships with a number of the other R&D Programs described in this Plan. These relationships include Airspace Redesign, Aviation Safety Risk Analysis, Joint Planning and Development Office, NextGen-New ATM Requirement, Runway Incursion Reduction, Wake Turbulence, Unmanned Aircraft Systems Research, and the William J. Hughes FAA Technical Center.

FY 2008 MAJOR ACTIVITIES AND ANTICIPATED ACCOMPLISHMENTS:

- Develop detailed cross-domain operational and technical evolution plans for transitioning to proposed Performance-Based Air Traffic Management concepts for the mid-term. Assess and coordinate user benefits (e.g. capacity) that may be realized from the concepts. Initiate development of terminal concept extensions to the current scope of the overall Performance-Based Air Traffic Management concept that could further enable transition to NextGen.
- Develop and validate a set of capabilities (technology, tools, and strategies) that can be integrated into the overall controller training process to reduce cost and length of time to train and certify new air traffic personnel, and enable a more effective transition of automation/ procedural advancements into operational use that is essential to support the operational changes and evolution of OEP/NextGen. Develop enhanced prototype intelligent tutoring systems that will enable self-paced/accelerated training, and increased standardization while reducing training staffing costs. Prepare technology transfer package to integrate validated *enroute***Trainer** prototype capabilities into ERAM.
- Perform analyses that characterize the performance of critical capabilities in various operational conditions for the en route mid-term concept. Detailed algorithmic analyses will determine the sensitivity of key performance metrics to algorithm parameters (e.g., problem resolution). Evaluations and analyses of future concepts and capabilities provide operational understanding for deciding the evolution of capabilities toward NextGen.

- Conduct experiments in collaboration with other research and stakeholder organizations to improve the FAA's understanding of key benefits enablers for the future TFM and NextGen operations.
- Identify gaps in the TFM future vision, particularly how it leads to the NextGen. Address gaps through concept development, refinement, and evaluation.
- Complete a benefits and safety assessment for mid-term wake vortex procedures for departures under pre-defined wind conditions. This will help the FAA to move forward with the implementation decision based on the benefits associated with safely increasing departure capacity at relevant airports.
- Research and explore sector and airspace management concepts (e.g. dynamic sectorization) in the mid-term for operational efficiency, productivity, and workload balancing to enable national decisions on airspace policy and facility structure.
- Continue to provide technical and systems engineering analysis of UAS operations concerning detect, sense and avoid concepts, air-ground communications requirements, and national and international standards for development and operation, resulting in integrated guidance to commercial and government operators of UASs.
- Refine Merging and Spacing (M&S)/Continuous Descent Arrival (CDA) concepts, algorithms, and simulations to allow the applications' benefits to be expanded, thus providing additional benefits to the airline as well as the FAA.
- Start to refine and validate other advanced, high-benefit NextGen cockpit-based ADS-B applications that will provide the greatest benefits to the FAA and user community.

FY 2009 PROGRAM REQUEST:

CAASD provides independent advanced research and development required by the FAA to obtain technical analyses, prototypes and operational concepts needed to fulfill the vision for the FAA's Flight Plan, the NextGen Integrated Plan, and the NAS enterprise architecture. CAASD has unique knowledge, skills, and capabilities in aviation research, systems engineering and analysis. Its expertise is critical to the FAA in transforming the nation's air transportation system in an effective and timely manner.

KEY FY 2009 MAJOR ACTIVITIES AND ANTICIPATED ACCOMPLISHMENTS:

- Work with the FAA to reflect in mid-term, OEP investment decisions results from detailed cross-domain operational and technical evolution plans for transitioning to proposed Performance-Based Air Traffic Management concepts. Complete analyses of the safety risks/mitigations strategies for the advanced automation components of these concepts, and of user benefits (e.g. capacity) that may be realized from the concepts. Develop, and validate via laboratory evaluations, extensions to the current scope of Performance-Based Air Traffic Management terminal concept that will enable transition to NextGen.
- Enhance the *enroute***Trainer** prototype with additional student performance measures and ITS capabilities that include additional real-time performance feedback and skill development aids. These will be assessed at ZID during developmental training. Evaluation data will support *enroute***Trainer** prototype capability technology transfer and investment decision.
- Develop additional capabilities (technology, tools, and strategies) that will help the controller perform tasks for the mid-term and post mid-term concept of operations. Conduct HITL evaluations with FAA operational personnel. Evaluations and analyses of future concepts and capabilities provide operational understanding for deciding the evolution of capabilities toward NextGen.

- Develop a concept of operations for en route wake turbulence avoidance and assess the potential impact of integrating wake turbulence separation standards in the automation for conflict probe, conflict alert, or as a distinct capability.
- Continue to conduct experiments in collaboration with other research and stakeholder organizations to improve the FAA's understanding of key benefits enablers for the future TFM and NextGen operations. These experiments will provide insight into the full benefits potential for future concepts and help identify concepts and capabilities holding the greatest promise for NAS stakeholders.
- Identify technical, operational, and safety risks and mitigations associated with implementing wind-dependent wake departure procedures nationally. This will help the FAA move forward with the implementation of new procedures that will safely increase departure capacity at relevant high density airports.
- Research and explore sector and airspace management concepts in the mid-term for operational efficiency, productivity, and workload balancing to enable national decisions on airspace policy and facility structure.
- Continue to provide technical and systems engineering analysis of UAS operations concerning detect, sense and avoid concepts, air-ground communications requirements, and national and international standards for development and operation, resulting in integrated guidance to commercial and government operators of UASs.
- Refine M&S/CDA concepts, algorithms, and simulations to allow the applications' benefits to be expanded, thus providing additional benefits to the airline as well as the FAA.
- Refine and validate other advanced, high-benefit NextGen cockpit-based ADS-B applications that will provide the greatest benefits to the FAA and user community. Applications could include call sign, oceanic – in-trail, and extensions of CDTI Assisted Visual Separation in other conditions.

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2007)	$236,732
FY 2008 Appropriated	24,640
FY 2009 Request	28,728
Out-Year Planning Levels (FY 2010-2013)	169,344
Total	$459,444

Budget Authority ($000)	FY 2005 Enacted	FY 2006 Enacted	FY 2007 Enacted	FY 2008 Enacted	FY 2009 Request
Contracts:					
Center for Advanced Aviation Systems Development (CAASD)	46,794	37,895	30,100	24,640	28,728
Personnel Costs	0	0	0	0	0
Other In-house Costs	0	0	0	0	0
Total	**46,794**	**37,895**	**30,100**	**24,640**	**28,728**

OMB Circular A-11, Conduct of Research and Development ($000)	FY 2005 Enacted	FY 2006 Enacted	FY 2007 Enacted	FY 2008 Enacted	FY 2009 Request
Basic	0	0	0	0	0
Applied	46,794	37,895	30,100	24,640	28,728
Development (includes prototypes)	0	0	0	0	0
Total	**46,794**	**37,895**	**30,100**	**24,640**	**28,728**

4A09A - Center for Advanced Aviation System Development Product and Activities	FY 2009 Request ($000)	Program Schedule					
		FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013
Research, Engineering and Development	**$22,981**						
Validate and demonstrate the productivity savings and user benefits of selected NAS en route, terminal and TFM capabilities and initiatives, and inform OEP implementation decisions related to those initiatives		◆	◊	◊	◊	◊	◊
Conduct analyses of key requirements issues (e.g. system safety) and plan for NAS evolution to inform OEP decisions related to productivity improvements, including defining functional and system requirements and NAS architecture changes		◆	◊	◊	◊	◊	◊
Continue and expand ZID field evaluation of the *enroute***Trainer**; develop enhanced intelligent tutoring capabilities; and prepare technology transfer package to integrate these capabilities into ERAM		◆	◊	◊	◊	◊	◊
Evaluate en route operational feasibility and validate productivity gains of key OEP concepts and capabilities for the mid-term			◊	◊	◊	◊	◊
Advance the maturity of TFM concepts to account for uncertainty in predictions and decision making by developing algorithms and prototype capabilities and conducting (HITL) evaluations		◆	◊	◊	◊	◊	◊
Provide assessments of TFM concept maturity, operational feasibility and implementation risks, including identification of cross-domain dependencies		◆	◊	◊	◊	◊	◊
Develop an aviation environmental portfolio tool that allows the FAA to evaluate the impact of environmental policies on aviation demand and on the national economy					◊	◊	◊
Evolve/perform next phases of merging and spacing, cockpit display of traffic information assisted visual separation, and continuous descent arrivals simulations		◆	◊	◊	◊	◊	◊
Develop/analyze/simulate additional highly beneficial air-to-air and air-to-ground ADS-B cockpit display applications			◊	◊	◊	◊	◊
Air Traffic Operational Research and Special Situation Support	**$5,747**						
Provide technical and operational expertise to enhance the quality and efficiency TRACON controller training		◆	◊	◊	◊		
Develop detailed evolution plan for mid-term airspace concepts, including the evolution of feasibility and benefits of proposed changes		◆	◊	◊	◊	◊	◊
Determine the potential safety risks, operational concepts, and standards associated with increased unmanned aircraft system access to the NAS		◆	◊	◊	◊	◊	◊
Total Budget Authority	**$28,728**	**$24,640**	**$28,728**	**$34,020**	**$43,092**	**$44,982**	**$47,250**

◆ - Activities Accomplished ◊ - Activities Planned

NOTES: OUT YEAR NUMBERS ARE FOR PLANNING PURPOSES ONLY. ACTUAL FUNDING NEEDS WILL BE DETERMINED THROUGH THE ANNUAL BUDGET PROCESS. IN THE ATO CAPITAL APPROPRIATIONS, PERSONNEL AND OTHER COSTS ARE BUDGETED IN ACTIVITY 5, NOT THE PROGRAM BUDGET LINE ITEM.

FAA Budget Appropriation	Budget Item	Program Title	Budget Request
S&O	**N/A**	**Commercial Space Transportation Safety**	**$125,000**

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

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

- Perform a study to provide a basic understanding of what information is necessary in an Informed Consent form for spaceflight participants.
- Perform a comprehensive review of wind requirements to support the launch of unguided suborbital launch vehicles that use wind weighted systems, survey adequacy of existing winds databases with particular emphasis on temporal winds databases to ensure proper considerations of winds to support analysis products and day of launch decision making.
- Perform a comprehensive survey of existing technologies available for determining wind conditions from the upper troposphere to the stratosphere (50,000 to 100,000 feet) It will address possible modifications of radar wind profilers to obtain data on winds to greater altitudes than currently available.

Agency Outputs:

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

- A report that includes an overview on what is Informed Consent, explanations of the concepts behind Informed Consent, and how those concepts drive legal requirements in the document. This report will include recommended guidelines for providing information to spaceflight participants, such as the level of technical detail that may be required.
- Delineation of wind requirements to support analysis of unguided suborbital launch vehicles using a wind weighting system, and recommendations with regards to the requirements for wind databases at launch site locations.
- A recommendation of a best mix of wind technologies and modeling, or best practices for obtaining wind data (model data) primarily for small RLVs operating out of remote launch sites.

Customer/Stakeholder Involvement:

The Personal Spaceflight Federation, through COMSTAC, requested that AST research what information concerning informed consent should be provided to spaceflight participants and how it should be provided. This project will provide better understanding of Informed Consent to both AST and companies interested in manned spaceflight.

The research project concerning temporal winds database study is requested by the Office of Commercial Space Transportation and to be performed by Aerospace Corporation. AST will review the findings of Aerospace Corporation and work in tandem with Aerospace Corporation to perform analysis to redefine wind requirements to support the launch of unguided suborbital launch vehicles using a wind weighted system.

The research project concerning a low cost, field portable, high altitude wind profiler is requested by the Office of Commercial Space Transportation to be performed by Aerospace Corporation. AST will review the findings of Aerospace Corporation and will work with them to perform analysis to redefine the knowledge base of best mix of wind technologies and modeling, or best practices for obtaining wind data at high altitudes, to support analysis products and day of launch decision making to support the launch of both RLVs and ELVs.

Accomplishments:

FY 2008 is the first year of funding for the new activities known as "Informed Consent Study", "Temporal Winds Database Study", and "Low Cost, Field Portable, High Altitude Wind Profiler"

R&D Partnerships:

It is expected that the research on Informed Consent may be conducted by legal entities that are familiar with state and federal laws pertaining to Informed Consent requirements of similar activities.

AST will partner with the Aerospace Corporation for the temporal winds database research project. This project is expected to generate interfaces with launch site operators and launch operators launching at licensed launch sites and identify current and future needs and requirements for wind databases at licensed launch site locations.

AST will partner with the Aerospace Corporation to conduct the research on low-cost, field-portable, high-altitude wind profiler. This project is expected to generate interfaces with launch site operators and launch operators launching at licensed launch sites.

MAJOR ACTIVITIES AND ANTICIPATED FY 2008 ACCOMPLISHMENTS:

The final report on informed consent will provide AST with insight into what a launch operator would be expected to provide to space flight participants in an Informed Consent form.

AST plans to generate findings which will establish current and future wind requirements to support launch operations of unguided suborbital launches using a wind weighting system at licensed launch site locations.

AST plans to generate findings which will support the decision making on purchasing wind measuring equipment that in turn supports analysis products and day of launch decision making regarding public safety.

FY 2009 PROGRAM REQUEST:

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

KEY FY 2009 PRODUCTS AND MILESTONES:

None identified as yet. However, as research is conducted during the year, there may be indications of additional research efforts required during FY 2009, with appropriate products and milestones determined at that time.

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2007)	$200
FY 2008 Appropriated	128
FY 2009 Request	125
Out-Year Planning Levels (FY 2010-2013)	500
Total	$953

Budget Authority ($000)	**FY 2005 Enacted**	**FY 2006 Enacted**	**FY 2007 Enacted**	**FY 2008 Request**	**FY 2009 Request**
Contracts:					
Commercial Space Transportation Safety	120	75	125	128	125
Personnel Costs	0	0	0	0	0
Other In-house Costs	0	0	0	0	0
Total	**120**	**75**	**125**	**128**	**125**

OMB Circular A-11, Conduct of Research and Development ($000)	**FY 2005 Enacted**	**FY 2006 Enacted**	**FY 2007 Enacted**	**FY 2008 Request**	**FY 2009 Request**
Basic	0	0	0	0	0
Applied	60	38	63	64	63
Development (includes prototypes)	60	38	63	64	63
Total	**120**	**75**	**125**	**128**	**125**

Commercial Space Transportation Safety Product and Activities	FY 2009 Request ($000)	Program Schedule					
		FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013
Commercial Space Transportation Safety	**$125**						
Informed Consent Study							
Report that includes an overview on what is Informed Consent, explanations of the concepts behind Informed Consent, and how those concepts drive legal requirements in the document. It will include recommended guidelines for providing information to spaceflight participants, such as the level of technical detail that may be required.		◆					
Temporal Winds Database Study							
Report that delineates wind requirements to support analysis of unguided suborbital launch vehicles using a wind weighting system, and recommendations with regards to the requirements for wind databases at launch site locations.		◆	◇				
Low Cost, Field Portable, High Altitude Wind Profiler							
A recommendation of the best mix of wind technologies and modeling, or best practices for obtaining wind data (model data) for small RLVs operating out of remote launch sites.		◆	◇				
Total Budget Authority	**$125**	**$128**	**$125**	**$125**	**$125**	**$125**	**$125**

◆ - Activities Accomplished ◇ - Activities Planned

NOTES: OUT YEAR NUMBERS ARE FOR PLANNING PURPOSES ONLY. ACTUAL FUNDING NEEDS WILL BE DETERMINED THROUGH THE ANNUAL BUDGET PROCESS. IN THE ATO CAPITAL APPROPRIATIONS, PERSONNEL AND OTHER COSTS ARE BUDGETED IN ACTIVITY 5, NOT THE PROGRAM BUDGET LINE ITEM.

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APPENDIX B: 2007 R&D Annual Review: Accomplishments

Table of Contents

R&D Vision, Mission, and Organizational Values

R&D Vision: A transformed aviation system that allows all communities to participate in the global marketplace, provides services tailored to individual customer needs, and accommodates seamless civil and military operations.

R&D Mission: Conduct, coordinate, and support domestic and international R&D of aviation-related products and services that will ensure a safe, efficient, and environmentally sound global air transportation system.

R&D Organizational Values:

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

By aggressively pursuing these values, the FAA will create the best value from limited R&D resources to help achieve the national vision of a transformed aviation system.

Introduction

The United States has a national aviation system that is second to none — one that has proven it can respond quickly to changing and expanding needs. It is a complex global system, with numerous public and private sector stakeholders. It consists of thousands of aircraft and airports supporting business travel, scheduled passenger service, airfreight, and recreational flying.

The growing needs of the 21st century present new challenges to the aviation system. Many experts are forecasting a tripling in air traffic in the United States by 2025. To meet this projected increase, the U.S. Congress and the President have set out a vision for a transformed national aviation system, the Next Generation Air Transportation System (NextGen). Their intent is to field NextGen, capable of handling three-times the capacity demands of the current aviation system with the same level of outstanding safety performance by 2025. That vision has been captured and represented in the Operational Evolution Partnership (OEP), the FAA's plan and process for achieving NextGen. The FAA uses the OEP to provide a cross-agency view of implementation, to prioritize resources, to focus future development, and to partner with industry. OEP Version 1, published in June 2007, describes the framework for the implementation plan and is divided into three domains:

- air traffic operations, focused on transformative operational capabilities;
- airport development, focused on new airport surface infrastructure that provides significant capacity increases; and
- aircraft and operation requirements, focused on developing a common view of avionics requirements and timelines that can provide the operational capabilities demanded by NextGen.

OEP contains both commitments, which are fully-funded implementation activities, and strategic initiatives, which are being validated for implementation.

FAA R&D programs are now focused on the development and implementation of the NextGen concept. In fact, R&D is central to the NextGen concept and its success. Ever-evolving R&D helps to achieve virtually all of the FAA's short and long term goals and objectives. Dedicated professionals facilitate the day-to-day operations of the National Airspace System (NAS) while they simultaneously develop NextGen. The R&D community conducts research activities ranging from fire safety and human factors studies to the prototyping and creation of new products, services, and procedures. Much of the R&D focus is experimental and iterative; it is only through multiple experiments and iterations that the FAA will be able to determine the best solutions for NextGen.

This *2007 Annual R&D Review* showcases the FAA's accomplishments in 2007 to make progress toward its ambitious goals. Through pivotal milestones, the FAA plans to demonstrate that its major NextGen goals can be achieved. Each year, the agency will continue to report its efforts and accomplishments against the goals and objectives of the NextGen concept, as crystallized in the NAS Enterprise Architecture, an extremely detailed system engineering plan that defines timelines and milestones for key infrastructure programs, as well as serves as the backbone of the OEP.

Aeromedical Research 2007 Accomplishments

Distribution of Fluoxetine in Human Fluids and Tissues

Medical researchers in the FAA's Civil Aerospace Medical Institute (CAMI) continue to make significant advances in the analysis of postmortem fluids and tissues following fatal aircraft accidents. Researchers routinely detect and measure drugs, alcohol, toxic gases, and toxic industrial chemicals in the remains of accident victims to rank these factors among the causes of accidents.

Fluoxetine is a selective serotonin reuptake inhibitor (SSRI). According to the manufacturer, fluoxetine is the most widely prescribed medication in history for the treatment of depression, obsessive compulsive disorder, premenstrual dysphoric disorder, and panic disorder. Treatment of depression with fluoxetine is relatively safe; however, certain side effects of this medication, including drowsiness, dizziness, abnormal vision, diarrhea, and headache, could affect pilot performance and become a factor in an aviation accident. Therefore, the use of this medication by pilots is not permitted by the FAA. For this reason, each pilot fatality received by CAMI is screened for fluoxetine.

A limited amount of scientific information concerning the distribution of fluoxetine has been reported. Additionally, none of this data pertains to therapeutic levels of the drug. Since scientific information concerning the distribution of fluoxetine at therapeutic levels is not available, in FY 2007, researchers determined its distribution in various postmortem tissues and fluids in 11 separate aviation fatalities. Blood fluoxetine concentrations in these 11 cases ranged from 21 to 1,480 ng/mL. This research determined distribution of fluoxetine in postmortem specimens and identified specimen types that may be suitable for estimating blood concentrations of fluoxetine in the event that blood is unavailable for analysis.

First-Generation H_1 Antihistamines Found in Pilot Fatalities of Civil Aviation Accidents, between 1990 and 2005

First-generation H_1-receptor antagonists (antihistamines) are popularly used for alleviating allergy and cold symptoms, but these antihistamines cause drowsiness and sedation. Such side effects could impair performance and be a significant cause or a factor in accidents. Therefore, the prevalence of these antagonists was evaluated in aviation accident pilot fatalities. During civil aircraft accident investigations, postmortem samples from pilots involved in fatal aviation accidents are submitted to CAMI for toxicological analyses. These analytical findings are stored in a FAA database. In 2007, the CAMI toxicology database was examined for the presence of the first-generation antihistamines in pilot fatalities of civil aircraft accidents that occurred during the 16-year period between 1990 and 2005.

Of 5,383 fatal aviation accidents from which specimens were received by CAMI, there were 338 accidents wherein pilot fatalities were found to contain the following antihistamines: brompheniramine, chlorpheniramine, diphenhydramine, doxylamine, pheniramine, phenyltoloxamine, promethazine, and triprolidine. Of the 338 accidents, 304 were general aviation accidents; 175 of the 338 pilots held private pilot airman certificates. Antihistamines were detected alone in 103 fatalities (one antihistamine in 94 fatalities and two antihistamines in nine), while other drug(s) and/or alcohol were also present in an additional 235 fatalities. Thirty-five of the 338 fatalities had more than one antihistamine.

The use of antihistamines, with/without other drugs and/or alcohol, was determined by the National Transportation Safety Board (NTSB) to be the cause in 13 and a factor in 50 of the 338 accidents. The majority of the accidents were of the general aviation category. There was an overall increasing trend in the use of antihistamines by aviators during the 16-year span. Blood levels of the antihistamines were in the sub-therapeutic to toxic range. Findings from this study will be useful in investigating future accidents involving antihistamines.

Validation of Alcohol Responsive Differential Gene Expression Data by Quantitative Polymerase Chain Reaction (QPCR)

Toxicological detection of alcohol use in aviation accidents is still problematic in 30 to 40 percent of cases. A study of moderate alcohol use was initiated to determine differentially expressed genes at five different blood alcohol levels. The gene discovery phase of this 2007 study was performed by interrogating >54,000 probe sets on microarrays. Quantitative Polymerase Chain Reaction (QPCR) is an alternative method that can be used to determine differential expression of individual genes suspected to be regulated in response to a stimulus. QPCR is often used to validate microarray data.

From microarray gene expression data, a total of 11 genes were chosen from two analyses. QPCR data validated that 10 of the 11 genes had the same expression pattern as seen by microarray analysis. Furthermore, these 10 genes were found to be differentially expressed to statistical significance, again bearing out the results from microarray analysis. Finally, the degree of change also was in good agreement with the microarray data. The single gene that was not validated by this method had the lowest fold-change of all the genes tested, 1.25. The next lowest gene by fold-change had a value of 1.5 indicating that the limit of detection by QPCR is between 1.25 and 1.5. This finding is in agreement with other investigators' findings seen in the literature.

QPCR has been shown to be similar to microarray analysis in ability to detect differential gene expression. This alternative methodology will be useful as a less expensive alternative to microarray analysis in research projects where a set of genes is suspected to be differentially expressed but needs to be empirically proven. In addition, QPCR has now been shown to be useful as a diagnostic tool for analysis of factors important in aerospace medicine.

Analysis of Aeromedical Decision Making and Aviation Safety Consequences

Bioinformatics methodologies are used to assess pathology questions in aeromedical certification. As part of the increasing trend toward evidence-based medicine and data driven decision making, FAA researchers developed a Scientific Information System (SIS), to assist in the analysis and modeling of aeromedical certification decision making and aviation safety. The SIS provides a continuous monitoring of medical certification records compared to aviation accidents or incidents and post-mortem toxicology reports. Researchers use a team-based and multidisciplinary approach, since no single person or approach works for all aviation safety problems. The analysis team includes people with aerospace medicine, medical certification, accident investigation, piloting, computer science, mathematics, and biostatistics skills to examine and solve problems in aviation safety, particularly in aeromedical certification cases.

To demonstrate the usefulness of SIS in aviation medicine, in 2007 researchers chose to study the most common form of cardiac dysrthymia, atrial fibrillation, in the U.S. civil pilot population. Almost 20 million electronic medical records of 2.5 million pilots from 1983 to 2005 were included in the study. Pilots with atrial fibrillation are as safe and, by some measures, slightly safer in terms of the chances of having an accident. The only fatal accidents due to atrial fibrillation as a cause or factor in the NTSB reports are due to three pilots who *falsified* their medical certification applications by not reporting their atrial fibrillation medical condition.

Researchers found that no pilots who were properly certified had an accident due to their atrial fibrillation and that their accident rate was the same as or better than all other pilots in comparison. No properly certified pilot with atrial fibrillation had an accident of any sort due to a medical event.

Improving Airplane Signage Display for Passenger Safety

Current federal aviation regulations require specific materials and presentation modes for safety information displayed aboard transport airplanes. These design criteria are based on significant research and years of application that have proven their effectiveness. Advancements in commercial presentation media and information displays present opportunities for new airplane signage and briefing materials, pending approval. The first such request for approval is a graphical exit sign (a lighted silhouette of a running figure) in lieu of the word “EXIT,” as required by FAA regulation 14CFR25.811.

Approval of replacement by advanced media of the required signs and placards requires comprehension testing of candidate materials to assure understanding by the flying public. Only minimal comprehension testing of a limited number of graphical sign exemplars had been previously conducted. In 2007, FAA researchers conducted a broad-based study of graphical signs and placards to support certification decisions by the FAA.

Results of the study provided comprehension assessment for four graphical exit signs and 15 safety briefing card pictorials and pictograms. Comprehension was tested with standalone graphics, as well as with signs placed within an airplane context. The safety briefing card pictorials and pictograms were taken from cards currently in use aboard airliners flying in the United States. Standalone graphical signs averaged comprehension in the mid 40 percent range, whereas comprehension of signs within an airplane context improved, on average, to the lower 60 percent range. Mean comprehension of briefing card pictorials and pictograms reached 65 percent. Extended analysis of the results and application of these findings to support certification decisions is in progress.

Aircraft Accident/Injury and Autopsy Data System (AA-IADS) Incidental Cardiovascular Findings

In 2007, researchers conducted a study to determine the cardiovascular abnormalities found in the autopsies of pilots involved in fatal aircraft accidents in the United States between January 1995 and December 2000, including all types of civilian operations. Specifically, they were looking at incidental cardiovascular findings (ICFs), ICFs may or may not have been the cause of death or accident, but were reported by the medical examiner/pathologist. The NTSB database, along with 919 autopsy reports from the CAMI Autopsy Database for the same period, was searched to determine the number of fatal accidents the fatalities were reviewed for the presence of ICFs in pilots medically certified by the FAA. The medical records of all fatally injured airmen were reviewed using the Aerospace Medical Certification Division (AMCD) Document Imaging Workflow System with the purpose of identifying previous cardiovascular conditions as established by AMCD via cardiovascular pathology codes. Pre-existing pathology codes were compared to autopsy cardiovascular findings.

Cardiovascular abnormalities were found in 43 percent of the study cases. Consistent with previous studies, the study also showed an increasing prevalence of cardiovascular diseases with age, particularly in pilots older than 40 years. Cases with evidence of acute myocardial infarction need further analysis to rule out a sudden medical incapacitation as the cause of the accident. Based on FAA findings, any cardiac risk detection program in pilots should be aimed primarily at general aviation pilots. Finally, the study provides additional information to support the use of autopsy data for decision making, to improve accident analysis and to confirm if coronary heart disease trends in pilots are changing.

Aircraft Safety 2007 Accomplishments

Terminal Area Safety

The area around terminals continues to be the most hazardous area in the NAS. The majority of accidents occur in the takeoff and landing phases of flight. While capacity issues have become very important, the accelerated introduction of new technology, procedures, and equipment to solve the capacity problems must be integrated into the existing operational infrastructure so that maximum benefits for both safety and efficiency are realized. Examples of what might be involved include land-and-hold short operations, terminal area navigation, air traffic control (ATC) operations, controlled flight into terrain on approach or landing, closely spaced runway operations, communication procedures, and airport lighting and signage.

In 2007, under a collaborative agreement between the FAA, the Netherlands Civil Aviation Authority, and the Dutch National Aerospace Laboratory, a study was conducted on aircraft landing performance of subsonic narrow-body jet aircraft during instrument landing system (ILS) approaches. One study developed methods to identify the aircraft touchdown points during commercial operations by using ILS information, based on analysis of 50,000 records of operational flight parameters. The objective was to support development of guidelines for land-and-hold short operations and aid in understanding the causes of runway overruns.

The FAA is also working with the Air Force Research Laboratory's Human Effectiveness Directorate to improve aircrew safety in situations where lasers are carelessly or maliciously pointed at aircraft. Through this inter-agency partnership project, a laser system was installed in the FAA B-737-800 advanced flight simulator in Oklahoma City to simulate the effects of unauthorized laser illuminations from ground sources. The system realistically mimics a laser flashed at an aircraft cockpit from the ground. With eye-safe lasers integrated into a flight simulator, the research team monitored pilots' reactions and recommended appropriate countermeasures to support AC70-1, “Outdoor Laser Operations” and AC 70-2, “Reporting of Laser Illumination of Aircraft.”

Safety Analysis Methodology

Aircraft type certification regulation includes the requirement to conduct a system safety assessment to demonstrate regulation compliance. Current regulations for type certification of large commercial aircraft state that certification credit in both quantitative and qualitative assessments may be taken for correct and appropriate corrective action by a flight crew to mitigate the effect of a system failure. According to the same regulations, quantitative assessments of the probabilities of flight crew errors are not considered feasible. As a consequence, the aircraft designer is allowed to take all the credit for correct flight crew action in response to a failure. Since flight crew error continues to be implicated in the majority of fatal accidents, there is a need for a methodology that provides certification credit for desirable design features intending to reduce these errors.

In 2007, the FAA, the Netherlands Civil Aviaition Authorities, and the Dutch National Aerospace Laboratory developed a list of key flight-deck design characteristics with descriptors for different performance levels and developed a scoring algorithm that combines design characteristics into an overall level of certification credit for flight crew intervention in the case of system failures. The method was prepared in three different ways. First, the method was applied to 68 cases of in-flight aircraft system failures. The cases described failures of four different systems for eight different aircraft types. Second, all failure cases for the Fokker 100 aircraft were ‘replayed’ in a Fokker 100 Level D training flight simulator. Finally, validation was provided by discussing the design of the Fokker 100 cockpit with representatives of the original Fokker design team.

The method is easy to apply, provided that the system failure modes and associated flight deck annunciations are known. The time needed to determine the amount of flight crew intervention credit for a single aircraft / failure case combination depends on the complexity of the system and the associated failure, and the familiarity of the analyst with the system involved. In the analyses, where the analysts had only limited pre-existing knowledge of the aircraft systems, application of the method required approximately one to two hours per failure case. Application of the method is expected to take only 10-15 minutes per failure case if the analysts are familiar with the systems involved, as might be expected during the aircraft's type certification process. The method produces higher average scores for more modern cockpits. The most modern aircraft in the example cases (Boeing 777 and Airbus A-330) did not obtain the maximum possible score, indicating that even for those aircraft there is still room for improvement. It was therefore recommended that the Aviation Rulemaking Advisory Committee be informed of the results of this study so that this method can be further developed under the committee's guidance.

Unmanned Aircraft Systems

In FY 2007, the FAA initiated a new research program on unmanned aircraft systems (UAS). The research program, which was authorized by Congress, supports FAA regulatory actions and safety oversight necessary to ensure the safety of civil operations in the NAS. The program's worldwide research activities focus on technology surveys, methodology development, data collection and generation, laboratory and field validation, and technology transfer. These activities provide the basis for developing airworthiness standards, devising operational requirements, establishing maintenance procedures, and conducting safety oversight activities for UAS civil applications.

The UAS research is focused on four technical areas: technology survey; system safety study; detect, sense, and avoid (DSA); and command, control, and communication (C3). Key research tasks within these six technical areas are: UAS regulatory study; propulsion technology and associated certification issues; DSA technology survey and regulation gap analysis; C3 technology and certification requirements; development of UAS system safety management; and UAS bandwidth requirements.

The objective of these research tasks is to provide technical information with supporting data towards development of UAS regulatory standards for operation in the NAS. These new standards will lead to implementation of UAS certification procedures, airworthiness standards, and operational requirements.

Software and Digital Systems

The combination of rigorous design and verification assurances has led to safe and reliable operation of civil aviation software and digital systems. Historically, such systems were designed as federated architectures, and although some significantly successful efforts in integrated modular avionics (IMA) system integration have occurred, such as in the Boeing 777 aircraft, documentation of practices and guidelines for integrating such complex systems is lacking.

The 2007 report "Real-Time Operating Systems and Component Integration Considerations in Integrated Modular Avionics Systems Report" (DOT/FAA/AR-07/39) was prepared by United Technologies Corporation, Pratt & Whitney Aircraft Division. This work was based on previous studies conducted for the FAA that discussed issues regarding the use of software, electronic hardware, and commercial off-the-shelf (COTS) components in aviation systems; provided a detailed look into the safety and compliance issues of using a COTS real-time operating systems (RTOSs) in aviation applications; and investigated the safety aspects of using a partitioned COTS RTOS and its integrated architectural features in aviation systems.

The 2007 work researched the integration of the RTOS and other software modules and components into the overall IMA system. The technical report presents the results of a research effort intended for use by both the certification authorities and industry to formulate a basis for evaluating the integration of RTOSs and other associated modules that support partitioning in space, time, input/output, communications, and other shared resources on an IMA system. Further, this report presents approaches to apply system safety assessment methods to IMA systems and details several role players (platform supplier, RTOS supplier, application supplier, and IMA system integrator) in IMA system development and their roles for integrating multiple functions at different integration stages. Information from the report is included in several publications: RTCA Special Committee SC-200 in the development of RTCA/DO-297 "Integrated Modular Avionics (IMA) Development Guidance and Certification Considerations"; "Beginning of a Job Aid on IMA"; and AC20-145, "Guidance for IMA".

Aircraft Icing

In FY 2007, the FAA joined with industry, Eglin Air Force Base, NASA Glenn Research Center, and the University of Illinois to conduct a propeller-icing test at the U.S. Air Force McKinley Climatic Laboratory. Previously, very little information on propeller icing and no data from controlled testing in a ground icing facility, had been available. A primary objective of the propeller testing was to document leading edge and runback ice accumulation characteristics in controlled conditions on both new propeller blades (metal and composite) and in-service metal blades. Performance measurements were made to provide data for analysis of propeller performance losses due to the ice accumulation.

A turbopropeller engine was tested with several propeller combinations on a thrust stand exposed to a simulated in-flight icing environment.

Ice shapes were documented in several ways: tracings of the final ice shapes were made at several locations; still photographs were taken of the final ice shapes; and stop action video of the propeller were made in real time during the test. Engine RPM, torque, propeller blade pitch angle, and thrust were measured continuously. The test was successful in approximately duplicating some results from flight testing. For some conditions, the ice accumulation covered a large portion of the propeller blade span. The data and information from this test established a more extensive basis for guidance on addressing propeller icing in the aircraft certification process.

Commercialization of Metallic Materials Properties Development and Standardization (MMPDS)

The Metallic Materials Properties Development and Standardization (MMPDS) project is an effort led by the FAA to continue the process described in the handbook *Metallic Materials and Elements for Aerospace Vehicle Structures* (MIL-HDBK-5). The commercial version of the MMPDS-03 Handbook was released in April 2007. There has been a substantial upgrade with approvals from the 7th through the 9th MMPDS General Coordination Meetings. This includes 12 new alloys and over 300 pages edited or added.

The handbook is recognized worldwide as the most reliable source for verified design allowables needed for metallic materials, fasteners, and joints used in the design and maintenance of aircraft, missiles, and space vehicles. Consistent and reliable methods are used to collect, analyze, and present statistically based aircraft and aerospace material and fastener properties.

The objective of the MMPDS project is to maintain and improve the standardized process for establishing statistically-based allowables that comply with the regulations, consistent with the MIL-HDBK-5 heritage, by obtaining more equitable and sustainable funding sources. This includes support from government agencies in the Government Steering Group, from industry stakeholders in the Industry Steering Group and from profits selling the handbook and derivative products.

Damage Tolerance Testing of Composite Honeycomb Fuselage Panels

Rising aircraft operating costs are driving aircraft manufacturers to reduce weight and improve efficiency by using more composite materials in aircraft design. Composite honeycomb sandwich fuselage designs have been used quite successfully in general aviation and commuter aircraft. The advantages of using composite structres compared to conventional structures include weight savings, an increase in bending rigidity and in-plane strength and stiffness, and improved stability. A critical technical challenge in airplane sandwich design is to adequately predict residual strength of a damaged structure.

Classical damage-tolerance philosophy, long used in the design of conventional metallic airplane structure, cannot be directly applied to composite sandwiched structure for several reasons. First, damage in composite structures is seldom representative of a single dominant crack necessary to apply continuum fracture mechanics principles. Second, due to its heterogeneous nature, damage in composite sandwiched structures is much more complex than in conventional metallic materials. It can be quite extensive, yet nonvisual, and can pose difficulties with regard to inspections. Third, there is a general lack of understanding of failure mechanisms and their interaction in the overall structural response. Fourth, linear engineering models are not typically equipped to handle complex nonlinear behavior exhibited by composite sandwiched structures and have limited predictive capability; however empirical approaches based on experimental data from coupon, subcomponent, and full-scale testing is time consuming and very costly. The FAA has performed several studies to develop models that predict structural response, damage progression, and residual strength. Methodologies have been developed and validated in a building block approach at the coupon and sub-element levels.

In this 2007 study, the damage tolerance characteristics of several all-composite sandwiched fuselage panels were undertaken using the Full-Scale Aircraft Structural Test Evaluation and Research Facility. The objective was to determine the effects of various damage scenarios, such as holes and notches, on the residual strength of composite panels that reflect a typical honeycomb sandwich fuselage structure subjected to combined loading. Six composite panels were loaded quasi-statically to failure while recording the structural response, damage evolution, and residual strength. A photogrammetric method was used to obtain full-field displacement and strain measurements at equal load intervals up to failure. The acoustic emission method was used to monitor damage growth in real time and served as an early warning for imminent failure. Several nondestructive inspection methods were used to scan for non-visual damage, including flash thermography and computer-aided tap testing. This study provided test data to validate predictions from earlier coupon and sub-element research as well as provides an accurate assessment of sandwich damage tolerance and design principles for use in aircraft.

Propulsion Malfunction Research

The FAA has an ongoing, multi-year effort to study propulsion malfunctions that precipitate inappropriate crew response type accidents and incidents. This effort is in response to research recommendations from a 1998 Aerospace Industries Association (AIA) report. The “Engine Damage Related - Propulsion System Malfunctions,”" study, completed in 2007, directly supports the AIA Propulsion Indications Task Team (PITT) that is working to develop recommendations for future changes in the Federal Register, Title 14 Code of Federal Regulations (CFR) Part 25.1305. This research also provided input for the propulsion section of recently published AC25-11A.

The 2007 study reviewed in-service accident and incident data to determine the potential to identify which engine was malfunctioning and annunciate the information to the pilot. Potential combinations of parameters were considered and analyzed to improve indication reliability.

The study primarily used available data (reports and flight deck recorder data) to document engine damage events and make generalized conclusions and recommendations for future areas of development. The final report includes detailed descriptions of the malfunctions and expected affects on the flight crew. Work is continuing in support of the AIA PITT team with the development of an information based display concept that will tie annunciations to pilot actions and minimize troubleshooting of propulsion malfunctions in the flight deck.

Assessing Airworthiness of Small Airplanes

The FAA established a research program to determine if potential continued airworthiness problems, due to aging, exist in the small airplane fleet. Researchers conducted an airworthiness evaluation of four aged airplanes used in commuter service: two Cessna 402s, a Piper Navajo Chieftain, and a Beechcraft 1900D Airliner. The intent of the program is to provide insight, from a flight safety perspective, as to whether a correlation exists between maintenance history and the condition of a typical aged airplane. The results have provided information for use in raising the awareness of aging on small airplanes and recommendations to enhance current maintenance guidance.

In FY 2007, an airworthiness evaluation of an aged Beechcraft 1900D aircraft was completed. The evaluation was conducted in two phases for the airframe, aircraft systems, and wiring: an inspection phase, and a teardown examination phase. During the inspection phase, tasks included (a) a survey of the aircraft maintenance records, (b) visual inspection of the airframe structure, and (c) Supplemental Inspection Document inspection. The teardown examination phase included four tasks: disassembly of the airframe and major aircraft sections; structural assessment utilizing alternative nondestructive inspection techniques; post nondestructive inspection; and microscopic examination including fractographic analysis of critical structural areas. As part of the destructive evaluation, inspections and laboratory testing were also performed on the electrical systems of the aircraft to assess the condition and degradation of electrical systems in small aircraft and to evaluate maintenance procedures.

Application and Validation of CVM Sensors for In-Situ Crack Detection in Aircraft Structures

Current aircraft maintenance operations require entry into normally inaccessible or hazardous areas to perform mandated, nondestructive inspections. To gain access for these inspections, it is often necessary that structure and sealant be removed and replaced, fuel cells be vented to a safe condition, or other disassembly be completed. These processes are not only time consuming but could do damage to the structure. The Comparative Vacuum Monitoring (CVM) sensor is a small, self-adhesive, elastomeric patch that can detect cracks in the underlying airframe material on which it is mounted. The sensor has laser-etched rows of tiny, interconnected channels and is mounted under near-vacuum conditions. Any propagating crack under the sensor breaches the near-vacuum and the resulting change in pressure is monitored. The sensor can be attached to aircraft structure in areas where crack growth is known to occur. Since the sensor is based on pressure measurements, there is no electrical excitation involved.

In FY 2007, a team consisting of the FAA, industry, several major airlines, and the developers of CVM technology completed a three-year validation study that resulted in the incorporation of CVM sensors into the *Boeing Common Methods NDT* (non-destructive testing) *(CMN) Manual*. During this validation study, CVM crack detection sensitivity was determined, installation procedures were developed, environmental tests were conducted, and numerous sensors were flown on aircraft to demonstrate their durability.

This was a significant accomplishment in two respects: it represented the first time a manufacturer has adopted Structural Health Monitoring techniques to allow the use of mountable sensors; and it was a major advancement from the traditional methods used to inspect aircraft. This recognition of in-situ crack detection as an allowable inspection method is an aviation industry first. CVM technology is now available for use as a validated means for performing in-situ crack detection inspections on Boeing aircraft, to address future service bulletins, and as an Alternative Means of Compliance for existing inspections.

Methodology to Evaluate Mechanical Systems

In an attempt to be proactive in the area of transport category mechanical systems safety, the FAA started a research program to identify any deficiencies in past design, current maintenance, and/or safety reporting with regards to commercial aviation mechanical systems. This work is consistent with recommendations in the FAA 1998 report titled “FAA Aging Transport Non-Structural Systems Plan.”

Researchers developed a methodology that could potentially be applied to any mechanical system on an aircraft. In FY 2007, the methodology and case study were published in an FAA technical report entitled, “Aging Mechanical Systems Program.”

This methodology involved the following: reviewing past designs and comparing them to today’s design standards; reviewing maintenance practices; and reviewing airline safety reporting practices. The goal was to locate and identify any potential risks and rectify the associated issues before an accident occurred.

In parallel with the methodology development, a case study was used with the purpose of testing and improving the methodology.

Second Generation Arc-Fault Circuit Breaker Development and Testing

In 1998, the FAA and the Office of Naval Research (ONR) initiated a program to develop arc-fault technology for aircraft. The program was started with recommendations from the National Transportation Safety Board investigations of the TWA-800 and SwissAir-111 accidents. Arc-fault circuit breakers (AFCBs) reduce the probability of electrically ignited fires on aircraft. The first stage of the program developed a single-phase, 400Hz AFCB that has now accumulated over 200,000 flight hours.

In FY 2007, FAA and ONR completed the second phase of the AFCB program that calls for development of 28Vdc and 3-phase AFCBs. The second generation units have passed safety of flight-testing and many design qualification tests. The units are currently being flight tested on the F15, F18 and P3 aircraft in a joint program with the U.S. Navy and Air Force. The successful completion of the second-phase AFCB program provides the aviation community with new circuit protection options for the current and future aircraft.

New Fatigue-Crack Growth Test Method for Rotorcraft

An assessment of American Society for Testing and Materials (ASTM) test method E-647 and the development of a new fatigue-crack growth test method to address fatigue life predictions were completed in FY 2007. The new test method was developed to address concerns with existing fatigue-crack-growth rate and threshold data.

Method E-647 has been used over the past 25 years to generate information on fatigue-crack growth for a wide variety of materials; however, research shows that calculated data can result in imprecise life predictions, especially for high cycle fatigue components such as in rotorcraft. Method E-647 was satisfactory for some materials, but quite unsatisfactory for others. FAA-sponsored research at Mississippi State University has led to the development of the new test method that uses a compression-compression pre-cracking amplitude or load reduction test.

This new method produces more accurate constant-amplitude crack-growth rate data and will provide input data to more accurately design aircraft and rotorcraft components against fatigue damage. The test method has been independently verified by both analysis and tests, and the ASTM E-08 Committee on Fatigue Growth Rate has accepted the data and subsequently agreed to revise the current test method, ASTM E-647.

Aluminum Failure Modeling using Johnson-Cook Formulation

In 2007, the FAA and its partners in the Airworthiness Assurance Center of Excellence completed a multi-year effort to study aluminum's ability to mitigate blade fragment penetration of aircraft fuselage and components. The University of California, Berkeley led the team that was supported by Lawrence Livermore National Laboratory (LNLL) and the aviaition industry. This effort developed an aluminum failure model that can be tuned based upon the thickness of the material. The effort was not successful in developing a single model that could transition from petaling to plugging failure modes as the thickness of the fuselage simulator increased. These models will be used as part of the LS-DYNA Aerospace Quality Control process, along with a significant repository of test data and analytical analysis of the various test completed under this effort. LS-DYNA is a general purpose nonlinear finite element program capable of simulating complex real world problems.

Berkeley facilitated the team and was the primary interface to the FAA. They also performed 50 caliber impact tests on various thickness aluminum sheets in their ballistic facility and worked with LLNL and industry to model the tests and compare the results to the test data.

During this effort, LLNL worked to improve the aluminum failure model developed under a previous FAA grant. Detailed analysis of the test data resulted in a new appreciation for the failure process, which identified a thickness dependency for the range of material thickness and impact speeds associated with uncontained engine debris impacting the aircraft fuselage. For any given thickness the failure could be tuned, but the penetration velocity for thinner material would be over predicted and for thicker material under predicted. This effort highlighted shortcomings in the commonly-used Johnson-Cook formulation for detemining structural damage that prompted the FAA and NASA to initiate an effort to develop a new material model that is currently being investigated.

Engine Containment Modeling

The FAA and its partners in the Airworthiness Assurance Center of Excellence completed a multi-year to study high-strength fabrics and their ability to contain blade fragments in engine containment systems. Arizona State University led the team that was supported by NASA and the aviation industry. The effort has developed a generic engine containment model that will be used as part of the LS-DYNA Aerospace Quality Control process along with a significant repository of test data and analytical analysis of the various test efforts.

NASA Glenn Research Center performed a test program where blade fragment simulators were shot into a fabric ring to determine the ballistic limit of the fabrics. The test program was the foundation for the containment modeling verification effort.

During this effort, industry researchers worked to improve the fabric impact material model developed under a previous FAA grant. Detailed analysis of the test data resulted in a new appreciation for the failure process that allowed the revised material model to better simulate the test data.

Researchers applied the new material models to proprietary engine models and provided a results-comparison against full scale engine containment tests. This experience was also used to develop a generic ring and fabric wrap model that can be used in the quality control process for LS-DYNA and also in aerospace training programs on the use of the code.

Arizona State University facilitated the team and was the primary interface to the FAA. They also performed detailed quasi-static testing of the fabric material in their laboratory and worked with industry to model and compare analytical results at multiple facilities to the test data. This effort highlighted differences in the results that prompted the FAA and NASA to initiate the LS-DYNA Aerospace Users Group with members from government, industry and academia. This group continues to meet and works to establish controls for consistency of the analysis in aerospace problems. The group has been very successful and has the full support of an ongoing FAA grant at George Washington University.

Standardized Training Requirements for Critical Composite Maintenance and Repair Issues

Standardized training requirements for awareness of the unique operational demands of composite aviation structures were developed in FY 2007. These training requirements will provide an awareness of safety issues regarding the maintenance and repair of composite materials utilized in aircraft structure. The audience for this training includes engineers, technicians, inspectors, and other individuals associated with aviation operations including those interfacing with composite aircraft structures on the flight line, in repair facilities, and overhaul locations.

A principal objective of the training requirements is to provide an industry standard for awareness of composite maintenance and repair safety issues which reflect the insights of worldwide experts in the field. The curriculum was developed, primarily through collaborative workshops and other forums, in order to involve industry, academia, and government regulatory agencies, to achieve complete and balanced standards.

Development of the awareness course resulted in a framework with safety messages, assessments for course developers, and teaching resources. These provide an industry standard that represents a complete and balanced approach with the consensus of experts from around the world. The Society of Automotive Engineers has adopted the terminal course objectives developed in this program as an Aircraft Certification Service standard for identification of key elements required to create acceptable awareness courses. In addition, detailed teaching material is provided in an FAA Aviation Research Report.

Aging Composite Structures Evaluation

The FAA recently undertook a program to examine as many aging aircraft with composite structures as possible. The focus is civil-composite primary and secondary structures put into service in the early development years that have reached or are nearing their service life. These composite structures will be evaluated to determine if the original certification requirements were met after their years in service. The goal is to assess the efficacy of civil certification requirements in providing a safe aircraft structure. Additional goals are to assess the aging mechanisms, characterize their effects on the composite structure, and to give recommendations pertaining to characterizing composite aging. This effort will provide design and certification guidelines for composite aircraft structures.

The first structure examined was a Boeing 737 composite stabilizer with 18 years of service and over 50,000 flight cycles. The B737-200 graphite/epoxy stabilizer was developed as part of the 1977 NASA Aircraft Energy Efficiency (ACEE) Program and was certified in 1982. The ACEE Program challenged aircraft manufacturers to redesign existing aircraft components using graphite/epoxy composites in early efforts to develop lighter structures.

The investigation consisted of nondestructive inspection (NDI), disassembly of the components, and physical, thermal, and mechanical tests. NDI evaluation with the recommended field methods verified the damage state of the retired stabilizer. Additional sophisticated NDI techniques, not available at the time of fabrication, such as shearography and laser ultrasonic testing were also used to characterize the damage state. NDI, mechanical, and physical test methods were compared with those used in the development program to assess differences in capabilities between 1982 and modern methods. Destructive evaluation, using the original certification test methods, established the end of service life capabilities of the structure.

The evaluation of the B-737 stabilizer determined that the composite structure was capable of meeting its design requirements even when retired from service. This examination of a sample civil composite aircraft structure demonstrates that the certification basis provided adequate safety even at the end of its service life. This gives the FAA certification service information to better assess new composite structures for safety and assure they exceed the established requirements.

Traffic Alert and Collision Avoidance System (TCAS)

Traffic Alert and Collision Avoidance System (TCAS) I is a mandated system for aircraft with less than 31 and more than 10 passengers, with no resolution advisory. TCAS II is a mandated system for all aircraft flying within the NAS and Europe with more than passengers or maximum certified takeoff weight greater than 33,000 lbs. TCAS II includes resolution advisories (RA) to instruct flight crews if a collision is imminent.

In 1993, TCAS was mandated within the United States after several notable midair collisions and near-collisions that had occurred over the previous 19 years. Congress enacted two public laws during that time period that called for the development of an anti-collision system. Since that time, the original Minimum Operational Performance Specification (MOPS) has been modified to Version 7 in order to accommodate over 300 Change Requests and Problem Trouble Reports submitted against Version 6.04A. These problems were identified as a result of active TCAS monitoring in Europe and the United States, pilot reports, and applied research activities. Version 7 of the MOPS was implemented globally.

While U.S. aircraft were not mandated to equip with Version 7, currently, two-thirds of the current U.S. commercial fleet is equipped with it. Europe elected to mandate TCAS Version 7.

In 2004, RTCA reconstituted its TCAS Special Committee (SC-147), as a direct result of a TCAS-related crash in Europe and a near-collision that occurred in Japan. The committee was tasked with examining these events to determine the cause and contributing factors. It was determined that TCAS suffers from a problem called reversal logic problem (i.e., SA01). In certain encounters between two aircraft, TCAS does not issue a sense reversal (e.g. change a “climb” command to a “descend” one) in a timely manner, if at all.

Based on limited monitoring in the United States and Europe, approximately 11 reversal logic episodes have been detected. The predicated rate of mid-air collisions associated with this problem is estimated to be once every four years, unless a fix is implemented immediately. Europeans have concluded that the primary causal factor of the opposite responses is the use of the ‘Adjust Vertical Speed, Adjust’ aural enunciation.

The Europeans have proposed two Critical Avoidance Safety (CAS) logic changes known as Change Proposal 112E (CP112E), to improve the reliability of the Sense Reversal RAs, as well as CP115 to improve pilot response to the negative resolution advisory RAs.

Based on limited monitoring in the United States and Europe, approximately 11 “reversal logic” episodes have been detected. The predicated rate of mid-air collisions associated with this problem is estimated to be once every four years, unless a fix is implemented immediately.

Additionally, monitoring of TCAS performance has identified instances where flight crews initially respond in the opposite direction to that specified by TCAS when a negative resolution advisory (RA) is displayed and announced to the flight crews. Europeans have concluded that the primary causal factor of the opposite responses is the use of ‘Adjust Vertical Speed, Adjust’ aural annunciation.

The Europeans have proposed two Collision Avoidance System logic changes known as Change Proposal 112E (CP112E), to improve the reliability of the Sense Reversal RAs, as well as CP115 to improve pilot response to the negative resolution advisory RAs.

The Advanced Technology Development & Prototyping (ATD&P) TCAS Program is overseeing the finalization and validation of a correction to these problems, updating the TCAS II MOPS (DO-185b), developing a w TCAS Encounter Model, and coordinating the appropriate rulemaking within the FAA for TCAS II equipage throughout the national fleet.

The ATD&P TCAS Program made the provided following accomplishments in FY 2007:

- developed Safety Risk Management Documents (SRMD) for CP112e (i.e., Sense Reversal Logic) and CP115 (i.e., LOLO);
- completed validation / verification simulations on updated TCAS pseudo-code;
- incorporated agreed upon change proposals into a revised version of the TCAS II version 7 MOPS in preparation for formal RTCA SC-147 Final Review and Comment (FRAC);
- completed RA monitoring feasibility testing on BI-6 & Mode-S systems; and
- conducted an ATC Operational Survey as part of CP115 (i.e., LOLO) safety validation activities.

Airport Technology 2007 Accomplishments

Automated Foreign Object Debris (FOD) Detection System Evaluation

The presence of foreign objects in the airport environment presents a major hazard to aircraft safety. Foreign object debris (FOD) is any substance, debris, or article found on an airport surface that could potentially cause damage to an aircraft or vehicle. The presence of FOD can be the result of the loss of parts from aircraft, pavement cracking, wildlife, ice and salt accumulation, or construction debris. Identification of FOD at airports requires regular observation of airport surfaces by airport personnel, or by chance recognition by aircraft pilots operating on airport pavement. Removal of such FOD is triggered only by those actual observations. In 2005, the FAA, in cooperation with the University of Illinois, conducted a preliminary short term evaluation of a radar-based FOD detection system at the John F. Kennedy International Airport. Through the use of millimeter-wave radar, this system demonstrated the capability to detect objects as small as a two-inch bolt on the pavement surface. As a result, it was determined that this type of system could provide airport personnel with timely FOD alerts, and provide specific information on the location of the object. The conclusions from the preliminary research effort demonstrated successful FOD detection under many operational and environmental conditions, but also identified a need to conduct further evaluation of the FOD radar on a longer term basis, under varying seasonal conditions. In 2007, two separate millimeter-wave radar units were installed at the Theodore Francis Green State Airport for further long-term evaluation. The FAA is also developing plans for further research of other FOD detection technologies, including high powered camera systems at three large U.S. airports. Evaluation of these new technologies will begin in early 2008, while the evaluation of the radar system is scheduled for completion in early to mid 2008.

Operation of New Large Aircraft – Second Level Fire Fighting Evaluation

Today, two major aircraft manufacturers are developing large commercial aircraft capable of carrying over 500 passengers on two levels and 80,000 gallons of fuel. These airplanes meet the FAA's Airport Design Group VI classification. The Airbus A-380 and the Boeing 747-8I, are the largest passenger carrying aircraft ever built, and have thus earned the name, New Large Aircraft (NLA). Scheduled service for the A380 in the United States is slated to begin in late 2008, with the 747-8I following a few years later. The physical size, both in passenger and fuel carrying capacities, of these aircraft require examination of the current Aircraft Rescue and Fire Fighting (ARFF) service standards and recommended practices for their adequacy to combat post-crash events. In January 2001, the FAA issued DOT/FAA/AR-0067, *Rescue and Firefighting Research Program*, covering several ARFF interrelated areas to improve passenger survivability when involved in post-crash fires. One of the key areas of that study was the identification of firefighting requirements in terms of training, firefighting techniques, and specialized equipment related to NLA. The need for a revised or new methodology to determine firefighting agent quantities required for NLA type aircraft was also mentioned. Current federal minimum agent requirements may not be sufficient to extinguish a major NLA fire. Physically, NLA will be significantly greater in fuselage surface area, wingspan, and tail height, and feature full upper passenger deck, significantly increased fuel loads, unique tail-located fuel tanks, and greater use of composite materials.

In response to this need for ARFF-related NLA research, the FAA, in cooperation with the Air Force Research Lab at Tyndall Air Force Base, constructed a mockup of full scale section of a NLA that will enable researchers to conduct large scale fire evaluations. The mockup has two passenger levels, a lower cargo level, three metal evacuation slides, the beginnings of the right wing root, and one inboard engine. The entire assembly is positioned inside a 100-foot diameter, environmentally-contained fire pit that can be filled with calibrated amounts of jet fuel for ignition. In addition, the mockup features three replaceable penetration points where aircraft skin piercing equipment can be evaluated. There are also three authentic evacuation slides that can be attached to the mockup for non-fire evaluations. The mockup was completed mid-2007 and will be undergoing a series of baseline testing throughout the remainder of 2007 into early 2008. With this valuable testing facility completed, the FAA is prepared to conduct several evaluation programs that will assist in finding the answers to the questions regarding what kinds of tools, strategies, and agents will be required to handle a fire event involving a NLA.

Deploying FAARFIELD – Advanced Airport Pavement Thickness Design Software

Researchers completed the new computer program, FAA Rigid and Flexible Iterative Elastic Layer Design (FAARFIELD) in August 2007. The program incorporates three-dimensional (3D) element structural analysis to compute stresses for rigid (concrete) pavement and rigid overlay thickness design. Previous FAA computer programs for thickness design, such as the LEDFAA 1.3, estimated rigid pavement stresses based on layered elastic analysis. FAARFIELD is a significant advancement in pavement design technology, representing the first time the powerful and accurate 3D finite element method has been used in a routine design procedure to compute the critical design stresses, such as stresses at the slab edges, for complex aircraft gears. Previously, 3D finite element based procedures were considered impractical for PC-based design applications because of the excessive time it took to complete modeling. A combination of faster computer processors and innovative programming methods reduced run times to the point where FAARFIELD can be used for routine pavement design. Some of the strategies employed by the FAA included optimizing the 3D meshes and using less accurate, less computationally-intensive methods in initial iterations to reduce overall processing time. The look and feel of FAARFIELD is virtually identical to LEDFAA 1.3, so users will have no trouble adjusting to the new program; however, researchers have incorporated many changes into the new software. The entire program uses the Microsoft Visual Studio.NET programming environment, making it more compatible with current PCs and operating systems. Engineers have completely revised the rigid pavement failure models to incorporate new full-scale test data for four- and six-wheel gears from the National Airport Pavement Test Facility rigid pavement tests. For flexible pavements and overlays, FAARFIELD incorporates all the changes made in LEDFAA 1.3 and adds automatic base layer design. Researchers also have completely rewritten the rigid overlay design procedures, making them more efficient than previous algorithms. FAARFIELD 1.1 will be the basis for the newly revised AC150/5320-6E, expected in early 2008. In anticipation of this change, FAARFIELD includes more runtime guidance. Also, the internal aircraft library has been revamped and expanded to include all current fleet aircraft and new models, including the Airbus A-380 and the Boeing B-787.

Rigid Pavement Test Sections at the National Airport Pavement Test Facility

In preparation for a new series of full-scale traffic tests on overlaid rigid pavements, engineers constructed three pavement test items at the National Airport Pavement Test Facility. In a project administered by the Innovative Pavement Research Foundation (IPRF) and funded by the FAA through a cooperative agreement, the overlay tests were designated Construction Cycle Four (CC4). This construction cycle differs from previous studies conducted at the facility because, under the agreement, the FAA was required to remove and replace the subgrade soil to IPRF specifications of thickness and strength, provide facilities for data collection, operate the test vehicle, and demolish and dispose of the pavement. The project is being done in two phases. In phase A, the subgrade was reworked to grade at a California Bearing Ratio of approximately eight. Portland Cement Concrete (PCC) slabs were placed in three different thicknesses on an aggregate sub-base and a one-inch-thick asphalt interlayer placed on top of the slabs. A PCC overlay was placed on top of the asphalt so that the finished grade was the same along the full length of the test pavement. Each test item was 300 feet long and simulated an overlaid PCC pavement with three different combinations of under- and overlay slab thicknesses. Construction of the test pavement for Phase A was completed in March 2006, including installation of the instrumentation, most of which was imbedded in the pavement. Phase A traffic testing was completed in November 2006 and the post-traffic materials testing, including removal of the overlay and interlayer, was completed in December 2006. Phase B started with trafficking of the underlay to achieve a uniform level of cracking in the test items and a new overlay with the same specifications as the first was completed in April 2007. Trafficking on Phase B started in September 2007. The CC4 series of tests provides full-scale test data on the performance of concrete overlays on concrete pavements to fill a gap in empirical knowledge. Previous tests on this type of construction are at least 35 years old and do not reflect current construction practices or aircraft loads. The present tests are intended to yield reliable performance data that the FAA can use to update the overlay thickness design procedures in its FAARFIELD computer program. The CC4 testing program largely follows a test plan that was prepared under a previous IPRF project, and is available at www.iprf.org.

Installation of Next Generation High Reach Extendable Turret

Past research done by the FAA Aircraft Rescue and Fire Fighting (ARFF) Research Program established the advantages and benefits of ARFF vehicles using High Reach Extendable Turrets (HRET) equipped with penetrating nozzles in aviation fire fighting. Since the introduction of HRETs in 1986, approximately 400 of the turrets have been retrofitted into existing ARFF vehicles or integrated on new ARFF vehicles. Some advantages and benefits of this technology include: increased throw range performance; increased range of motion of the turret, more efficient application of the agent by directing it to the seat of the fire; faster extinguishing of two-dimensional pool and three-dimensional flowing fuel fires; and the ability to penetrate inside an aircraft to cool the interior cabin and extinguish fire. This technology increases passenger survivability, protects property, and extinguishes fire faster right after an aircraft crash.

The December 18, 2003, aircraft accident at Memphis International involving a wide body DC-10 cargo aircraft demonstrated the importance an HRET outfitted with a penetrating nozzle can have at an accident. Upon landing, the failure of one landing gear caused the aircraft to skid on its fuselage and catch fire. While two ARFF vehicles concentrated on the fuel spill fire, the ARFF vehicle with the HRET penetrated the aircraft from the opposite side. Firefighters were concerned that the fire would burn through the fuselage and create an interior fire. The HRET-equipped vehicle flooded the interior with foam and 99 percent of the cargo was spared fire damage. The saved cargo value, estimated at $25 million, was greater than the value of the aircraft. This accident demonstrated the need and ability of a HRET at an aircraft accident, and the role it can play in protecting cargo and increasing survivability in passenger aircraft.

Because the current HRET performance criteria have been in place for over a decade, researchers have begun work to develop new HRET performance criteria to meet the challenges posed by the new Airbus A380 and other New Large Aircraft (NLA).

The distance from the front of the ARFF vehicle to the burning aircraft fuselage is commonly referred to as standoff distance. Current HRETs cannot reach a second level doorway of a Boeing 747 or Airbus A380 unless the ARFF vehicle is positioned right next to the aircraft fuselage. Unfortunately, this placement eliminates visibility of the operator controlling the HRET as well positioning the operator in the hazardous area. Other challenges that NLA present to the firefighters are complex slide arrangement and engine pylon locations.

The ARFF Research Program has completed the installation of a 65’ next-generation HRET on their research vehicle. Testing of this new technology has begun with the objective to further refine the performance requirements to meet the challenges of the commercial aviation fleets of today and tomorrow.

Wildlife Mitigation R&D Program

The FAA's wildlife hazards mitigation R&D program consists of three main areas aimed at reducing the risks of aircraft encountering wildlife on or near airports. Many of the studies are carried out through partnerships with other federal agencies and academic centers of excellence.

The first area, Wildlife Hazard Management research, focuses on techniques for managing the wildlife habitat on or in the vicinity of airports by making them less attractive to wildlife. Wildlife Hazard Management involves the study of methods for controlling wildlife presence, including deterring or scattering birds. The second area involves the detection and tracking of birds on or near airports to reduce the risk of an aircraft strike. The third area is the development of a North American Bird Strike Advisory System (NABSAS). All three areas currently focus on obtaining accurate and timely information that will ultimately lead to reducing the risk of severe and potentially catastrophic wildlife-aircraft strikes.

Wildlife Management and Control R&D Projects were carried out under agreements with the U.S. Department of Agriculture (USDA). Studies conducted in FY07 included the establishment of a new Interagency Agreement with USDA to characterize bird use of storm water detention basins on airports in the Southwest region of the United States. Alternative varieties of vegetation continued to be evaluated to identify bird foraging preferences and ultimately make airport vegetation less attractive to birds. The USDA completed the study of trash transfer facility types and characteristics that make them wildlife attractants.

In 2006, the FAA established several cooperative agreements with key universities, agencies and airports as first steps toward the development of the NABSAS. The system is based on a strategic plan drafted in 2005 by the FAA, U.S. Air Force, and Transport Canada. The vision of the original draft focused on providing near real time hazard advisory information to a variety of end users such as pilots, air traffic controllers, airport operators and wildlife control personnel. While that long-term objective is still viable, recent lessons learned and advances in technology have shifted the approach toward initially validating current avian radar capabilities, and providing risk assessments for key flight operational zones in the airport environment. Major cooperators in this study are the U.S. Air Force; the USDA; the University of Illinois at Urbana-Champaign; Embry Riddle Aeronautical University; several commercial airports, including Seattle-Tacoma, John F. Kennedy International and Dallas/ Fort Worth International; and avian detection radar vendors. The FAA also serves as a participating partner in a complimentary effort being conducted by the U.S. Navy.

Field studies began at the first of several test sites in early 2007. The first test avian radar system was deployed at Seattle-Tacoma International where it currently detects and tracks bird movements in that locale. Additional avian radar systems are slated for deployment at John F. Kennedy International, and Dallas/Ft. Worth International Airports.

Light Emitting Diode (LED) Airport Applications

For over 50 years the standard light source used for airfield lighting was an incandescent lamp. These lamps are not very efficient in producing light as most of the energy is in the form of heat. With the advancements in the Light Emitting Diode (LED) field, it has become viable to consider their use as a replacement for the incandescent lamp. LEDs have the potential to provide significant energy savings, reduced maintenance, and overall life-cycle cost savings while providing a more reliable visual cue. During the initial implementation of LEDs it was discovered that this new source did not act the same as the incandescent source. Items such as brightness perception, and their ability to handle the airfield circuits that were designed around the incandescent lamp needed to be addressed.

A study was completed May 2007 that investigated the brightness perception issue and found the LED has the perception of being brighter.

An FAA/Industry team was formed for the development of a common electrical infrastructure for LED lights sources. This infrastructure included a power distribution system that:

- maximizes efficiency of the LED fixture
- supports reduced total cost of ownership
- supports an open architecture.

Runway Incursion Reduction 2007 Accomplishments

Overview

The Runway Incursion Reduction Program (RIRP) within the Advanced Technology Development and Prototyping group (ATD&P) conducts research, development, and operational evaluation of technologies to increase runway safety. Consistent with NTSB recommendations and initiatives identified in the FAA Flight Plan, research emphasis remains on technologies that provide for direct safety warnings to pilots and aircrews as well as those that can be applied cost effectively at small to medium airports. The program explores alternative small airport surface detection technology and the application of these technologies to pilot, controller, and vehicle operator situational awareness tools. Initiatives include operational evaluation of alternative Runway Status Lights (RWSL) configurations to address diverse airport runway geometries, Low Cost Ground Surveillance (LCG) and Final Approach Runway Occupancy Signal (FAROS) awareness tools. When appropriate, solutions are prototyped and tested in an operational setting to validate their technical performance and operational effectiveness.

Runway Status Light

For FY 2007, ATD&P completed the evaluation and testing of RWSL using Takeoff Hold Lights (THLs) at Dallas-Fort Worth International Airport and Runway Entrance Lights (RELs) at San Diego International Airport. The RWSL project leverages the existing FAA investment in Airport Surface Detection Equipment Model X (ASDE-X) to augment a layered defense system and reduce the likelihood of a runway collision at selected airports in the NAS. RWSL integrates airport lighting equipment with the ASDE-X approach and surface surveillance system to provide a visual signal to pilots indicating that it is unsafe to enter/cross or begin takeoff on runway. It was developed and evaluated through the RIRP to assess its performance and suitability for integration at high volume airports. RWSL will contribute toward the reduction of Category A and B (high-hazard) runway incursions. The ATD&P group successfully completed the initial investment decision process (JRC 2A) and transferred this program to the Terminal Service Unit for implementation throughout the NAS.

Low-Cost Ground Surveillance Systems

In addition to RWSL, the ATD&P group tested and evaluated two LCGS systems at Spokane International Airport. These non-cooperative sensors can provide essential surveillance capability at small and medium airports. Two different LCGS candidates were evaluated: the Critical Area Management System (CAMS) and the NOVA 9000 ATC System.

– CAMS uses an array of millimeter wave sensors (MWS) distributed throughout the airport movement area to provide coverage of runways, taxiways, and ramp areas. MWS requires no aircraft-installed equipment to operate. The current system installed at Spokane as part of the LCGS evaluation is integrated with the Automated Radar Terminal System (ARTS) ARTS-IIE. This system can also be integrated with an Optical Identification Sensor (OIS).

– The NOVA 9000 ATC System uses Terma X-Band radar to provide complete coverage of the airport movement area. It requires no aircraft-installed equipment to operate. The current system installed at Spokane is also integrated with the ARTSIIE system.

A final evaluation report was submitted to the Office of Runway Safety in September 2007. The project had such favorable results that the FAA is developing a pilot program to deploy LCGS systems at up to three additional airports in order to gather further business case data in anticipation of an investment decision in FY09.

Final Approach Runway Occupancy Signal (FAROS)

The ATD&P group also tested a basic FAROS concept at Long Beach Airport, using in-pavement loops to sense the presence of an aircraft or vehicle on the runway. This system indicated traffic on the runway, by flashing Precision Approach Path Indicators, in three limited areas. An advanced version of FAROS is being developed to employ ASDE-X and Airport Surveillance Radar to determine, for a specified critical point on the approach path, whether there might be traffic on the runway that will conflict with approaching aircraft. This improved surveillance and smaller alert window is necessary at busy, high capacity airports, such as Dallas – Fort Worth International Airport, where the system will be installed and tested.

Aviation Weather 2007 Accomplishments

Avoiding In-Flight Icing Conditions

The formation of even a thin coat of ice on an aircraft surface can seriously affect an airplane's ability to fly by increasing drag, increasing aircraft weight, and decreasing lift. In many cases, ice build-up is so rapid that the pilot does not have enough time to take corrective action. NTSB reports indicate that in-flight icing causes more than 25 accidents annually, with over half of these resulting in fatalities and destroyed aircraft. This equates to $100 million in injuries, fatalities, and aircraft damage each year.

To address this problem, FAA-funded researchers have developed the Current Icing Product (CIP-Severity) and the Forecast Icing Product (FIP-Severity). These products alert users to areas of known and forecasted in-flight icing by graphically displaying the probability that icing will occur along their planned flight path.. During fiscal year 2007, the joint FAA/National Weather Service Aviation Weather Technology Transfer Board approved the FIP-Severity for experimental use. During the experimental use phase, users can view the product and provide performance feedback to researchers for refinements before making the capability fully operational.

FIP-Severity has the following new features: Expected Icing Severity; Probability of Icing Encounter; Improved Color Scale; and Improved Cloud Top Estimates. These new features were added to mitigate risks identified by assessments conducted by the FAA. Severity is needed to delineate where icing conditions reside, so that uncertified aircraft can avoid these areas. The new product uses a relative scale that has been calibrated to depict the probability of encountering icing. The FIP-Severity also has improved cloud top estimates which will reduce the volume of airspace being depicted as hazardous without compromising safety. Additionally, supercooled large drop regions, which represent conditions outside the current certification envelopes, are depicted as cross-hatched overlays for quick reference.

These improvements will allow users to plan more effective routes of flight that will avoid hazardous icing areas.

Mitigating the Effects of Low Ceilings and Visibility

According to a University of Illinois study, pilots licensed to operate in visual flight rules who lack instrument training lose of control of their aircraft in less than 3 minutes, on average, from the time they lose visual orientation. Low cloud ceilings and poor visibility conditions are safety hazards for all types of aviation. In the continental United States, 72 percent of ceiling and visibility related accidents result in fatalities. To mitigate these types of accidents, FAA-funded researchers have been developing a National Ceiling and Visibility Analysis (NCVA) and a forecast capability to warn users of areas with low ceilings and poor visibility.

The NCVA provides users in the lower 48 states an automated graphical display, updated every 15 minutes, showing current ceiling, visibility, and flight category conditions along their route of flight. The NCVA capability also incorporates tools that allow concurrent examination of other weather data, including satellite and radar imagery.

NCVA was approved by the joint FAA/National Weather Service Aviation Weather Technology Transfer Board for experimental use in FY 2005. User feedback obtained during the experimental phase resulted in improvements to NCVA including an enhanced cloud-mask that identifies cloud free areas between data sites. Development of NCVA was completed in 2007 and is expected to be approved for full operational use in FY 2008.

Wind-Dependent Wake Turbulence Mitigation

In 2007, the FAA completed the concept feasibility demonstration of a cross-wind based air traffic wake turbulence mitigation decision support tool to enable greater capacity for closely-spaced runways. The FAA also completed assessment of NASA's concept for wind-dependent wake turbulence mitigation procedure for aircraft arriving on closely spaced parallel runways.

Wake Turbulence Operational Change

Relying on NASA's wind-dependent wake turbulence mitigation procedure, in June 2007**,** the FAA approved an operational change at Lambert-St. Louis International Airport (STL) for ATC operation of the airport's closely spaced runways**.** The requested change allows STL to accept traffic on both of its closely-spaced parallel runways under adverse weather conditions. Under previous wake mitigation guidelines, STL would have had to shut down one of the runways for arriving traffic. This change in procedure allows pairing of aircraft as they approach the STL runways, requiring the leader of the pair be a small or large weight category aircraft. This change implemented dependent staggered Instrument Landing System approaches in Instrument Flight Rules conditions, allowing significant arrival and departure capacity increases, and minimizing flight delays.

Capacity 2007 Accomplishments

Center for Advanced Aviation System Development (CAASD)

AviationSimNet® Simplifies Testing of New Aviation Concepts

In the past, joining laboratories at government agencies, commercial airlines, and universities to conduct distributed evaluations of new aviation concepts was expensive, time consuming, and required dedicated communications lines and proprietary interfaces. This environment limited opportunities for joint research. To increase joint research and reduce the cost and preparation required, CAASD, in conjunction with others in the aviation community, defined and developed a standard to facilitate distributed evaluations between simulation laboratories.

Known as AviationSimNet, this standard is a flexible, reusable technical specification for conducting real-time air traffic management (ATM) simulations over the public Internet. Building upon proven simulation and communication standards like the Department of Defense's high-level architecture, DIS 1278.1a, and FAA and International Civil Aviation Organization (ICAO) standards, AviationSimNet reduces the time and cost of fielding new capabilities.

The AviationSimNet Specification Version 2.0 was made available to the public in August 2006, and continues to be expanded to meet needs identified by the AviationSimNet community. The publicly available AviationSimNet Federation Object Model was updated in September 2007 to include flight object, weather extensions, and additional simulation management capabilities.

Organizations participating in AviationSimNet include: the Air Line Pilot Association, The Boeing Corporation, the Center for Applied ATM Research at Embry-Riddle Aeronautical University, Lockheed Martin Transportation and Security Solutions, NASA's Ames Research Center and Langley Research Center, Raytheon, and United Parcel Service. In addition to building gateways that make their labs accessible via AviationSimNet, participating organizations are also hosting SimCenters, which are communications facilitators for the simulation environment that include labs at multiple organizations.

More information can be found at http://aviationsimnet.net/.

Clean Sheet Airspace Design Tools

Historically, airspace has been redesigned by air traffic controllers when they identify a problem, like a busy merge area with too much traffic to handle efficiently. Since many airspace design efforts cross facility boundaries, redesign can be costly and labor intensive processes, at times taking controllers away from directing air traffic for extended periods of time. Also, due to the size, complexity, and interconnectedness of the NAS, controllers' solutions to their local problems may have unintended ripple effects elsewhere in the system.

To make airspace redesign more efficient, CAASD has partnered with the FAA and developed a prototype set of Clean Sheet airspace design tools that offer a three-step, semi-automated process for airspace redesign. The term "clean sheet" is used because the tools are intended to wipe the slate clean of preconceived notions about airspace redesign and produce completely objective solutions. The tools are programmed to develop sector designs to service any user input traffic flow, regardless of existing sectors or control facility boundaries. Using objective, repeatable, and transparent methods, the tools allow faster, less expensive, and more efficient airspace redesigns.

The first step creates a map of geographically distributed traffic complexity (based on a specific set of metrics) in the area to be redesigned. Once a map is created, an automated airspace partitioner divides the airspace into areas of equal complexity. The target amount of complexity for each partition is adjustable and can be used to design sectors requiring up to three controllers. The second step in the Clean Sheet process uses fast-time, dynamic simulation to test the complexity regions and identify operational problems that controllers might have. The third step employs a knowledge database of airspace design principles and best practices captured from ATC experts to suggest solutions to the problems identified in the second step. Work continues to enhance the knowledge database and apply it more efficiently.

In 2007, this process was used to inform airspace design decisions in Florida, Chicago and New York. The results of these efforts are being incorporated into on-going design work in these critical regions of the NAS..

Integration of Advanced Simulation Technologies into Controller Training

Transformation toward NextGen will require significant improvements in the technologies and processes used to train controllers in the en route and terminal domains. The FAA is faced with the additional challenge of training approximately 12,000 new en route and terminal controllers over the next decade to fill the void of the air traffic controllers that are expected to retire during this timeframe. Currently, training and certifying a controller requires significant instructor resources and can take on average, three to five years in the en route domain, and over two years for many facilities in the terminal domain.

To improve controller training in terms of quality, effectiveness, cost to the FAA, and to prepare for evolutionary changes toward NextGen, advanced simulation technology for controller training is being developed and adapted by CAASD. Leveraging its accomplishments in aviation system concept exploration, prototype development, and field evaluations, CAASD has developed a stand-alone en route training simulation prototype, referred to as the "*enroute*Trainer"**.** A prototype is currently in use at the Indianapolis Air Route Traffic Control Center to valuate these advanced capabilities in an operational setting. With its high-fidelity, scenario-based instruction, the *enroute*Trainer provides students with a realistic practice environment, simulating the effect of winds, aircraft climb/descent rates, and aberrant conditions. The system**'**s speech recognition and synthesis capabilities simulate pilot/controller interaction, enabling self-paced training, and increased standardization. The *enroute*Trainer also simulates a variety of scenarios to familiarize the student with sector and area operations, procedures, and traffic patterns. The prototype enables the instructor to play back any trainee scenario to assess a student's performance and can generate reports on significant measures, including operational deviations and errors.

In FY 2007, CAASD continued the evaluation of the *enroute*Trainer at the Indianapolis center. A group of students were trained using this system as their primary tool during their final stage of radar simulation training (e.g., Stage IV) before beginning their on-the-job training with live traffic. The primary objective of this on-going field evaluation is to determine the set of validated simulation capabilities and training curriculum that can be integrated into the overall controller training process that will shorten training time, reduce the cost to certify a controller, improve the quality and consistency of training, and to enable a more effective transition of automation/ procedural advancements into operational use. A significant area of research in which CAASD is in the forefront is the development of Intelligent Tutoring Systems that will enable self-paced and accelerated training, and increased standardization, while reducing training staffing costs. This is viewed as a key enabler to support the evolution toward NextGen.

The first group of students completed their on-the-job-training in 50 percent less time than scheduled (with the acceleration attributed in part to improved realism) and achieved Certified Professional Controller status a full seven months ahead of schedule (about a 20 percent reduction in training time). CAASD is working with FAA to transfer this technology to industry for broad application across the FAA's training program.

In the terminal domain, CAASD is leading the development and assessment of new concepts for improving the delivery of critical ATC training information, and has developed an initial prototype that demonstrates the concept of use for airspace and procedures as well as enhanced simulation training. The objectives are similar to en route training: to shorten training time;

reduce the cost to certify a controller; improve the quality and consistency of training; and enable a more effective transition for the future.

Performance-Based Air Traffic Management: Validation Activities toward OEP/NextGen

Increases in air traffic volume and complexity, combined with projected budget constraints over the coming years, will create challenges for the U.S. air traffic management system. The safety, capacity, and productivity of the NAS can be significantly improved through the OEP by integrating enhanced automation technologies and procedures to enable operational demands on the NAS to be met efficiently and safely.

CAASD and the FAA have jointly developed an operational concept as a subset of the OEP evolution toward NextGen known as Performance-Based Air Traffic Management (P-ATM). The concept introduces fundamental shifts in the use of automation capabilities across the NAS in order to increase operational productivity while maintaining a human-centered operation. The path toward NextGen will require significant improvements in technologies as well as fundamental shifts in the roles and responsibilities of the users and service providers. CAASD has played a significant role in helping the FAA develop and validate operational capabilities for a subset of key OEP initiatives to support traffic demands and improve services over the next decade and beyond.

Under P-ATM, many routine ATC tasks will be automated. Terminal operations will leverage a network of highly precise Area Navigation/Required Navigation Performance (RNAV/RNP) routes. These routes would be designed to increase flexibility, efficiency, and capacity. Flight deck automation would enable aircraft to fly these routes and altitude profiles precisely while exchanging flight status and intent information with the ground system. In en route operations, responsibility for problem prediction would migrate from controllers to ground automation, and controllers would solve problems using automated resolution assistance. The integration of advanced automation with air/ground data communications would assist the controllers in accommodating pilot requests and providing more efficient maneuvers when resolving predicted conflicts.

The P-ATM concept provides for better management of uncertainty with capabilities that support enhanced decision-making and efficient execution of flight-specific initiatives. The reduction in execution time, along with improved tools for defining and monitoring the initiatives would allow for better flow planning and provide the opportunity to implement initiatives incrementally and only when necessary. In this highly predictable operational environment, user preferences would be better accommodated through collaborative ATM activities. The P-ATM portfolio of capabilities can provide vastly improved air traffic services that promote increased safety, capacity, efficiency, and operational productivity.

In FY 2007, CAASD designed and conducted numerous human-in-the-loop experiments of this future environment. These experiments evaluated specific operational conditions and traffic scenarios that extended previous experiments. FAA managers from across the country were the key participants for assessing both the quantitative benefits and operational feasibility of this P-ATM concept.

In addition, CAASD developed an evolution path toward this integrated set of capabilities, identifying incremental operational changes and capturing dependencies among the capabilities that will enable these operational changes. This evolution path will help the FAA in developing the detailed plans for achieving a subset of capabilities defined in the OEP. CAASD also conducted a preliminary safety analysis to identify potential safety concerns, influence the concept development as appropriate, and identify key research areas to address these concerns. CAASD has also begun identifying potential customer benefits that can be achieved with these operational changes.

The results of the work conducted thus far have a significant impact on the FAA's plans for NextGen. The P-ATM concept aligns very well with the core capabilities that are part of the NextGen vision, but also represents a set of operational changes that can be achieved in a more near-term timeframe. The P-ATM research and validation activities will continue to inform OEP activities for transforming air traffic operations toward NextGen and changing the controllers' roles and responsibilities to safely and efficiently meet the future demand on the NAS.

Estimating Runway Capacity at Complex Airports

An estimate of runway capacity can provide a key measure of the effectiveness of new technologies, procedures, and infrastructure intended to improve the ATC system. An accurate model for estimating runway capacity is a valuable tool for predicting the effects of new technologies on the system and for making decisions about building new runways. Accurately modeling runway capacity has become increasingly complex because today's environment consists of multiple decision support systems in the cockpit and on the ground, specialized separation rules for multiple approach and departure traffic streams, and interactions between nearby airports in major terminal areas.

To capture the dynamic effects of the interactions between traffic streams in runway capacity modeling, CAASD researchers developed a prototype simulation-based modeling system called *runway*Simulator. In less than an hour, a trained analyst can configure this system to simulate the traffic streams for a set of runways at a single airport, or a group of nearby airports, operating under any set of ATC separation techniques. The simulation presents its results both as numerical measures of throughput and as an animation of the aircraft traffic streams that produced the numbers. The modeling system captures statistics describing runway usage, interactions between the traffic streams, and flow rates. These results are categorized in a variety of ways, including by the particular aircraft types and runways being used. Together, the statistics and animation provide increased insight into the most efficient way to operate a complex system of runways.

The new *runway*Simulator provides important advantages over the Enhanced Airfield Capacity Model that is currently used to calculate estimated runway capacity. The older analytical steady-state model estimates the average maximum sustainable throughput for a limited set of configurations using predetermined separation rules. The new system also estimates the average maximum sustainable throughput, but it can model any configuration and any set of separation rules. In addition, being a simulation, it also captures the dynamic interaction between traffic flows and produces much more detailed output that permits greater insight into why an airport is limited to a given capacity. In FY 2007, the development team introduced the *runway*Simulator to the modeling experts within FAA. Together, they began a thorough evaluation of the model's capabilities to assess the potential effects of planned procedures, technologies, and infrastructure upon an airport's capacity.

Modeling Improvements to the National Airspace System

The performance of the NAS, commonly measured by flight delays and traffic loads on airports and airspace, depends on the complex interactions of airspace users, air traffic service providers, aviation infrastructure, and weather. Analysts use simulations to capture these complexities when estimating the effects of increased traffic volumes, new fleet mixes, alternative route structures, new runways, and improved technologies, procedures, and operational concepts on the NAS.

In 2007, CAASD, improved its new fast-time simulation capability, *systemwide*Modeler, which increases the fidelity and speed with which it can examine the future NAS. It simulates the progress of individual flights through airports, terminal areas, and en route sectors while modeling delays and workload caused by congestion and weather, airport capacities, and traffic management initiatives. Implemented in a state-of-the-art simulation language with a flexible architecture, *systemwide*Modeler simulates a day of NAS operations in tens of minutes and can report details for aggregate or focused analysis and visualization. It has already been used by CAASD to provide the FAA with an analysis of the FAA's Operational Evolution Partnership plans, to predict airports that will have capacity problems, and to inform analysis of data communications investments.,

The *systemwide*Modeler includes a unique model of controller workload for en route traffic that reflects the differences in work associated with different flight activities: merging and spacing flows, resolving conflicts, and managing climbing and descending traffic. Through its representation of traffic events and controller tasks, it goes beyond traditional traffic count-based models to help analysts understand the effects of new communications and automation technologies as well as new procedures and airspace design.

Operational Concept Validation 2007 Accomplishments

"Big Airspace" Study

The strain of increasing air traffic demand is especially apparent in the arrival and departure airspace surrounding major metropolitan areas, particularly those where there are multiple airports with interacting arrival and departure flows. A study called the Integrated Arrival/Departure Control Service, or "Big Airspace," was undertaken by the FAA in 2007 to develop and validate an operational concept for improving operational efficiencies in major metropolitan areas. The study was performed using a combination of procedures, such as integrating arrival and departure airspace into one control service and one facility as well as employing dynamic airspace reconfiguration of bi-directional arrival/departure routes.

To test the operational feasibility of Big Airspace, a series of simulation studies employing different techniques was conducted. The studies included fast-time system performance simulation, fast-time human performance simulation, and real-time human-in-the-loop simulation. Each technique had its own unique strengths, thus enabling a comprehensive evaluation of Big Airspace regarding its impact on efficiency, capacity, safety, and human performance. Using generic airspace as a platform for analysis, the simulation evaluations supported the BA concept. The studies also helped drive operational and technical requirements for further development of the concept by demonstrating service provider improvements and operational efficiencies. These benefits were evaluated in terms of workload, task performance, safety, and controller acceptance. Operational efficiencies include savings in flight time and distance flow with more efficient flow strategies. A preliminary cost-benefit analysis shows that all sites evaluated are expected to produce cost benefits with a short payback period with benefits rates ranging from 2.8 to 11.7.

Commercial Space Transportation 2007 Accomplishments

Safety Operations Personnel Duty and Rest Analysis

In 2007, the FAA developed rest and duty restrictions to ensure the safety of commercial space transportation. These regulations were based upon crew rest requirements imposed by the Air Force at federal launch ranges. The FAA, in cooperation with industry and other government agencies, commissioned Clemson University to review the scientific literature pertaining to crew rest and duty restrictions and provide recommendations for those involved in commercial space transportation. The goal of this effort was to improve commercial space transportation safety system by ensuring that ground support personnel and flight crewmembers have the opportunity to get the needed rest to safely perform their routine and emergency duties.

The study focused on sleep, circadian rhythms, stages of sleep, best time to sleep, effect of sleep disruptions, sleep requirements, countermeasures to fatigue and insomnia, shift-work, shift-work scheduling tools, and current aviation and space flight crew rest and duty time requirements. The study found the following: although all sleep is beneficial, slow wave sleep is more recuperative; the best time to sleep is during the circadian trough (between 22:00 and 08:00); interruptions of nighttime core sleep reduce sleep quality and effectiveness; individuals need roughly eight hours of sleep to be properly refreshed; and sleep loss is cumulative and may take multiple nights of sleep to fully recover. The study also provided recommendations for managing commercial space transportation crew duty and rest.

Human Space Flight Training Preparation Study

The recent development of commercial launch vehicles designed to carry humans has created a need by the FAA to determine if space flight crews meet training requirements that ensure the safety of the crew and the uninvolved public.

In 2007, the Commercial Space Flight Launch and Reentry Vehicle Pilot Training Survey was developed to help the FAA understand the opportunities available in critical aviation and space flight training fields, by supplying profiles of training providers as well as a final report that summarizes the survey.

The following disciplines where surveyed:

- physiological training;
- high-performance jets;
- high-performance gliders;
- altitude chamber (hypobaric and hyperbaric);
- parachute training;
- unusual attitude training;
- high-altitude flight;
- high-g (gravity);
- low-g (gravity);
- pressure suit training;
- flight simulation; and
- spaceflight operations.

Each profile included the following items:

- list of the training area(s) that the organization provides;
- contact information;
- description of the training course(s);

- brief background and professional training experience of the organization;
- description of the equipment and facilities that the provider owns or uses to conduct the applicable training; and
- data on the cost of the training offered.

Historical Database of Failures & Reliability of Rocket-powered Vehicles

In 2007, at the suggestion of the of the Commercial Space Transportation Advisory Committee Reusable Launch Vehicles Working Group, a database review of historic failure modes of rocket powered vehicles (both expendable and reusable) using open source literature was conducted. The ultimate goal is to provide the emerging commercial space transportation industry with insight into which components of rocket powered vehicles fail and why.

In this database, the definition of “failure” draws from a clause in the FAA Office of Commercial Space Transportation *Guide to Probability of Failure Analysis for New Expendable Launch Vehicles*, specifically: “an in-flight failure occurs when a launch vehicle does not complete any phase of normal flight.” This definition excludes failures where a vehicle’s lower stages had already placed the spacecraft in orbit, such as the failure of an apogee kick motor attached to a satellite that had already been placed in a transfer orbit by the lower stages of its launcher.

The study progressed in two phases: first for all U.S. and foreign expendable-launch vehicles over the last 50 years (e.g., Atlas) and followed by rocket-powered aircraft (e.g., X-15). For the 255 expendable launches for which a failure reason could be determined during the 1957-2007 period, propulsion anomalies were found to be the salient failure mode (51 percent) with guidance and navigation as the next leading cause of failure (20 percent). Upon review of the 142 launch failures with known causes that have occurred since 1980, propulsion anomalies remain the salient failure mode at 54 percent, guidance and navigation remains the next leading cause of failure although it has dropped significantly to 12 percent, and software and computing-related failures is growing and has become significant at 9 percent. The database for rocket powered aircraft has been completed but is still under review and will be finalized in FY2008.

Environment and Energy 2007 Accomplishments

Developing Analytical Tools for Effective, Comprehensive Noise and Emission Mitigation

The FAA, in collaboration with Transport Canada and NASA, is working with an international team of researchers to develop a comprehensive suite of software tools. In 2007, the FAA demonstrated capabilities that included incorporating the latest aviation noise/emission science, aircraft technology forecasting, and cost analyses of environmental impacts for aviation. These new capabilities are the cornerstone of a new comprehensive approach to assessing environmental policies that help guide policies and actions that annually cost the FAA $500 million in mitigation expenses and industry between $5 billion and $6 billion in implementation expenses.

Policy, Analysis, and the Aviation Environmental Design Tool

During 2007, the Aviation Environmental Design Tool (AEDT) was used to support several domestic and international initiatives at both the regulatory and policy levels. In support of the ICAO's Committee of Aviation Environmental Protection, AEDT was the centerpiece of an exercise that was designed to assess the tool's readiness for conducting a policy analysis for various nitrogen oxide (NOx) stringency scenarios. Researchers integrated common modules and databases as well as implemented many concepts of the overall AEDT architecture to develop worldwide estimates of fuel burn, emissions, and noise. The effort included a comparison of AEDT with other international environmental tools and analysis of reduced NOx limits, also called "NOx stringency" in the years of 2012 and 2016 at reduced levels of 0 percent (no stringency), 6.5 percent, and 18 percent. The use of an integrated tools suite, including the economic analysis capability in the Aviation Environmental Portfolio Management Tool (APMT), demonstrated the unique capabilities of the FAA's tools, such as the ability to investigate noise and emissions interdependencies to better inform policymakers. Model outputs compared very favorably with the other tools exercised and AEDT was the only tool to provide global fuel burn, emissions, and noise results.

In 2007 AEDT was also used in the analysis of Continuous Descent Arrivals (CDA) at a major U.S. airport. A total of nine modeling scenarios were generated to investigate the fuel burn, emissions, and noise benefits of CDA implementation. The scenarios were generated using historic trajectory information based on actual radar data for the baseline arrivals and with optimal vertical components for the CDAs , directly linking model results to actual operations. Previous modeling efforts quantified only one environmental effect due to a single or handful of events; AEDT provided comprehensive results, at a level of detail typical of that required by a National Environmental Policy Act analysis.

Development efforts in 2007 included initiation of the integration of AEDT with databases that support the Joint Planning and Development Office's vision for NextGen. This work involved updating AEDT modules and databases to work directly with the NASA Airspace Conflict Evaluation Simulator (ACES) tool. Full integration of ACES and AEDT will allow for streamlined and consistent analysis of aviation environmental issues during the design of NextGen.

The AEDT development team, led by the FAA with support from the U.S. Department of Transportation's Volpe Center and industry ,initiated a design review group, consisting of both aviation noise and emissions experts to help guide the development of the tool. The review group, assembled from members of the existing Emissions and Dispersion Modeling System (EDMS) and Integrated Noise Model (INM) review groups, will be integral to ensuring stakeholder interests are met throughout the AEDT development process. AEDT connectivity with APMT and the Environmental Design Space (EDS) was substantially advanced during 2007. For example, development and use of the Flight Operations Module was carefully coordinated between the AEDT and APMT development teams. Significant efforts were also undertaken to ensure that the AEDT Fleet Database meets all the needs of AEDT, APMT and EDS. This is especially important to ensure consistent use of assumptions across environmental modeling (e.g., AEDT), implementation of technology assumptions (e.g., EDS) and exercise of policy scenarios, especially the potential economic and human impacts (e.g., APMT).

Predicting Scenarios and the Environmental Design Space Tool

EDS estimates source noise, exhaust emissions, performance, and economic parameters for aircraft designs under different technological, policy, and market scenarios. These capabilities allow for assessments of interdependencies between aviation-related noise and emissions effects. In 2007, the EDS Technical Advisory Board, initially formed to guide development and facilitate industry review of EDS, was expanded to allow for a more thorough assessment of EDS processes and assumptions, including model components and structure, and model capabilities in predicting aircraft noise and emissions levels relative to appropriate validation data. The new EDS Independent Review Group (IRG) brings together industry experts to review specific details of the model in the areas of engine performance, aircraft performance, noise, and emissions. The IRG also includes members of various research establishments to provide a level of independent review. The IRG currently includes representatives of the aircraft and engine manufacturing industry, the EDS development team, NASA, the FAA, and several European research organizations.

The EDS development team continued a rigorous assessment of EDS in 2007 through close collaboration with engine and airframe manufacturers. A key result of this assessment was an update to the fundamental architecture of EDS from a single point to a multiple point design for the engine based on airframe thrust requirements. The multiple point design approach is more consistent with current industry practice. The update to the EDS architecture for the 300 passenger class vehicle has been completed and is in review by the IRG. The EDS development team also working with the IRG to assess the sensitivity and uncertainty of EDS input parameters and results. This will enable the accuracy of the EDS tool to be better understood and will also highlight EDS components in need of improvement.

EDS connectivity with both AEDT and APMT was established and demonstrated through a sample exercise designed to assess the readiness of the environmental tool suite for conducting a policy analysis for various NOx stringency scenarios. In support of the ICAO's Committee of Aviation Environmental Protection's Modeling and Database Task Force, EDS provided the technology response to a potential NOx stringency in years 2012 and 2016, including proposed stringency levels of 0 percent (no stringency), 6.5 percent, and 18 percent. EDS provided future aircraft designs that could be potentially introduced to the fleet in response to proposed NOx stringency levels.

Aviation Environmental Portfolio Management Tool

Historically, aviation environmental modeling tools generated either noise or emissions outputs, after which the costs to implement a policy were considered against a single environmental performance indicator (e.g., NOx emitted). Subsequent advances on common databases and inputs have highlighted the need to better consider noise, local air quality, fuel burn, and greenhouse gas emissions interdependencies and to monetize costs and benefits. The FAA is developing a comprehensive suite of software tools that will allow for thorough assessment of the environmental effects of aviation. The main goal of the effort is to develop a new capability to assess the interdependencies between aviation-related noise and emissions effects, and to provide comprehensive impact, and cost and benefit analyses of aviation environmental policy options. The impact and economic analysis function of this suite of software tools has been given the rubric APMT.

The design requirements for APMT are built on the efforts of previous aviation environmental economic analysis tools, as well as projected international and domestic analysis needs and best practice guidance. The resulting architecture of APMT takes aviation demand and policy scenarios as inputs, and simulates the behavior of aviation producers and consumers in order to evaluate policy costs. Detailed operational modeling of the air transportation system within AEDT provides estimates of the emissions inventories and noise exposure. Then, a benefits valuation module within APMT is used to estimate the health and welfare impacts of aviation noise, local air quality and climate effects, using a variety of metrics. These metrics include monetary estimates of the value for these changes in environmental quality.

In 2007, several critical APMT capabilities were demonstrated. At the start of the year a workshop for the Transportation Research Board was held to brief the results of initial testing of the APMT prototype functionality for addressing various policy questions, as well as assessment and propagation of uncertainties. Lessons learned from the initial prototype testing effort influenced design modifications that led to APMT version 1.

Releasing Integrated Noise Model (INM) Version 7.0

As the last major version release before its full integration into the AEDT, INM Version 7.0 represents a significant improvement over the INM 6 series as the FAA’s current standard tool for predicting noise impact in the vicinity of airports. In addition to several updates related to aircraft noise/performance for commercial aircraft, Version 7.0 includes detailed modeling of helicopter noise based on the FAA’s Heliport Noise Model Version 2.2, and algorithms consistent with updated guidance documents, including the European Civil Aviation Conference (ECAC) Doc 29 (3rd Edition) “Report on Standard Method of Computing Noise Contours around Civil Airports.”

INM Version 7.0 includes the following new operational and computational features:

- improved helicopter noise modeling capabilities;
- compliance with ECAC Doc 29, the European standard;
- scenario-case format;
- new multi-threaded run mode; and
- graphical user interface changes.

INM 7.0 provides much more accurate noise modeling capability to the over 1,000 users of INM worldwide.

Emissions and Dispersion Modeling

Version 5.0 of EDMS was released by the FAA as the last stand-alone in the series before EDMS becomes the local air quality module within the AEDT. The major enhancements to EDMS 5.0 represent the important steps toward integration of noise and emissions assessment capabilities. A dynamic flight profile generator, common to noise assessments, has been incorporated using the best available methodologies and aircraft performance data from the Society of Automotive Engineers, Boeing Fuel Flow Methods, and EUROCONTROL’s Base of Aircraft Data. In addition, common airport and aircraft fleet databases from FAA’s other environmental models, including INM, System for Assessing Aviation's Global Emissions (SAGE), and Model for Assessing Global Exposure to the Noise of Transport Aircraft (MAGENTA) provides harmonization for interdependency tradeoff analyses performed on the global, regional, and single airport scales.

At the request of expert EDMS users, several new sophisticated features have been incorporated into EDMS 5.0 to improve the fidelity of airport activity and accuracy of emissions estimates, which will become the cornerstone capabilities for AEDT in the future. An enhanced airport configurations function now allows the user to model aircraft operations consistent with actual airport procedures by matching runway use with wind speed and direction. The model can now accept aircraft schedules to separate arrivals and departures as well as enable the user to route aircraft on unique taxi paths, which facilitates the use of an improved aircraft queuing model to improve the accuracy of aircraft ground emissions calculations. For the first time, EDMS 5.0 calculates start-up emissions from aircraft engines. EDMS 5.0 incorporates the latest advances in the First Order Approximation method to predict particulate matter (PM) emissions from aircraft engines. Fleet coverage has been expanded by over 220 new aircraft and 65 new engines.

Modeling and Analysis of Aviation Emissions Impact

With the projected demand for aviation expected to grow, aviation emissions and associated environmental impacts contributing to climate effects will consequently increase. Although at present, aircraft emissions are a very minor contributor to overall emissions, relative magnitude of aircraft emissions is expected to increase, owing to generally decreasing emissions from non-aviation sources.

With environmental factors identified as a major constraint of the NextGen, the Joint Planning and Development Office (JPDO) has developed an integrated plan for implementation that calls for development of environmental protection by 2025 that allows for sustained aviation growth. In particular, one of the NextGen objectives is to reduce uncertainties for aviation-induced climate impacts to a level that would enable appropriate actions to address them.

With this stated objective, the FAA and NASA, as participating federal agencies to the JPDO, co-sponsored an international workshop on the Impacts of Aviation on Climate Change in June 2006 to assess and document the current state of scientific knowledge, identify key uncertainties and gaps, and make recommendations on how to address them. One consensus finding is the acknowledged need for focused research efforts to address identified uncertainties and gaps in the understanding of current and projected impacts of aviation on climate and to develop metrics to characterize these impacts. The workshop report is available at: http://web.mit.edu/aeroastro/partner/reports/climatewrksp-rpt-0806.pdf.

Following the workshop recommendation, with the support from the U.S. Climate Change Science Program, in 2007 the FAA and NASA have jointly developed the Aviation-Climate Change Research Initiative (ACCRI) with the objective to improve the state of scientific knowledge through research while making the best practical use of available science and modeling capability to update and refine the magnitudes of climate impacts of aviation. From the policy perspectives, another key objective of ACCRI is to identify and develop metrics for aviation-induced climate impacts at all relevant spatial and temporal scales.

The overall structure of ACCRI is based on a sequential, four-step process with the vision that outcomes of the prior steps will guide the direction and expectations to the next step. The timelines to implement various steps of ACCRI and their expected outcomes are designed in a way that they will provide timely intermediate input toward scoping and implementation of subsequent steps while scientifically informing policy-making decisions for NextGen and the ICAO Committee on Aviation Environmental Protection. The four key steps of ACCRI are as follows: 1) develop white papers to provide in-depth reviews of the scientific understanding and key uncertainties as well as assessment of current modeling capability in seven thematic areas that are considered to be critical in understanding climate impacts of aviation; 2) convene a meeting of scientific experts to develop community consensus on composite findings of these white papers, develop pathways for research to address key gaps, develop recommendations for practical application of multiple-state-of-the-science models to simulate a number of emission scenarios that develop a range of climate impact estimates, and quantify underlying levels of uncertainties. Recommendations for practical applications and research gaps identified under Step 2 will be implemented in parallel under steps 3 and 4 respectively. Outcomes from steps 3 and 4 will provide guidance to each other for future work. Activities under step 3 will be repeated as scientific understanding improves through research activities under step 4.

With support from the FAA, ACCRI has implemented the first step, identifying seven thematic scientific areas that are considered to be critical for quantifying aviation related climate impacts and has solicited proposals from the science community. All seven in-depth review white papers under step 1 will be delivered in early FY 2008 and the science meeting under step 2 will be held early calendar 2008. Activities under steps 3 and 4 will initiate during 2008-2009.

Atmospheric impacts of aviation are most visible through the formation of contrails and induced cirrus clouds at the cruise altitude. Climate impacts associated with contrails and cirrus clouds are difficult to quantify. Over the last several years, the FAA has funded key research activities in this area. In particular, the FAA funded a modeling project with the objective of simulation of contrails and induced cirrus clouds and quantification of their associated radiative and climate impacts on the global scale within the same modeling framework, with a particular focus on the US regional domain.

Aviation Emissions and Air Quality: Air Quality and Health Impact Analysis

In preparation for meeting the projected growth in aviation, airports around the nation are considering expansion plans. At the same time, concerns are increasing about how, and to what extent, air pollutant emissions from airports contribute to local and regional air quality, and hence to potential health impacts. Airports are frequently asked, during the environmental impact study, to estimate the direct emissions of criteria and hazardous air pollutants (HAPs) from all airport sources and their potential environmental impacts. There is no consistent framework for emissions and impact analysis available that airports could employ to support their decision making. One of the key environmental protection goals of the NextGen vision is to reduce the air quality impacts of aviation emissions in absolute terms, regardless of the anticipated growth in air traffic. Therefore, to inform policy making decisions and to support environmentally conscious airport expansion plans, there is a need to understand the magnitude of incremental environmental impacts due to current and projected airport emission sources and its comparison against the changing background air quality.

Analysis of environmental impacts of air pollutant emissions goes beyond merely analyzing the magnitude of direct emissions, because these emissions undergo atmospheric evolution during their dispersion and give rise to formation of other secondary pollutants, such as ozone and PM. The FAA is undertaking a number of initiatives on both air quality modeling and measurement fronts to better characterize the airport level emissions and their potential impacts on air quality and public health.

As an example of one of these initiatives, the Energy Policy Act of 2005 requires that FAA and EPA consider the impacts of air quality and public health in assessing opportunities to enhance fuel efficiencies and reduce emissions. In response, researchers have used current models and inventories to estimate aircraft emissions at 325 airports, many of which are located in air quality non-attainment areas. These estimates are now being used to characterize the impact of aircraft operations on local air quality and their subsequent health impacts.

Recently, the Airport Cooperative Research Program (ACRP) has recognized the need to pursue airport-related air quality research activities. The ACRP is funded by FAA funded and managed by the Transportation Research Board. Currently, the ACRP is funding a number of research projects for better characterization of airport emissions for PM and HAPs.

On the modeling front, the FAA research efforts include sub-scale dispersion simulations encompassing regions within the airport vicinity and larger multi-scale grid resolution based air quality modeling and analysis for both criteria and HAPs. In addition, the FAA is pursuing analysis of air quality measurements specific to airport emissions as well as community-based monitoring of air pollutant concentrations within the airport vicinity. This fine-scale ambient monitoring of air pollutants is essential to characterize their concentration gradients particularly from the health impact analysis point of view. Consistent air quality analysis through model simulations and measurements for the same period and ambient conditions helps to guide the need for further improvements and establishes the confidence in the models and analysis that can be applied to other airports and conditions. This type of comparative analysis also helps with interpretation of results from the source attribution studies. The results from these stated air quality analysis projects directly feed into the exposure and health risk analysis specific to airport emissions that the FAA is pursuing through the Harvard School of Public Health.

Aircraft Emissions Characterization Roadmap

A recent review of updated data reveals significant new information on the behavior of pollutants, especially PM and the inclusion of hydrocarbon species, often called HAPs, which are not unique to aircraft engine emissions. Regardless, HAPs are a growing concern associated with airport development activities. The FAA is addressing this and other concerns with efforts that include measurement methodologies, database development, and analytical procedures for compilation of inventories to establish a knowledge-base that properly quantifies these emissions.

The data collected thus far seems to confirm scientific theories on the relationship among pollutants, the emissions levels, and characteristics at different engine power settings. The Society of Automotive Engineers is using this research to develop important new Aerospace Recommended Practices. These recommendations will help in selecting the proper instruments and measurement methodologies for quantifying levels of PM emitted from commercial as well as military aircraft engines. This work is nationally coordinated under the FAA- sponsored Aircraft Emissions Characterization (AEC) Roadmap. The AEC Roadmap serves as a foundation for promoting research coordination and collaboration to understand particulate matter (PM) and HAP emissions from aviation. It defines work plans to conduct needed research resulting in knowledge that can inform policy decisions. Close coordination of all aviation related HAP and PM emissions research activities is the primary goal of the AEC Roadmap to establish a sound basis for decision-making relative to domestic compliance and internationally relative to standard setting, particularly those activities being undertaken by the ICAO Committee of Aviation Environmental Protection.

Comparative Emissions Database

The FAA and the U.S. Department of Transportation's Center for Climate Change and Environmental Forecasting (CCCEF) jointly funded an effort to create a comparative emissions database. Researchers collected emissions data from a wide variety of transportation sources using multiple research-grade instruments that measured gaseous and particle emissions in a number of focused field studies. These datasets represented state-of-the-art measurements that continue to provide insights into specific transportation-related issues, such as PM formation mechanisms and chemical speciation of particulate emissions. Aerodyne compiled and compared these unique datasets from aviation, heavy-duty diesel, automobile, and marine vehicles for key emissions characteristics.

Emission indices were obtained for the following: NOx; carbon monoxide; specific hydrocarbon species; and particulate mass, number, and chemical composition. The resulting reduced data and analysis of the similarities and differences across transportation modes were included in a final report and a presentation of results to the FAA and the CCCEF. The final report focused on how the analyzed data could be added to existing emissions inventories for the respective transportation modes and used in quantifying contributions to local and regional air quality and, especially, global climate change. The work provided a foundation that will allow for more informed decisions concerning mitigation of the environmental impact of various transportation sectors in a manner that maximizes impact while minimizing cost.

PARTNER Turns Four

The PARTNER Center of Excellence, established in 2003 by the FAA, in collaboration with Transport Canada and NASA, turned four and entered its second phase in 2007. Originally comprising eight universities, the second phase PARTNER consists of lead university, Massachusetts Institute of Technology and the following members: Boise State University, Georgia Institute of Technology, Harvard University, University of North Carolina, Pennsylvania State University, Purdue University, Stanford University, University of Missouri-Rolla, and York University in Canada. With 50 advisory board members, PARTNER brings academia, industry, and government into one organization to promote and sponsor advancements that enhance mobility, economy, national security, and the environment.

One of PARTNER’s strategic growth areas is international collaboration. PARTNER has established collaboration with Omega, a group of nine universities formed in 2006 by the British government to help the aviation industry meet the environmental challenge. Through PARTNER, the FAA and the United Kingdom are working together to establish collaborative efforts on several fronts, including modeling, measurements, alternative fuels, and economic assessment. This collaboration will enable a greater ability to share knowledge, and foster a common commitment to the mutual goals of PARTNER and Omega.

PARTNER is also contributing to fostering the next generation of scientists who will tackle aviation environmental effects. The PARTNER Joseph A. Hartman Student Paper Competition is a prime example. This competition captures the best technical solutions, economic analyses, methodologies, and processes that work towards reducing aviation noise and emissions exposure through source reduction technologies, noise abatement operating procedures, compatible land use management, and airport operational control measures. At the March 2007 PARTNER Advisory Board meeting in Cincinnati, Ohio, two first place winners were honored for their accomplishment. Dr. Liling Ren, whose paper won First Place Graduate Paper Award in 2007, and Daniel Robinson, who took the First Place Graduate Paper Award in 2006, presented their work. This type of effort demonstrates PARTNER’s commitment to furthering research in sustainable aviation by all of academia.

In 2007, PARTNER was awarded the ‘Best Innovation’ in Airlines Operations Research award by the Airline Group of the International Federation of Operational Research Societies for a paper presented at the organization’s annual symposium in Rome in October 2006. The paper, “Continuous Descent Arrivals: Flight Procedures that Reduce Fuel Burn,” was based on PARTNER research. CDAs are proving to be a highly effective and efficient way to reduce emissions and mitigate aviation noise effects on local communities. Both the economic and environmental advantages of CDA offer it as a way forward in sustainable aviation and PARTNER is leading the way. The delegates to the symposium, representing airlines from around the world, believed that the paper possessed the attributes that best contribute the technical development and deployment of an original idea.

Whether it’s investigating alternative fuels, environmental impacts, noise mitigation, or aiding industry research, PARTNER remains an integral element in effecting a safer, cleaner, more viable aviation for tomorrow.

Understanding Low Frequency Noise

While the level of aviation-associated noise that individuals can tolerate seems variable and personally determined, researchers need a generic, scientifically-based metric to assess the effects of aircraft noise on humans. In its search for such a metric, the FAA funded the Partnership for AiR Transportation Noise and Emissions Reduction (PARTNER), an FAA-Transport Canada-

NASA sponsored Center of Excellence, to study low frequency noise. The resulting study encompasses factors such as noise source level and spectrum, atmospheric propagation, and the impact on homes in the form of noise, vibration, and rattle.

In 2007 researchers conducted laboratory-based psycho-acoustic testing of human subjects using noise signatures recorded indoors at Washington Dulles International Airport in 2004 for subjective assessment of annoyance. Several variations of recorded signatures were designed with different target frequency ranges using a synthesis process. The recorded signatures and their variations having different levels of low-frequency noise were reproduced in a simulator and then the subjects were asked to rate the signatures for annoyance. Subjective judgments were statistically analyzed and compared between each signature and within each signature set against commonly used objective metrics. Results show that all other things being equal, higher levels of low-frequency content in aircraft noise can result in increased annoyance in subjects and that the C-weighted sound exposure level correlated with this annoyance response.

The results of the four-year study were documented in a PARTNER report. It confirmed that levels of low-frequency noise at houses within a few thousand feet of runways can be high enough to exceed previously establish criteria. The report includes subjective evaluations to determine the numbers and types of sound characteristics that are important, how they factor into noise annoyance, and the ability of metric calculations to predict their actual physical, as distinguished from perceived, impact. It also recommends a method of assessing the potential for a given location to have a low-frequency noise problem. The report also has practical recommendations on how to avoid onset of rattle.

Mitigating Sonic Boom

In April 2005, the FAA and NASA, through PARTNER, initiated a project on Sonic Boom Mitigation research to better understand sonic boom impacts. Pennsylvania State University and Purdue University are leading the project team. The team's long-term objectives are to aid the FAA in determining the following: what noise levels or waveforms are acceptable; whether low-annoyance waveforms remain low-annoyance after propagating through atmospheric turbulence or weather; and how to design and operate small supersonic jets so the noise levels are acceptable. During the first year, researchers designed and conducted two sets of tests to compare the realism of three existing sonic boom simulators. The tests surveyed existing sonic boom simulators to compare their abilities to reproduce sonic boom sounds and began to assess human opinions of the simulated sounds. After evaluating the tests results, researchers confirmed the existing sonic boom simulators agree and compare well to the sound of real sonic booms.

In 2007, the researchers focused on low-boom subjective testing. Researchers developed a method for generating atmospheric turbulence effects into sonic boom waveforms that are needed for subjective testing. Four project industry partners supplied signatures representing predictions of low booms based on models. The predicted low booms included waveforms types and modifications: cruise booms, acceleration booms, multi-shocks, N-waves, and variations based on different relative humidity conditions. The researchers were able to produce low-boom sonic boom waveforms including turbulence of sufficient quality for subjective testing.

Researchers carried out subjective tests using low-boom sonic booms to assess annoyance in comparison to blasts and thunder. In May 2007, the researchers conducted this test using one of the existing sonic boom simulators. A comprehensive experiment used test subjects to rate annoyance or acceptability. Research to date has confirmed that existing sonic boom simulators compare well to the sound of real sonic booms; established lexicons and vocabularies for the description of low-boom sonic booms; determined the relative loudness and annoyance of low-boom sonic booms compared to other man-made and naturally occurring transient sounds; and developed preliminary improved metric(s) for the loudness and annoyance of low-boom sonic booms. This work is a critical step toward enabling supersonic aircraft.

Alternative Fuels for Aviation

Interest in alternative fuels for commercial aviation has grown in tandem with concerns about rising fuel costs, energy supply security, and the environmental effects of aviation. At the moment, the largest single driver for industry development and adoption of alternative fuels is the high cost of petroleum. High world oil prices encourage the development of alternative sources of aviation fuel. However, the possibility of disruptions in oil supplies and possible environmental benefits are also powerful drivers. Exploring the potential move to alternative aviation fuels makes sense for a variety of reasons.

The FAA, together with U.S. industry, launched the Commercial Aviation Alternative Fuels Initiative (CAAFI) to develop a national roadmap for assessing, developing and possibly adopting, alternative aviation fuels. In less than two years CAAFI has developed into a forum focusing the alternative fuel efforts of the U.S commercial aviation supply chain and enabling all of the leading aviation stakeholders to share and collect needed data and motivate and direct research and development. Early lessons from CAAFI include: the airlines are interested in the possible savings and price stability offered by alternative fuels; the fuels industry is willing to produce these fuels if there is a viable market for them; and the aviation industry may be able to use alternative fuels to deal with some local air quality and/or global climate issues. CAAFI is demonstrating that the aviation community is able to work in a coordinated fashion to attract the attention of fuel suppliers. Thus, alternative fuels efforts may offer opportunities to achieve balanced and robust strategies to mitigate aviation’s environmental impact and improve aviation economics.

Although alternative fuels may offer environmental benefits, it is important to take into account life-cycle effects when making such an assessment, including feedstock production, fuel conversion, delivery and combustion in the analysis. Initial studies show, for example, that synthetic fuel from coal, after burning in an engine and in the absence of carbon sequestration, would have produced approximately twice as much carbon dioxide than similar fuel derived from crude oil. This type of study underscores the need for development of biomass derived fuels that can offset some or all of the carbon dioxide from production and operations. It is also important to understand the environmental impacts of fuel combustion including the impacts of fuel composition on: aircraft operating capability, aircraft fuel consumption, greenhouse gas emissions, and criteria pollutants that affect local air quality around airports.

There are also reasons for caution with respect to the prospects for alternative fuels for commercial aviation. It remains to be seen what technical difficulties may be encountered even with so-called “drop in” fuels. Slight differences in fuel composition can have a significant effect on operations over time, and there is a constant need to ensure the safety of operations. Consumption of fuel by ground transport is significantly greater than aviation fuel consumption and ground transport has considerably more experience and flexibility in alternative fuel use (e.g., ethanol and liquefied natural gas). Ground-based vehicles may compete with aviation for initial application of cleaner alternative fuels. Additionally, while oil prices have risen to one hundred dollars a barrel in 2007, the risk of a drop in oil prices is real and would remove one of the major incentives for the further development of alternative fuels. Finally the emission of carbon dioxide during the production process may be a problem with some alternative fuels.

PARTNER investigators, together with industry, completed a landmark study of alternative fuels by addressing the technical feasibility, identifying the drivers for adoption, identifying the necessary ground infrastructure to support transition, and determining what measures might be needed to promote alternative fuels. The study also began the work of defining the life cycle environmental and local air quality benefits of various fuel options. The study concluded that alternative fuels now exist that could reduce greenhouse gases and improve local air quality, but at present the ability to produce these fuels is limited and the costs of production are high. Further research and development is needed to make these promising fuels a reality.

Introduction of Continuous Descent Arrival (CDA) Procedure at Los Angeles International Airport and Related Activities

A PARTNER research team, led by representatives of the Georgia Institute of Technology – with collaborating FAA, NASA, and aviation industry members – is seeing the fruits of their labor with the first publicly-charted CDA procedure going into operation at Los Angeles International Airport in December 2007. The CDA and conventional arrivals are both enhanced due to optimized aircraft separation criteria that address the broader mix of fleet traffic types.

The PARTNER team has been advancing the design, demonstration, and provisional use of CDA aircraft flight procedures within the national airspace system. CDAs provide advantages over current arrival patterns by reducing ground noise along much of the flight path, as well as saving time and fuel. The research team continues to study the development of operational procedures, including surface management concepts, where environmental benefits can be effectively incorporated.

Similarly at Louisville International Airport, further enhancements by United Parcel Service of their initially demonstrated CDA profile are being supplemented with en route speed guidance for full-mission performance efficiency and ADS-B/GPS digital flight bag avionics for pilot situational awareness that tests the ability to maintain (cockpit) self-separation.

At Atlanta Hartsfield airport, PARTNER researchers also completed CDA flight demonstrations with Delta airlines for adapting CDA for the significant use of downwind-based and final-leg traffic patterns. Environmental demonstrations applying CDA procedures at airports with some capacity margin offer the greatest potential window of opportunity.

International Aviation Interoperability for the Environment (AIRE) is on the Horizon

During the 2007 Paris Air show, the FAA and the Vice President and Transport Minister of the European Commission announced the creation of the Aviation Interoperability Initiative to Reduce Emissions (AIRE) Partnership to work closely to: (1) hasten development of operational procedures to reduce aviation's environmental footprint for all phases of flight; (2) accelerate world-wide interoperability of environmentally-friendly procedures and standards; (3) capitalize on existing technology and best practices; and (4) provide a systematic approach to ensure appropriate mitigation actions with short, medium and long-term results.

Simply put, the FAA and European authorities would seek enhanced ATM interoperability, improved energy efficiency, reduced engine emissions, and lower aircraft noise. As such, AIRE partnership objectives include taking advantage of new technologies and air traffic procedures that offer the most immediate, near-term fuel consumption and emission reduction benefits. The FAA is also moving swiftly to establish partnerships and define the plan to begin tracking AIRE progress for major operations such as oceanic, surface, and terminal/en route. The FAA is also accelerating the programming of its AEDT to support the technical demonstration projects involved in AIRE.

Human Factors Research 2007 Accomplishments

Improving the Air Traffic Controller Experience

Performance Standards: Performance standards for the ATC occupations in tower, terminal radar approach control, and en route facilities were developed as part of the workforce training initiative in response to the large turnover of air traffic controllers. The objective of this effort was to support the Air Traffic Control Optimum Training Solution (ATCOTS) procurement by developing performance standards for each controller station. This work included a thorough job/task analysis of the three controller occupations. The FAA also conducted a series of standard setting workshops with current controllers to determine the performance standards for each station, developed corresponding proficiency level descriptors for each standard, and compiled this information into a performance requirements framework. In addition to supporting ATCOTS, this work provides an update to analyses that are used in selection and training applications for all three controller stations.

Structured Interviews: A structured interview process was developed for use in examining ATC Specialist applicants. Interviews are conducted by facility managers after a centralized selection panel has made a tentative job offer. The interview is used to make a placement decision, based on past experience, and to assess candidate suitability for the job. The interview process is now operational. Follow-up will occur to determine if the process is being used properly.

Vision Test: A prototype job-related color vision test was developed for selection of controllers who will utilize color graphical displays. Applicants must fail both the standardized and job-specific color vision tests before the decision is made that they will be unable to perform the job. Initial validation of the color vision test was promising; additional validation data are currently being collected.

Life Experience: A biographical inventory called the Life Experiences Questionnaire (LEQ) was developed by human factors researchers. The purpose of the LEQ is to identify candidates who are likely to pass the Air Traffic Selection and Training (AT-SAT) battery so they can be targeted to take AT-SAT. As the cost of taking AT-SAT is about $800 per person, it is cost-prohibitive to allow all who expresses interest to take the test. Prior to implementation of the LEQ, candidates were randomly selected to take AT-SAT, so use of the LEQ improved the selection process.

Improving Pilot Performance

*Pilot Visual Approaches***:** Because of the current pilot shortage, air carriers are faced with training low-time pilots for jet operations. This raises the potential for safety vulnerability in operations, an issue that was raised by regional airlines. In response to these concerns, FAA researchers developed training and assessment strategies to assure effective performance on visual approaches in aircraft with this pilot population. The results of this study will be applicable industry-wide. Researchers also collected preliminary data from instructor and evaluator line check airmen to determine the current state of training and what methods work and don’t work. Research continues to develop new training and assessment methods.

Pilot Automation Training: In an attempt to validate the FAA’s programmatic approach to air carrier automation training, human factors researchers met with all major air carrier training organizations to collect data on their views of the current state of automation training problems. FAA researchers have developed a survey that will be administered to all training managers and flight operations managers in early FY 2008. The data will allow human factors researchers to address the most important automation issues from an industry perspective. This will be accomplished through research or training design, whichever is deemed appropriate.

Color Vision Requirements for Pilots: Researchers collected altitude chamber data to assess the effects of mild hypoxia on color vision and performance among normal and color deficient individuals. The research team is also examining differences in gene expression under hypoxic conditions. A cognitive test battery was developed to assess changes in performance at ground level and at altitude.

General Aviation Pilot Aging: Human factors researchers are collaborating with industry on proposals to research the effects of aging among general aviation pilots. To date, participants have discussed the relative merits of each proposed approach, broader limitations of both proposals, and alternatives that might advance the existing literature to produce more definitive research.

Enhancing Safety

Safety Culture: A partnership between the FAA and St. Louis University is changing the safety culture of the FAA maintenance workforce. The objective of the project is to improve the technical operations safety culture. The initial mechanism that has been introduced is a voluntary reporting system modeled after the Aviation Safety Action Program that has been highly successful among pilots and aircraft maintainers.

Electronic Flight Bags (EFBs): Human factors researchers provided input to operational approval and training guidance (including input to Advisory Circulars) to mitigate risks associated with the implementation and integration of EFBs on the flight deck. Researchers also prepared an updated review of the EFB industry. In addition, they collected safety reports related to EFBs operating in approved systems to identify issues and concerns and make recommendations for improvements.

Notice to Airmen: Safety issues surrounding the use of Notice to Airmen (NOTAMS) became a top priority in FY 2007. Human factors researchers formed and led industry working groups to discuss the human factors shortcomings of NOTAMS and the safety impact on air carrier operations. As a result of this work, previous research on NOTAMS, and recent findings of the NTSB concerning NOTAMS, the FAA is currently investigating and implementing improvements to the NOTAMS system. Research continues through working groups and data sharing meetings and by involvement in the redesign process for NOTAMS. Researchers will work to assure that the NOTAMS redesign efforts conform to appropriate human factors standards.

Human Factors Analysis

The Human Factors Analysis and Classification System (HFACS) is a system to categorize both the latent and immediate causal factors that have been identified in aviation accidents. The purpose is to provide a framework for use in aviation accident investigations and a tool for assessing accident trends. The final download of NTSB data was accomplished in January 2007, which will eventually yield a coded database of accidents from 1990 to 2006. Data analysis of HFACS data for accidents with visual flight rules (VFR) into instrument meteorological conditions (IMC) as a factor and for general aviation accidents without VFR into IMC as a factor was completed. The overall descriptive characteristics for each accident group and the human error associated with these accidents were both completed. Detailed analyses were performed on the general aviation VFR into IMC accidents.

Visual Flight Rules/Instrument Meteorological Accidents (VFR/IMC)

Human factors researchers collected data from over 200 pilots, mechanics, corporate aviation executives, and Transport Canada representatives participating in focus groups regarding interventions aimed at reducing VFR-IMC accidents. A final list of over 150 unique interventions was generated. The list was given to five general aviation subject matter experts and two human factors experts for prioritization on four dimensions: effectiveness, feasibility, acceptability, and cost. Data are currently being analyzed and a final report was submitted at the end of FY 2007.

Rudder Survey

The FAA designed a Lateral Control Events Survey (Rudder Survey) to investigate issues involved in transport airplanes and “upset” (defined by the survey as an airplane motion that a pilot believed required immediate corrective action). The survey also explored rudder pedal characteristics including pedal control, over control, cross control, sensitivity (e.g., pedal binding, unexpected control stop, heavy or light pedal forces), pedal usage and yaw/roll conditions. In addition, training, experience, knowledge of rudder, and maneuver speed were assessed. Researchers are now working to gain a better understanding of lateral control events and other rudder issues in transport airplanes. The ultimate objective of this study is to develop a knowledge base from which certain characteristics of transport category airplanes can be better understood. These characteristics include pilot and mechanical issues in upset conditions, as well as issues associated with rudder operation.

Terrain Awareness

Research on Terrain Awareness and Warning System (TAWS) feasibility for helicopter operations began in FY 2007. The team prepared profiles and measurements in fixed-wing aircraft, and collaborated with university researchers in developing profiles for simulator testing in the FAA’s helicopter simulation facility. The TAWS software was updated to incorporate displays and alerting for current fixed wing and helicopter applications. Researchers also developed profiles that allow surprise alerts, rather than planned alerts. This is evolving into a broader evaluation effort as a result of the Radio Technical Commission for Aeronautics (RTCA) Special Committee 212’s need for reaction time data to set length of time of alerting systems for helicopters.

Safety Alerts

Air Traffic Controllers receive several types of alerts that warn of potentially hazardous situations, including Conflict Alerts (CAs), Mode-C Intruder (MCI) alerts, and Minimum Safe Altitude Warnings (MSAWs). These alerts are presented visually on the radar display, and in some environments, there is a corresponding audible alert. In response to several recent incidents in which controllers may not have responded properly to alerts, researchers visited several ATC facilities, observing safety alerts during live operations, interviewing personnel about their experiences using alerts, and reviewing data and voice recordings. They also examined automation data and voice recording. Controller responses to alerts, such as issuing traffic advisories and control instructions, were analyzed when those responses occurred relative to alert activation.

Results show that 62 percent of the CAs examined and 91 percent of the MSAWs examined in en route received no response from controllers. Similarly, 44 percent of the CAs examined and 61 percent of the MSAWs examined in terminal received no response from controllers. However, in none of these cases did an operational error or deviation occur. When controllers did respond to conflict situations, they made the response prior to the alert 67 percent of the time. For MSAW situations, controllers made the response prior to the MSAW 68 percent of the time. Furthermore, 31 percent of the CAs examined in en route and 36 percent in terminal lasted such a short time that controllers must have resolved the situation prior to the alert or the situation resolved itself without action. These results led researchers to estimate that 81 to 87 percent of CAs and 87 to 97 percent of MSAWs are nuisance alerts or unnecessary, in that the alerts are valid according to the algorithms, but do not provide useful information to the controllers.

A large number of nuisance alerts can create serious human factors problems. By design, alerts cause controllers to interrupt their current tasks and focus attention on the aircraft involved. When these interruptions are frequent and unnecessary, controller workload is increased and overall performance may be reduced. In addition, a large number of nuisance alerts can desensitize controllers to the alerts overall, which may lead to poorer responses to genuine alerts. Furthermore, a large number of nuisance alerts can reduce controller trust in automation.

The research team recommends that the FAA make reducing nuisance alerts a top priority. One potential method for reducing nuisance alerts is to provide more sophisticated alert suppression functions. For example, alert suppression can act like a “snooze” function, in which a suppressed alert automatically reactivates when additional criteria are met. A second potential method is to base the alert algorithm parameters (such as the look-ahead time) on human factors data, such as how quickly controllers can identify and resolve hazardous situations. A potential method for reducing the impact of nuisance alerts is to provide graded alerts in which the alert presentation becomes increasingly obvious as the situation becomes more urgent. If the ATC alerts are improved according to these recommendations, controller performance will increase and the NAS will become safer.

Future En Route Workstation (FEWS) Research

As traffic increases in the NAS, so do delays. Some ATC bottlenecks are due to limitations of the voice communications system (controllers can only issue clearances to a limited number of aircraft per unit of time), associated data entries into the automation system, and limits on the number of aircraft the controller can effectively monitor. In FY 2007, human factors researchers completed a simulation testing of the Future En route Workstation (FEWS). The research determined whether FEWS would enable air traffic controllers to safely manage a larger number of aircraft in the same volume of airspace. FEWS was designed on the principles of integrating currently-independent automation tools, providing information when and where it is needed, and reducing the number of housekeeping tasks that controllers currently perform, thus freeing resources to focus on critical tasks of sequencing and separating aircraft.

The high fidelity, human-in-the-loop simulation compared system performance, controller workload, and situation awareness using the current Display System Replacement (DSR) workstation, the next-generation En Route Automation Modernization (ERAM) workstation, and FEWS. Some of the simulations were conducted with voice communications only and others with voice plus data communications. Simulations were used to test one- versus two-controller operations in the sector and differences in the radar associate display.

Results indicate that two controllers using FEWS and having data communications can safely and efficiently manage approximately 30 percent more traffic than a single controller with DSR and only voice communications. The FEWS interface reduced (by approximately 50 percent) the number of data entries that controllers must make with either DSR or ERAM. Researchers found that FEWS design features (e.g., automatic handoff acceptance, automatic data-block drop-off, preferred leader line orientations, data-block dragging) can be readily incorporated in the near-term. The research team is beginning work on a follow-on simulation that will include airborne capabilities envisioned in the NextGen (e.g., pilot self-spacing) and ways to reduce the number of objects controllers need to actively monitor on the radar screen.

Certification Job Aid for Flight Deck Human Factors

Certification Job Aid was developed to provide quick and easy access to regulatory and human factors information that may be used by certification personnel for identifying and addressing human factors considerations in flight deck design. The current version of Job Aid provides information addressing all human factors considerations related to the design of displays, controls, and systems in the flight deck for large transport category aircraft. Version 8.0, with completed content for Parts 23 and 25, was delivered in September 2007. Additional content includes human factors considerations for equipment, tasks and procedures; and testing assumptions. The set of human factors considerations will provide a comprehensive way to address human factors in any certification project, provide a more even approach to certification, and reduce the time required for certification.

Job Aid has been structured to allow certification team members to access information from one of three paths: FAA regulations and guidance material; information related to a specific component; and specific human factors topics. When users selects a particular regulatory or guidance document, component, or human factors topic, they will be provided with a list of related human factors considerations. This list provides a systematic method of evaluating design, and can serve as a general checklist during a certification task.

Separate sets of human factors considerations have been developed related to display design; control design; system design; equipment, tasks and procedures; and testing assumptions. The human factors considerations address the design issues of the component in isolation as well as design issues related to the integration of this component within the full flight deck environment. The tool provides summaries of regulatory and guidance material as well as human factors research literature for each human factors consideration.

Pilot Simulator Training

A shortage of qualified airline pilots represents a threat to passenger safety world-wide. Newly-hired pilots arrive with limited and diverse backgrounds. Combined with an increase in complexity of both the flight deck and the airspace due to automaton and congestion, differences in pilot experience represent a real challenge to airline pilot training. To meet this challenge, access to high-quality simulators is critical. The key issue in making simulation more available is the cost of acquiring and maintaining full-motion simulators and the equivalent training effectiveness of those simulators versus other training devices. Previous studies by human factors researchers found that, in the presence of a visual system that generates the perception of motion, the current mandatory platform-motion systems may not add any training value. Such systems nearly double the price of simulator rentals, raising not only acquisition costs but also the cost of housing, electricity and maintenance. In FY 2007, human factors researchers were invited to participate in a study employing a Full Flight Trainer (FFT) – a fixed base training device with the highest fidelity flight data package and visual system, but limited motion cues provided by a dynamic seat. Researchers assisted with a proof-of-concept validation of the FFT. Data showed that the FFT represented the airplane well and that there were no problems transitioning to the airplane. Type-rating of additional pilots served as a test bed for data collection for a more formal evaluation of the FFT’s training value. One of the purposes of these studies was to validate the FFT for type rating. In FY 2008, a comparison study will be conducted. The evaluation will compare pilots trained in the FFT to pilots trained in the full flight simulator. This study will compare the training effectiveness of the FFT to the training effectiveness of the full slight simulator. It is hoped that the outcome of this and the previous studies will be considered in the determination of future U.S. and international regulations on whether alternatives to platform motion can be accepted for at least some aspects of airline pilot training. This will permit a reallocation of resources to those aspects of flight simulation that may have the largest impact on safety, such as accurate simulation of flight-deck technologies and the airline environment, including ATC communications.

Joint Planning and Development Office (JPDO) 2007 Accomplishments

NextGen Concept of Operations

The JPDO completed and issued the draft *NextGen Concept of Operations*. It provides an overall, integrated view of NextGen operations in the 2025 time frame, including the key transformations from today's operations. Version 2.0, issued June 13, 2007, identifies key policy and research issues that require resolution to achieve NextGen.

NextGen R&D Plan

The first NextGen *Research and Development Plan,* FY-2009- FY- 2013 was issued. Version 5.0 of the Plan (August 31, 2007) details the R&D requirements for NextGen operational improvements, and identifies the R&D responsibilities and contributions of each JPDO member agency.

NextGen Integrated Work Plan

Version 0.1 of the *Integrated Work Plan* was issued. The Plan describes the major implementation milestones, dependencies, responsibilities, and resources needed to achieve the end-state vision described in the *Concept of Operations*. Version 0.2 of the Plan was issued in October 2007.

NextGen Enterprise Architecture

On June 22, 2007 version 2.0 of the Enterprise Architecture was issued. The Enterprise Architecture provides traceability from the NextGen goals to the underlying technology needed to optimize performance. It compares the current state to the desired end-state to identify a transition path to NextGen, and it defines how operations, investments, policies, processes, organizational structures, information, and systems must change to achieve Next Gen.

JPDO Restructuring

The JPDO realigned its original eight Integrated Product Teams into nine Working Groups. These are: Aircraft, Air Navigation Services, Airport, Environment, Global Harmonization, Safety, Security, Net-Centric Operations, and Weather.

Next Gen Business Case

The NextGen Business Case (Exhibit 300) was completed and submitted to the President's Office of Management and Budget. The Business Case establishes the business justification for investment into the Next Gen programs and capabilities.

4D Weather Cube Requirements

A Joint Weather Study Team was established to define common functional four-dimensional (4D) weather cube requirements, evolve baseline requirements, and refine the 4D weather cube cost-benefit analysis. The Study Team will complete its work and submit a final report by January 2008.

Research, Engineering, and Development Advisory Committee (REDAC) 2007 Accomplishments

Reports

During 2007, the Research, Engineering, and Development Advisory Committee produced three reports: *Guidance for FAA Fiscal Year 2009 R&D,* November 13, 2006; *Separation Standards Working Group Final Report*, October 16, 2007 (FAA Response, May 14, 2007); and *Review of FAA Fiscal Year 2009 Program Plans,* June 12, 2007 (FAA response, August 20, 2007).

Separation Standards Working Group

The REDAC Working Group on Separation Standards completed its report, which was submitted to the FAA Administrator on October 16, 2006. The Working Group carefully examined all the issues related to separation standards in the current NAS and the future NextGen. The report recommended major R&D efforts to transform separation standards to meet demands expected over the next two decades. The FAA is implementing those recommendations within its NARP and its OEP.

Weather - Air Traffic Management Integration Working Group

In 2007, the Committee created the Weather-Air Traffic Management Integration Working Group to study the potential benefits associated with a higher degree of integration between two dissimilar and fundamentally inexact sciences, namely weather and air traffic management. The Working Group will provide specific research recommendations to the FAA that are considered most likely to lead to better, more efficient ATM solutions, in the face of weather constraints. The report is expected early in FY 2008.

APPENDIX C: Partnership Activities

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

1. Working with Government
   - 1.1 Memoranda of Understanding and Agreement
   - 1.2 Interagency Committees

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

3. Working with Industry
   - 3.1 Small Business Innovation Research
   - 3.2 Intellectual Property and Patents

4. Working with Academia
   - 4.1 Joint University Program
   - 4.2 Aviation Grants
   - 4.3 Centers of Excellence

1. Working with Government

1.1 Memoranda of Understanding and Agreement

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

Table C.1 – Active Agreements

MOU and MOA		
Agreement Type	Subject	Objective
FAA/NASA MOU	A Partnership to Achieve Goals in Aviation and Space Transportation	Partnering in the pursuit of complementary goals in aviation and space transportation, including safety, airspace system efficiency, environmental compatibility, international leadership, and others.
FAA/NASA MOA	Support of FAA R&D Field Offices at NASA Research Centers	Continuing operation and support of the FAA Field Offices established at NASA Centers.
FAA/NASA MOA	Commercial Space Transportation Infrastructure Development	Advancing and developing the national commercial space transportation infrastructure, including design, development, demonstration, and technology transfer of technologies, systems, equipment, processes, operating concepts, and facilities associated with spaceports and ranges.
FAA/NASA MOA	Air Traffic Management Research and Technology Development	Supporting the NASA Aviation Systems Capacity Program and FAA Air Traffic Management with respect to conducting research, development, and technology transfer to FAA.
FAA/NASA MOA	Impact of Aviation Air Emissions on Climate and Global Atmospheric Composition	Establishing programs and plans to determine aviation emissions that have the potential to impact global atmospheric composition, stratospheric ozone and climate.
FAA/NASA MOA	Aeronautical Safety and Human Factors	Establishing a strategic partnership with respect to the conduct of human factors research in commercial air transportation, general aviation, vertical flight, aviation maintenance, flight technologies and procedures, air traffic control/airway facilities, and bioaeronautics.
FAA/NASA MOA	Aircraft Noise Reduction Technology	Establishing programs and plans to achieve the joint long-term national goal of containing objectionable aircraft noise within airport and compatible land use boundaries.
FAA/NASA MOA	Aviation Safety Reporting System (ASRS)	Describing the basic relationship between the FAA's Aviation Safety Reporting Program and the NASA ASRS, and outlining the roles and responsibilities of each agency.
FAA/NASA Interagency Agreement	Wake Turbulence and Associated Reduced Separation Research	Building upon and expanding the long-standing research relationship between the FAA and NASA in the areas of wake turbulence and required separation between aircraft to insure flight safety.
FAA/NASA Interagency Agreement	Airborne Weather RADAR with Turbulence Detection Capability	Establishing a cooperative procedure to develop minimum performance standards for airborne turbulence detection systems.
FAA/DOD MOA	Collaboration on Research and Development to Measure and Mitigate the Environmental Impacts of Aircraft Noise and Aviation Air Emissions	Conducting and coordinating research and development projects and exchanging research and development data, analyses and related information and material concerning the environmental impacts of aircraft noise and aviation emissions.

1.2 Interagency Committees

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

2. Working with Government, Industry and Academia

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

2.1 Cooperative Research and Development Agreements

Cooperative Research and Development Agreements (CRDAs) allow the FAA and its partners to share facilities, equipment, services, intellectual property, and personnel resources with industry, academia, and state and local governments in collaborative R&D activities. CRDAs are a highly effective way to meet congressionally mandated technology transfer requirements. In fiscal year (FY) 2007, the FAA established 7 new CRDAs, bringing the present total of active agreements to 24. Details of the new CRDAs are shown in Table C.2.

Table C.2 – Active FAA Cooperative R&D Agreements, FY 2007

CRDAs					
CRDA Number	FAA Program	Subject	Recipient Organization	Award Date	Completion Date
1993-A-0043	Weather	Development of advanced weather information systems with graphical display products	WSI Corporation Billerica, MA	09/13/93	09/13/08
1994-A-0065	Airport Technology	Testing of a soft ground arresting system developed to safely stop aircraft that overrun the available length of runway	DATRON Engineered Systems Division, Aston, PA	09/07/94	09/07/08
1996-A-0097	Airport Technology	Development of the National Airport Pavement Test Machine	The Boeing Company Seattle, WA	07/29/96	07/29/11

CRDAs					
CRDA Number	FAA Program	Subject	Recipient Organization	Award Date	Completion Date
2001-A-0164	Airport Technology	Utilize statistical analysis for determining airplane contact risks of varying span airplanes on taxiways of varying separation	The Boeing Company Seattle, WA	04/05/02	04/05/08
2002-A-0171	Capacity and Air Traffic Management Technology	Develop modeling and simulation tools to assist in tech implementation of capacity enhancing capabilities for the National Airspace System	The Boeing Company McLean, VA	07/17/02	07/17/12
2003-A-0181	Communications, Navigation, and Surveillance	Controller Pilot Data Link Communication Builds 1 and 1A	SITA Information Networking Computing, B.V. Vienna, VA	09/25/03	09/25/08
2004-A-0189	Office of Innovations and Solution	Video security system to enhance aviation security	Presearch Incorporated Fairfax, VA	01/27/04	01/27/08
2004-A-0199	Air Traffic Organization	Research on the Success of the Radical Organizational Change at the Federal Aviation Administration's Air Traffic Organization	University of Maryland at College Park College Park, MD	05/13/04	05/13/09
2005-A-0203	Air Traffic Management	Efficiency of the Air Traffic Controller Operator Working Position	Frequentis, USA Rockville, MD	04/14/05	04/14/09
2005-A-0206	Advanced Traffic Management Systems	Evaluation of the Surface Management System Capabilities and Improvements	FedEx Express Memphis, TN	05/24/05	05/24/08
2005-A-0208	Air Traffic Models and Evaluation Tools	Utilize state-of-the-art technologies and the initial development of the Aviation Integrated Reasoning Modeling Matrix to develop a system that will support the current and future needs of the FAA	Optimal Systems, Monroeville, NJ	06/08/05	06/08/08
2005-A-0209	Information Resource Management	Electronic submission of confidential financial disclosure forms	HRWorX, LLC, Herndon, VA	08/25/05	08/25/09
2005-A-0213	Air Traffic Models and Evaluation Tools	Machine-graded aviation English test for pilots for measuring levels of English language proficiency	Ordinate Corporation, Menlo Park, CA	01/17/06	01/17/11
2006-A-0216	Air Traffic Models and Evaluation Tools	Development and improvement of a graphical user interface for the display of recorded air traffic data	Rowan University, Glassboro, NJ	07/25/06	07/25/08
2006-A-0219	Human Factors & Aviation Medicine	Air Traffic Controller Cognitive Modeling	Drexel University, Philadelphia, PA	2/20/07	2/20/10

CRDAs					
CRDA Number	FAA Program	Subject	Recipient Organization	Award Date	Completion Date
2006-A-0220	Communications, Navigation, and Surveillance	Utilize ADS-B technology to facilitate procedures improving aircraft arrival rates and situational awareness in the air and on the airport surface while reducing fuel consumption and noise generation.	Aviation Communications & Surveillance Systems, Phoenix, AZ	09/21/06	09/21/08
2006-A-0221	Atmospheric Hazards/Digital System Safety	Testing to document the shape, location, and aerodynamic effects of propeller icing.	Hartzell Propeller, Inc., Piqua OH	05/12/06	02/12/08
2006-A-0222	Atmospheric Hazards/Digital System Safety	Testing to document the shape, location, and aerodynamic effects of propeller icing.	MT-Propeller USA, Inc., DeLand, FL	05/23/06	02/23/08
2006-A-0223	Surveillance	Airport surface surveillance	RVision LLC, San Diego, CA	12/13/06	4/13/08
2006-A-0227	Simulation	Voice recognition and response system	UFA Inc. Gaithersburg, MD	12/13/06	12/13/08
2007-A-0231	CAMI/Optical Instruments	Comparison of optical vision screeners currently used by Aviation Medical Examiners	Titmus Optical, Inc., Chester, VA	7/18/07	7/18/08
2007-A-0232	CAMI/Optical Instruments	Comparison of optical vision testers currently used by Aviation Medical Examiners	Stereo Optical, Inc., Chicago, IL	7/12/07	7/12/08
2007-A-0233	Surveillance	Flight testing for ADS-B separation standards	CNS Aviation, Vienna, VA	7/18/07	7/18/09
2007-A-0235	SERC/NextGen	Provide guidance for NetCentric standards and protocols that may be incorporated by the NextGen Program.	Network Centric Operations Industry Consortium Inc., Newport Beach, CA	9/21/07	9/21/09

3. Working with Industry

3.1 Small Business Innovation Research

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

3.2 Patents issued through the U.S. Patent and Trademark Office

Inventors are encouraged to patent new technologies through the U. S. Patent and Trademark Office. A patent is a grant of a property right and gives the owner the right to exclude anyone else from making, using, or selling the invention. Inventions patented by the FAA inventors are available for commercial licensing with royalty payments being shared with the inventor and the agency. Legislation allows for inventors to receive up to $150,000 a year over their salary from royalty payments. The agency's Technology Transfer Program Office promotes the agency's patents for commercialization. Table C.3 provides a list of the current U.S. patents issued to the U.S. Department of Transportation, FAA.

Three (3) licensing agreements are in effect for Patent No. 5,981,290 "Microscale Combustion Calorimeter" and Patent No. 6,464,391 "Heat Release Rate Calorimeter for Milligram Samples." One (1) licensing agreement is in effect for the software product that automates the annual process of collecting and reviewing the Office of Government-wide Ethics Financial Disclosure Form.

Under the patent provisions of Government funding agreements, recipients must disclose each subject invention that they make to the Federal agency and may elect to retain title to any patentable subject matter. If the recipient retains title, the Government is granted a broad license to use the invention for Government purposes throughout the world.

The FAA has identified approximately 60 active patents resulting from FAA funded agreements. These patented technologies are available for use by the Government, and its contractors, on a cost-free basis when used for Government purposes. For more information, see http://www.tc.faa.gov/technologytransfer/ttpatentsthru_grant.html.

Table C.3 – Patents Issued for DOT/FAA

Patents Issued			
Patent No.	Date of Patent	Title	Description
6,899,540	5/31/05	Threat image projection system	A means for training and testing baggage screening machine operators.
6,812,834	11/02/04	Reference sample for generating smoky atmosphere	A reference sample for testing fire detectors and a method for testing using the reference samples.
6,470,730	10/29/02	Dry transfer method for the preparation of explosives test samples	A method of preparing samples for testing explosives and drug detectors of the type that search for particles in air.
6,467,950	10/22/02	Device and Method to Measure Mass Loss Rate of an Electrically Heated Sample	A device and a method for measuring the mass loss rate of a sample of combustible material placed on a mass-sensitive platform.

Patents Issued			
Patent No.	Date of Patent	Title	Description
6,464,391	10/15/02	Heat Release Rate Calorimeter for Milligram Samples	A calorimeter that measures heat release rates of very small samples (on the order of 1 to 10 milligrams) without the need to separately and simultaneously measure the mass loss rate of the sample and the heat of combustion of the fuel gases produced during the fuel generation process.
6,116,049	09/12/00	Adiabatic Expansion Nozzle	A nozzle for producing a continuous gas/solid or gas/aerosol stream from a liquid having a high room temperature vapor pressure.
5,981,290	11/09/99	Micro-scale Combustion Calorimeter	A calorimeter for measuring flammability parameters of materials using only milligram sample quantities.

4. Working with Academia

4.1 Joint University Program for Air Transportation Research

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

4.2 Aviation Grants

The FAA awards research grants to qualifying colleges, universities, and legally incorporated nonprofit research institutions. The evaluation criteria for grant proposals include the potential application of research results to the FAA's long-term goals for civil aviation technology. Table C.4 is a list of the FAA research grants initiated in FY 2007. In FY 2007, FAA awarded $2,749,726.00 in new grants. It also awarded an additional $8,754,745.51 to grants that originated in prior fiscal years for a total of $11,504,471.51 in grant awards in FY 2007.

Table C.4. FAA Research Grants Originating in FY 2007

Research Grants				
FAA Program	Grant Number and Objective	Recipient Institution	Award and Completion Dates	Award Amount
Aviation Safety Risk Analysis/System Safety Management	2007-G-001 Investigation of Decision Support Systems for Aviation Safety Evaluation.	Rutgers, The State University of New Jersey	11/30/2006 11/28/2008	$372,639
Aviation Safety Risk Analysis/System Safety Management	007-G-002 Addressing the Alert Problem in ATC Facilities	The Regents of New Mexico State University	1/18/2007 1/17/2008	$40,000.00
Landing and Navigational Aids	2007-G-003 eLoran/GPS User Receiver Development	University of Maine	3/29/2007 9/27/2008	$150,000
Aviation Safety Risk Analysis/System Safety Management	2007-G-004 Structural Knowledge Analysis of Aviation Safety Reports	The Regents of New Mexico State University	4/10/2007 10/8/2008	$85,000
Aircraft Catastrophic Failure Prevention Research	2007- G-005 A Detailed Look at Uncontained Engine Fragment Fuselage Penetration energy Absorption.	The Regents of The University of California	6/12/2007 1/10/2009	$219,511
Aeromedical Research	2007-G-006 Customer Service in a Regulatory Agency – Literature Review	The University of Tulsa	6/26/2007 12/31/2007	$24,237
Aeromedical Research	2007-G-007 Validating FAA’s Job-based Color Vision Test for Air Traffic Controller Applicants	The Board of Regents of the University of Oklahoma	7/11/2007 1/10/2008	$50,055
Aging Aircraft/Continued Airworthiness	2007-G-009 Aging Aircraft Issues for Structural Damages	Wichita State University	8/22/2007 8/21/2009	$100,000
Fire Research and Safety	2007-G-0010 Functionalized Graphite Oxide Flame Retardants.	William Marsh Rice University	8/9/2007 8/8/2008	$50,000
Aging Aircraft/Continued Airworthiness	2007-G-011 Probabilistic Structural Risk Assessment and Risk Management for Small Airplanes	The University of Texas at San Antonio	8/22/2007 8/21/2010	$465,000
Frequency and Spectrum Engineering	2007-G-012 Global Navigation Satellite System (GNSS) Evolutionary Architecture Research for Civil Aviation.	Illinois Institute of Technology	8/22/2007 8/21/2008	$201,124

Research Grants				
FAA Program	Grant Number and Objective	Recipient Institution	Award and Completion Dates	Award Amount
Weather Program	2007-G-013 Redesigning Weather-related training and Testing of general Aviation Pilots – Phase II	Board of regents of the University of Wisconsin System	8/24/2007 1/23/2008	$194,000
Unmanned Aircraft Systems Research	2007-G-014 Remote Operations of UAS and Technologies for Command, Communications, and Computers	The Regents of the University of Colorado	8/22/2007 8/21/2008	$85,438
Aviation Safety Risk Analysis/System Safety Management	2007-G-015 A Study of Operational Landing Distance Performance for Regional Jet Aircraft.	University of Louisville	8/29/2007 8/28/2008	$89,725
Oceanic Automation System	2007-G-016 Investigation of Aircraft Separation Standard and Navigational Equipment on Oceanic Airspace Capacity and Safety.	Rutgers, The State University of New Jersey	8/28/2007 9/4/2008	$162,997
Aging Aircraft/Continued Airworthiness	2007-G-017 Data and Methodologies for Structural Life Evaluation of Small Airplanes – Phase III	Wichita State University	9/7/2007 9/6/2008	$100,000
Advanced Materials/Structural Safety	2007-G-018 Structural Health Monitoring (SHM)	The University of Texas t San Antonio	9/5/2007 9/4/2010	$360,000

4.3 Air Transportation Centers of Excellence

The FAA sponsors seven Centers of Excellence (COE) established through cooperative agreements with 75 academic institutions throughout the U.S. to assist in mission-critical research and technology development, education and training. Through these long-term collaborative, cost-sharing efforts, the government and university teams leverage their resources with industry affiliates to advance aviation technology. The COE partnerships have generated more than $100M in matching funds over the past decade significantly augmenting FAA R&D efforts. The seven centers of excellence are the following.

- COE for Research in the Intermodal Transport Environment (RITE)
- Joint COE for Advanced Materials (JAMS)
- Partnership for Air Transportation Noise and Emission Reduction (PARTNER)
- COE for General Aviation Research (CGAR)
- Airworthiness Assurance Center of Excellence (AACE)

- National Center of Excellence for Aviation Operations Research (NEXTOR)
- COE for Airport Technology

The pages that follow provide a brief description of each of the seven centers with a table identifying the COE grants awarded in 2007.

4.3.1 COE for Research in the Intermodal Transport Environment (RITE)

Selected by the Administrator in 2004, Harvard University and Purdue University are the technical leads for the newly named COE for Research in the Intermodal Transport Environment (RITE), which was formerly known as the Air Transportation Center of Excellence for Airliner Cabin Environment. Auburn University serves as the administrative lead. RITE conducts R&D on cabin air quality and chemical and biological threats. As a result of the Phase I evaluation, RITE is positioned to broaden its potential funding base by expanding research activities to include research and related activities in the intermodal environment. New cooperative agreements have also been negotiated with member universities including: Boise State University, Kansas State University, the University of California at Berkeley, and the University of Medicine and Dentistry of New Jersey.

Through 2007, the FAA Office of Aerospace Medicine has provided $11 million in grant funds and supported 30 tasks while preparing more than 65 students to serve the aviation community. RITE partners and industry affiliates have contributed in excess of $11 million in matching funds. For additional information see http://www.acer-coe.faa.gov

Table C.4.3.1 –COE Grants Awarded in 2007 for
Research in the Intermodal Transport Environment (RITE)

RITE				
University Recipient	Grant Title	Amount	FAA Point of Contact	University Point of Contact
University of California – Berkeley	Ozone in Passenger Cabins	$74,997	C. Ruehle	W. Nazaroff
Auburn University	Materials Compatibility of Critical Avionics and Aircraft Electrical Systems	$480,408	C. Ruehle	W. Gale
Boise State University	Materials Compatibility of Critical Avionics and Aircraft Electrical Systems	$170,312	C. Ruehle	S.M. Loo
Purdue University	Decontamination and Infectious Disease Transmission	$306,378	C. Ruehle	Y. Chen
Kansas State University	Aircraft Recirculation Filter Research for Incident Assessment	$150,000	C. Ruehle	S. Eckels
University of Medicine and Dentistry of New Jersey	Pesticide Study Supplement	$50,000	C. Ruehle	C. Weisel

RITE				
University Recipient	Grant Title	Amount	FAA Point of Contact	University Point of Contact
Harvard University	Effects of Partial Pressure on Airline Passengers	$174,101	C. Ruehle	J. Spengler
Harvard University	In Flight/Onboard Monitoring, ACER's Component for ASHRAE 1261, Part II	$524,021	C. Ruehle	J. Spengler
Boise State University	In-Flight Sensor System Development and Deployment	$50,618	C. Ruehle	S.M. Loo
Purdue University	Study of Infectious Disease Transmissions in Airliner Cabins for ASHRAE	$100,854	C. Ruehle	Y. Chen
University of Medicine and Dentistry of New Jersey	ASHRAE Ozone Pesticide	$125,000	C. Ruehle	C. Weisel
Harvard University	Incident Monitoring & Reporting	$117,111	C. Ruehle	J. Spengler

4.3.2 Joint COE for Advanced Materials (JAMS)

Selected by the Administrator in 2003, the University of Washington and Wichita State University serve as co-leads for the Joint COE for Advanced Materials (JAMS). JAMS conducts R&D on material standardization and shared databases, bonded joints, structural substantiation, damage tolerance and durability, maintenance practices, advanced material forms and processes, cabin safety, life management of materials, and nanotechnology for composite structures. Other member universities include Edmonds Community College, Northwestern University, Oregon State University, Purdue University, the University of California at Los Angeles, the University of Delaware, Tuskegee University, and Washington State University.

The FAA has provided $9 million in grant funds and supported 20 tasks while preparing more than 40 students to serve the aviation community. JAMS university members and industry affiliates are providing $9 million in matching funds as mandated in the COE enabling legislation. For additional information see http://www.jams-coe.com

Table C.4.3.2 – Grants Awarded in 2007 for
Joint COE in Advanced Materials (JAMS)

JAMS				
University Recipient	Grant Title	Amount	FAA Point of Contact	University Point of Contact
Wichita State University	Damage Tolerance Testing and Analysis Protocols for Full-Scale Composite Airframe Structures Under Repeated Loading	$4,000	C. Davies	J. Tomblin

JAMS				
University Recipient	Grant Title	Amount	FAA Point of Contact	University Point of Contact
Florida International University	Identification and Validation of Analytical Chemistry Methods for Detecting Composite Surface Contamination and Moisture	$75,000	C. Davies	R. Sirvastava
University of Washington	Standardization of Analytical and Experimental Methods for Crashworthiness Energy Absorption of Composite Materials	$30,000	A. Abramowitz	P. Feraboli
University of Washington	Improving Adhesive Bonding of Composite through Surface Characterization	$75,000	C. Davies	B. Flinn
University of Washington	Combined Global/Local Variability and Uncertainty in Integrated Aeroservoelasticity of Composite Aircraft	$140,000	C. Davies	E. Livne
Purdue University	Damage Tolerance and Durability of Adhesively Bonded Composite Structures	$65,000	C. Davies	Siegmund
Wichita State University	Crashworthiness of Composites - Material Dynamic Properties	$30,000	A. Abramowitz	S.R. Keshavanarayana
Wichita State University	Development and Safety Management of Composite Certification Guidance	$60,000	C. Davies	J. Tomblin
Wichita State University	Certification by Analysis	$30,000	A. Abramowitz	G. Olivares
University of Delaware	VARTM Variability and Substantiation	$65,000	C. Davies	D. Heider
Wichita State University	Administration of the FAA Center of Excellence for Composites and Advanced Materials at Wichita State University	$75,000	C. Davies	J. Tomblin
University of Washington	Administration of the FAA Center of Excellence on Advanced Materials in Transport Aircraft Structures (AMTAS)	$74,127	C. Davies	M. Tuttle
University of Washington	Development of Reliability-Based Damage Tolerant Structural Design Methodology	$115,000	C. Davies	K. Lin
Wichita State University	Damage Tolerance Testing and Analysis Protocols for Full-Scale Composite Airframe Structures under Repeated Loading	$65,000	C. Davies	J. Tomblin

JAMS				
University Recipient	Grant Title	Amount	FAA Point of Contact	University Point of Contact
Wichita State University	Damage Tolerance Testing and Analysis Protocols for Full-Scale Composite Airframe Structures under Repeated Loading	$50,000	C. Davies	J. Tomblin
Wichita State University	Effect of Repair Procedures Applied to Composite Airframe Structures	$30,000	C. Davies	J. Tomblin
Wichita State University	Aging of Composite Aircraft Structures	$60,000	C. Davies	J. Tomblin
Oregon State University	Failure of Notched Laminates Under Out-of-plane Bending	$61,000	C. Davies	T. Kennedy
Edmonds Community College	Course Development: Maintenance of Composite Aircraft Structures	$125,000	C. Davies	J. Mosier
Wichita State University	Production Control Effect on Composite Material Quality and Stability	$125,000	C. Davies	J. Tomblin
Edmonds Community College	Course Development: Maintenance of Composite Aircraft Structures	$15,000	C. Davies	J. Mosier

4.3.3 COE Partnership for Air Transportation Noise and Emissions Reduction (PARTNER)

Selected by the Administrator in 2003, the COE Partnership for Air Transportation Noise and Emissions Reduction (PARTNER) is co-sponsored by NASA and Transport Canada with FAA and led by the Massachusetts Institute of Technology. PARTNER conducts R&D to identify, understand, and measure the impacts of aircraft noise and aviation emissions and, as appropriate, to mitigate these problems. It seeks to reduce uncertainty in issues dealing with climate impact and the health and welfare effects of emissions to a level that enables actions to be undertaken to address their effects. New cooperative agreements were also negotiated with other member universities including: Boise State University, the Pennsylvania State University, Purdue University, Stanford University, and the University of Missouri-Rolla. During the Phase I evaluation completed in FY 2007, Harvard University and the University of North Carolina – Chapel Hill joined this partnership.

Grants and contracts awarded to PARTNER and matching funds provided by the academic members and industry affiliates to date total $33 million and helped prepare more than 100 students to serve the aviation community. For further information see http://web.mit.edu/aeroastro/www/partner or www.partner.aero

Table C.4.3.3 – COE Grants Awarded in 2007 for
Partnership for Air Transportation Noise and Emissions Reduction (PARTNER)

PARTNER				
University Recipient	Grant Title	Amount	FAA Point of Contact	University Point of Contact
Georgia Institute of Technology	Objective Measures of Airspace Complexity to Support Airspace Management	$230,000	S. Bradford	A. Pritchett
Massachusetts Institute of Technology	Opportunities for Reducing Surface Emissions through Airport Surface Movement Optimization	$150,000	N. Brown	J. Hansman
University of Missouri - Rolla	Emissions Characteristics of Alternative Aviation Fuels	$200,000	C. Ma	P. Whitefield
Georgia Institute of Technology	Top of Decent Determination for CDA	$30,000	S. Lui	J-P. Clarke
Georgia Institute of Technology	CDA Implementation in Low-through High Density Traffic	$180,000	S. Lui	J-P. Clarke
Pennsylvania State University	Sonic Boom Mitigation	$60,000	L. Fisher	V. Sparrow
Pennsylvania State University	Noise Quest	$77,000	B. Hua	A. Atchley
University of North Carolina	Investigation of Air Quality Impacts of Aviation Emissions - Case Studies for T.F. Green and Atlanta Airports	$109,988	M. Gupta	S. Arunachalam
Harvard University	Health Impacts of Aviation-Related Air Pollutants	$192,410	M. Gupta	J. Levy
Pennsylvania State University	Quantifying and Mitgating the Impact of Aircraft Noise on People	$114,000	M. Marsan	A. Atchley
University of Missouri - Rolla	PM and HAPs Emissions Characterization for a Gas Turbine Engine Using an Alternative Fuel	$250,000	C. Ma	P. Whitefield
University of Missouri - Rolla	UMR COE for Aerospace Particulate Emissions Reductions Research Continuation	$324,000	C. Ma	P. Whitefield
Georgia Institute of Technology	APMT Development	$200,000	M. Locke	D. Mavris
Georgia Institute of Technology	EDS Tool Development	$1,000,000	J. DiPardo	D. Mavris
Purdue University	Noise Quest	$25,000	B. Hua	K. Li
Purdue University	Quantifying and Mitigating the Impact of Aircraft Noise on People	$114,000	M. Marsan	P. Davies

PARTNER				
University Recipient	Grant Title	Amount	FAA Point of Contact	University Point of Contact
Purdue University	Sonic Boom Mitigation	$60,000	L. Fisher	P. Davies
Purdue University	Sound Transmission Modeling	$72,000	L. Fisher	K. Li
Purdue University	Health Effects of Noise	$72,000	M. Marsan	P. Davies
Massachusetts Institute of Technology	Environmental Design Space	$300,000	J. DiPardo	I. Waitz
Purdue University	Network Restructuring Scenarios for ATO Forecasts	$50,000	J. Post	D. DeLaurentis
Massachusetts Institute of Technology	Program Management for Aircraft Noise and Aviation Emissions Mitigation Center of Excellence	$170,200	L. Maurice	I. Waitz
Massachusetts Institute of Technology	Investigation of Air Quality Impacts of Aviation Emissions Using CMAQ	$111,500	M. Gupta	I. Waitz
Massachusetts Institute of Technology	Program Management for Aircraft Noise and Aviation Emissions Center of Excellence	$124,8600	L. Maurice	I. Waitz
Georgia Institute of Technology	APMT Development	$117,032	M. Locke	D. Mavris

4.3.4 COE for General Aviation Research (CGAR)

Selected by the Secretary of Transportation in 2001, Embry-Riddle Aeronautical University serves as the lead for the COE for General Aviation Research. The FAA, members and affiliates evaluated CGAR during FY 2007 and as a result CGAR will continue to conduct safety-related R&D with application to non-commercial aviation through 2011. In FY 2007, the FAA negotiated new cooperative agreements with core members: Wichita State University, the University of North Dakota, and the University of Alaska – Fairbanks and Anchorage.

The FAA safety organizations have supported 100 tasks while preparing more than 200 students to serve the aviation community. FAA grants and contracts awarded to this CGAR and matching funds provided by the university members and industry affiliates total $33 million to date. For further information regarding this COE, see http://www.cgar.org

Table C.4.3.4 – Grants Awarded in 2007 for
COE for General Aviation Research (CGAR)

CGAR				
University Recipient	Grant Title	Amount	FAA Point of Contact	University Point of Contact
Wichita State University	Operational Loads Monitoring of Firefighting Airplanes	$50,262	T. DeFiore	K. Rokhsaz
Embry-Riddle Aeronautical University	Year Seven - Management & Administrative Support - General Aviation Center of Excellence	$33,000	P. Sparacino	S. Hampton
Embry-Riddle Aeronautical University	Command, Control, and Communication for Unmanned Aircraft Systems: Technology Survey and Regulatory Gap Analysis	$86,126	T. Vu	T. Wilson
Embry-Riddle Aeronautical University	Regulatory Gap Analysis for Detect, Sense, and Avoid	$79,327	J. Zvanya	T. Wilson
Embry-Riddle Aeronautical University	Gap Analysis/Risk Analysis for UAS Propulsion Systems	$47,036	X. Lee	T. Wilson
Wichita State University	Detection & Prevention of Carbon Monoxide Exposure in General Aviation Aircraft	$210,000	M. Vu	S. Cheraghi
Embry-Riddle Aeronautical University	Establish a North American Bird Strike Advisory System	$56,250	R. King	A. Dickey
Embry-Riddle Aeronautical University	Development of an Aviation Weather Database Weather Encounters (Phase I)	$99,981	AJP-6360	Bazargan
Embry-Riddle Aeronautical University	Evaluating the Effectiveness of ADS-B in the Collegiate Flight Training Environment	$344,836	AJP-6340	Schumacher
Embry-Riddle Aeronautical University	Course Development for Qualification Training for Technically Advanced Aircraft	$37,488	AFS-520	Hampton

4.3.5 Airworthiness Assurance COE (AACE)

Selected by the Administrator in 1997, the Airworthiness Assurance Center of Excellence is a multi-institutional, multi-disciplinary team that includes 32 academic members. AACE has conducted safety-related R&D in aircraft maintenance, inspection and repair, crashworthiness, propulsion and fuel systems safety, and advanced materials. The members of this partnership completed their 10-year requirements as an Air Transportation Center of Excellence on September 11, 1007.

Grants and contracts awarded by the FAA and matching contributions provided by industry and academia have exceeded $100 million and helped prepare more than 550 students to serve the aviation community. For further information see http://www.coe.faa.gov/aace

Table C.4.3.5 – Grants Awarded in 2007 for Airworthiness Assurance COE (AACE)

AACE				
University Recipient	Grant Title	Amount	FAA Point of Contact	University Point of Contact
Ohio State University	The Evaluation of Cold Dwell Fatigue in Ti-6241	$150,000	J. Wilson	J. Williams

4.3.6 National Center of Excellence for Aviation Operations Research (NEXTOR)

Selected by the Administrator in 1996, the National Center of Excellence for Aviation Operations Research (NEXTOR) has been managed by five universities: the University of California at Berkeley, Massachusetts Institute of Technology, Virginia Polytechnic Institute, the University of Maryland, and George Mason University. NEXTOR performs R&D in the following areas: traffic management and control; human factors; performance metrics and measurements; safety data analysis; scheduling, workload management and distribution; navigation, communications, data collection and distribution; and aviation economics. The FAA, NEXTOR university members, and industry affiliates conducted a rigorous 10-year evaluation and determined in 2007 that this team has successfully completed its obligations serving as an Air Transportation Center of Excellence dedicated to the FAA.

Over the past decade, grants, contracts and matching funds have totaled more than $50 million and helped prepare more than 350 students to serve the aviation community. NEXTOR is now serving the FAA, other public and private organizations, and the aviation community as a fully successful national resource, as originally designed. For further information see http://www.nextor.org

4.3.7 COE for Airport Technology

Selected by the Administrator in 1995, the FAA expanded the scope of the COE for Airport Pavement Research as a result of the Phase I evaluation and changed its name to Airport Technology. The Center is led by the University of Illinois at Urbana-Champaign and conducts research in airport pavement technology, wildlife hazard mitigation, lighting, and related topics. The Center has entered into a 5-year cooperative agreement to continue operation as an Air Transportation Center of Excellence through 2010. Other member universities include: Northwestern University, Georgia Institute of Technology and Rensselaer Polytechnic Institute. Special outreach activities have included an ongoing partnership with the North Carolina A&T.

The FAA has provided $11 million in grant funds to support more than 30 tasks, and has supported the education of more than 75 graduate students to serve the aviation community over the life of this COE. To date, the university members and industry affiliates have provided $11 million in matching funds as mandated in COE enabling legislation. For further information see http://cee.uiuc.edu/research/coeairporttech/

Table C.4.3.7 – COE Grants Awarded in 2007 for Airport Technology

Airport Technology				
University Recipient	Grant Title	Amount	FAA Point of Contact	University Point of Contact
University of Illinois - Urbana Champaign	Deployment and Operation of FOD Detection Systems at Airports	$500,000.00	E. Herricks	J. Patterson
Rensselaer Polytechnic Institute	Evaluation of Elevated Runway Guard Lights	$110,000.00	N. Narendran	D. Gallagher
Rensselaer Polytechnic Institute	Investigation of PV-LED Lighting System	$75,000.00	N. Narendran	D. Gallagher
Rensselaer Polytechnic Institute	Visual Guidance Support	$152,912.00	E. Herricks	D. Gallagher
University of Illinois - Urbana Champaign	GIS, Hazard Assessment, and Hazard Visualization as Components of Wildlife Management Programs at Airports	$313,885.00	E. Herricks	R. King
University of Illinois - Urbana Champaign	Deployment and Evaluation of Avian Radars	$828,885.00	E. Herricks	R. King
University of Illinois - Urbana Champaign	Center of Excellence for Airport Technology - CEAT	$421,893.00	D. Lange	D. Brill
Rensselaer Polytechnic Institute	Metrics and Measurement Procedures for LED Lighting Systems	$150,000.00	N. Narendran	D. Gallagher

APPENDIX D: Research, Engineering and Development Advisory Committee (REDAC)

The Federal Aviation Administration (FAA) values the ongoing involvement of the Research, Engineering and Development Advisory Committee in reviewing its current and planned research and development programs. The FAA has established a formal process for the agency to reply to Committee recommendations. This document summarizes recent Committee recommendations with the FAA responses. In fiscal year 2007, the Committee submitted and/or the FAA responded to the following reports:

- *Review of the FAA Fiscal Year2009 R&D Program Plans*, June 12, 2007
- *Guidance for the FAA Fiscal Year 2009 R&D,* November 13, 2006
- *Separations Standards Working Group Final Report,* September 20, 2006

In fiscal year 2008, the FAA expects to receive the Committee's recommendations on the FAA's planned research and development investments for fiscal year 2010, including detailed recommendations from the standing subcommittees. Note that the REDAC recommendations were based on an initial assessment of research and development needs for fiscal year 2009.

1. ***Review of the FAA Fiscal Year2009 R&D Program Plans*, June 12, 2007**

The Aircraft Safety Subcommittee was unable to meet due to scheduling and member health issues. Some safety issues were reviewed by the full REDAC, which was briefed on the status of the Aviation Safety Information and Sharing System (ASIAS). The REDAC feels that ASIAS is an important cornerstone of the FAA safety strategy and was encouraged by the collaboration between the FAA and NASA in the development of methods of advanced data analysis. The Committee also cautions that the expectations for ASIAS will push the state of the art and will require significant intellectual capability and effort.

FAA Response: We were pleased to have had the opportunity to present a detailed briefing on the Aviation Safety Information Analysis and Sharing (ASIAS) requirement to the full REDAC, as well as respond to the other recommendations of the Aircraft Safety Subcommittee (SAS) from their meeting held in August 2006. We appreciate the support and feedback from the Committee regarding the Agency's ASIAS plans. We recognize that developing and implementing ASIAS will be a challenge, but one we look forward to given the anticipated benefits to aviation safety. We believe the team of the FAA, NASA, MITRE/CAASD, and industry partners that we have assembled is well qualified to meet that challenge. We look forward to future reviews of our progress on ASIAS with the Subcommittee, which has now been fully reconstituted under the leadership of Dr. Michael Romanowski.

Subcommittee on Airports

Recommendation: The subcommittee is pleased with the co-operation that has been exhibited between the FAA Technical Center and the projects that are being funded by the Airports Cooperative Research Program (ACRP). The Subcommittee is particularly pleased with the efforts that are being made to eliminate any duplication of effort between FAA research efforts and those of the ACRP.

FAA Response: The FAA, through its membership on the ACRP Board of Governors, will continue to review all ACRP topic submittals to identify and take appropriate action to avoid any duplication of efforts between ACRP and the Airport Technology Research Program.

Recommendation: The Subcommittee recommends further staffing increase of 2 positions in the Airport R&D Branch. One position for safety projects and one position for pavement research. The positions are necessary to support the significant growth of Airport Technology Research from $7.5 million to over $18 million in the FY 2008 request.

FAA Response: The FAA concurs and has requested a position for Airport Technology Research in the Fiscal Year (FY) 2008 President's budget and a second position is under consideration in the FY 2009 budget.

Recommendation: The Subcommittee encourages the support of the Wm. J. Hughes Technical Center in helping AAR-410 in obtaining permits, etc. to construct the pavement test lab that has been planned and funded.

FAA Response: The FAA agrees and is working with the William J. Hughes Technical Center to obtain the appropriate permits.

Recommendation: The Subcommittee strongly supports the proposed research tasking in:

- Airfield pavement friction and roughness studies
- Fire fighting techniques for 2nd level fires and composite fires
- Bird detection and wildlife control
- Airfield pavement behavior and longevity
- LED and Retro-reflective lighting devices for General Aviation airports
- Continued research and promotion of EMAS installations
- Initiation of an environmental research (runoff water quality) task within AAR-410
- Continued testing of low cost Foreign Object Detection (FOD) radars at airports

FAA Response: We will continue research on these topics. In the water quality runoff initiative, since there are ACRP projects underway in this area, we believe it is appropriate to wait until those ACRP projects are completed before determining what additional research is required in airport water quality.

Recommendation: The Subcommittee is very pleased with the initiation of work in an environmental area that has been the bane of many airports large and small across the United States in recent years - that of the detrimental environmental aspects of the effect on ground water quality due to runoff from airfield pavements. The Subcommittee commends the Airport Technology Branch for moving into this critical area, the impact of which can be highly beneficial both to the environment and to the airports themselves. The Subcommittee supports including $500,000 in the FY 2009 budget request for research on water quality issues. This water quality research initiative also has the strong support of the Environmental Subcommittee.

FAA Response: As indicated in our response to number 4, since there are ACRP projects underway in this area, we believe it is appropriate to wait until those ACRP projects are completed before determining what additional research and funding is required in airport water quality.

Subcommittee on Environment and Energy

The subcommittee identified the following specific issues as matters to bring to the attention of the Administrator.

Issue 1: Subcommittee maintains that environment is a key – if not the key – constraint to NextGen. Subcommittee commends the Administrator for her leadership providing resources under the NextGen Finance Reform proposal to address aviation environmental issues in FY08 and beyond. All members unanimously supported CLEEN and believe the FAA needs to ensure it is ready to execute this important effort.

Recommendation: Immediately convene a task group – under the auspices of the REDAC E&E subcommittee to weigh options for establishing the CLEEN consortium and recommending how to implement. Need to ensure that all key stakeholders are engaged. Secure some seed funding to do a detailed program plan.

FAA Response: We agree that ensuring we are ready to effectively manage the Continuous Low Energy, Emissions and Noise (CLEEN) effort is critical to its success. We are seeking new approaches that will foster creativity and effective partnerships to develop new clean and quiet technologies and alternative fuels. We will convene a task group of the Environment and Energy REDAC subcommittee to advise us on approaches to managing this consortium, and look forward to your inputs. We are also reviewing budget priorities within the Environment and Energy R&D portfolio so we can start developing detailed program plans for CLEEN in FY 2008.

Issue 2: Subcommittee is concerned that the right emphasis be placed on addressing airport environmental needs in the short term. Subcommittee commends the

Administrator for the proposal to expand the ACRP program, dedicating $5 million to environmental issues. The subcommittee encourages the FAA to work with Airports and other stakeholders to ensure that the ACRP environmental program has a strategic vision and avoid any duplication of efforts.

Recommendation: Work with the TRB to add a position on the ACRP Board to be filled by FAA's Office if Environment and Energy. Ensure that FAA's Office of Environment and Energy as well as appropriate Office of Airports staff are fully engaged with all ACRP environmental projects through participation in the panels formed to oversee the projects.

FAA Response: We support the ACRP and hope that Congress will make this pilot program permanent and increase its funding to address environmental issues. While we agree with you that it is important that FAA staff engages with the Transportation Research Board (TRB) in this critical endeavor. ACRP is set up independently of FAA through a Memorandum of Agreement. That Memorandum includes a Board of Governors with one position for FAA, currently filled by the Office of Airports. We will explore approaches to ensure the Office of Environment and Energy also engages with the TRB, while not compromising the independence of the ACRP. About the need for a strategic vision for the ACRP, you should convey your views to the ACRP Board of Governors, as directing such an effort is not our decision.

Issue 3: Subcommittee believes that clean and quiet operational procedures have the potential to provide significant environmental mitigation in the short to mid term, complementing the benefits we derive from technologies. The Subcommittee commends the Administrator for innovative proposals like the Environmental Mitigation Demonstration Pilot Program and the augmentation of RE&D and Capital 1 funding to address procedures. The subcommittee expressed concerns that some airports may not be able to participate in the pilot program because their regional mitigation funds were already committed for several years.

Recommendation: Ensure that funding made available for the Demonstration program is widely available to all airports and not constrained by commitments already in place for mitigation.

FAA Response: We agree that the Environmental Demonstration Pilot Program is a key element of our environmental mitigation strategy and that it is important that airports interested in participating have every opportunity to do so. We will address your concerns as they draft guidance for implementing the program.

Issue 4: Subcommittee was very pleased with the augmentation in RE&D and Capital 1 budget to support NextGen needs. The subcommittee endorsed the FY09 budget request and urged the Administrator, the Department and the Office of Management and Budget to support the FY09 budget as presented in the FY08 NARP. Subcommittee members felt that this was a good step – but that given the potential benefits of mitigating impacts (billions of dollars), that investment decisions may need to be revisited in the future, particularly in CLEEN and climate impacts research. Members also suggested some minor wording changes to Sect 606 (CLEEN) of the Administration NextGen Finance Reform Bill proposal. However, they recognized that the proposed legislation has gone to the Hill and FAA was not in a position to make these edits. Individual Members indicated they would pursue this through the legislative committees.

Recommendation: For NextGen RE&D a) Consider CLEEN a pilot program. After weighing success, consider expansion. b) Continue to work with CCSP to establish a robust aviation climate impacts research program with appropriate levels of funding.

FAA Response: We agree that it is important that we evaluate the effectiveness of the investment in CLEEN before considering further growth. We continue to work with the Climate Change Science Program and its participating agencies to develop a robust research program to address aviation climate impacts.

Issue 5: Subcommittee was encouraged by the move to and funding allocated towards establishing an Environmental Management System. However, there were concerns that this has not fully been scoped.

Recommendation: Direct the Office of Environment and Energy to provide the subcommittee a detailed description of the concept of EMS, including how it would be used; as well as how RE&D and Capital 1 programs will support its development at the next subcommittee.

FAA Response: The Office of Environment and Energy is working with our stakeholders to refine the concept of EMS. They will provide the Environment and Energy Subcommittee a detailed description on the concept and our R&D plans to enable its elements at the next subcommittee meeting in August 2007.

Subcommittee on Human Factors

The subcommittee identified the following issues.

Recommendation: The FAA needs to increase its human capital and expertise in the area of human factors. There is a general concern regarding the national aviation human factors capability. The FAA and others are having difficulty filling current human factors openings and the FAA should take a leadership role in rejuvenating the aviation human factors field.

FAA Response: The FAA ATO-P Human Factors Group will use its national leadership position to help develop the Nation's expertise in aviation human factors and fill key positions. Proposed increases in human factors funding for NextGen systems will create a stable foundation for the development of this expertise in industry and academia. The FAA will continue to work with its national and international partners to highlight this critical need.

Recommendation: Human-Systems integration considerations will be critical for NextGen. Many of the key concepts proposed for NextGen have significant human factors issues. The subcommittee recommends that the FAA and JPDO assure that human factors lessons learned are integrated into NextGen concepts and that Human-System performance metrics and risks are considered. Human factors considerations should be included early in the development process and extend beyond the operational concept to include human-system integration, procedures, selection, and training. It will also be necessary to develop a strategy to manage human factors considerations in the development process with methods such as simulation and in-use human assessment

FAA Response: The ATO-P Human Factors Group will continue to work with other FAA offices and the Joint Planning and Development Office to ensure that human factors lessons learned regarding controller-pilot-data link communication and human-automation interaction are integrated into NextGen concepts, planning, research and development. New forms of human error will arise from NextGen systems that require a higher degree of automation and air-ground coordination in network-enabled operations. Human error mitigation strategies, risk management approaches, and system performance metrics will use formal methods such as computational human performance modeling and human-in-the-loop simulations to increase efficiency, capacity, and safety.

Recommendation: The research requirements process could be more effective if it included a longer term component and had more continuity. The current process is effective at linking research and operational units but tends to focus on short term emergent concerns. The committee recommended a portfolio approach with some focus on longer-term NextGen issues to achieve portfolio balance.

FAA Response: The ATO Operations Planning service unit is putting in place a set of mechanisms that will enable the FAA to generate and prioritize research requirements that address mid-term NextGen needs. Proposed NextGen human factors funding will allow the FAA to balance mid-term requirements with continuously emerging short-term concerns.

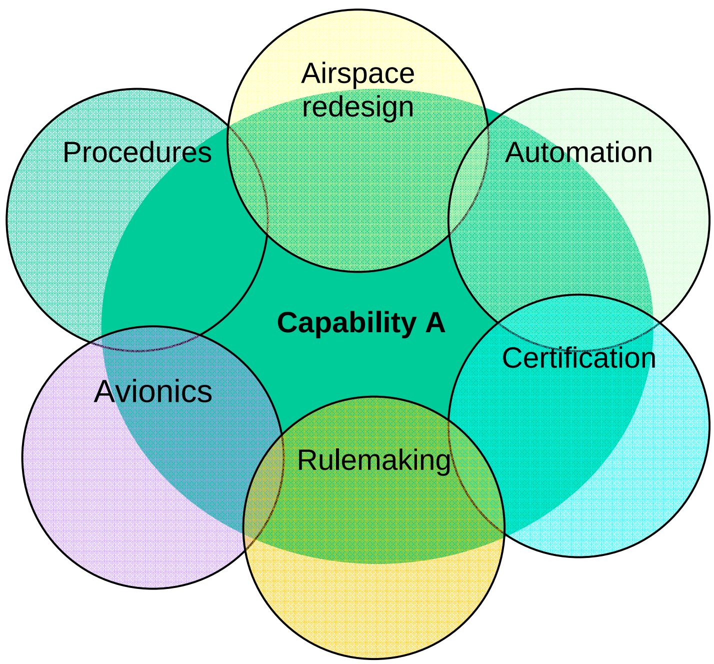
NAS Operations Subcommittee

Finding 1: The forecasted increase in demand leads not only to a requirement for the NextGen capabilities and paradigms to increase capacity, but also for a reduced combined ANSP/user per-operation cost in NextGen to decrease overall system costs. Most of the research presented, however, did not provide a potential life-cycle cost assessment.

Recommendation: R&D projects, even at very early stages, should be presented with some attention to the life-cycle costs impact on the ATM system and system users, with improving fidelity of these estimates being provided as the R&D matures toward the OEP Core.

FAA Response: We agree that life-cycle costs are very important. The FAA Acquisition Management System includes a life cycle cost analysis as part of the decision to invest in a product. The R&D phases precede the life cycle cost analysis but support the collection of performance and rough order cost data. However, the R&D activities are designed to validate the technical performance and operational benefits of a particular technology. The products assessed and developed are evaluated against various criteria including performance, operational benefits, and life-cycle cost before the Joint Resource Council final decision to invest. In many cases the NextGen benefits will be realized with the delivery of multiple products that deliver a service capability, therefore the life-cycle cost must consider the benefits derived from the complete set of products that make up that capability.

Finding 2: In several briefings, the connections of the R&D to the requirements of instantiating the NextGen system, such as examining the impact on safety or assessing stakeholder perceptions, were not made.



Recommendation: The capability paradigm which is used by ATO-P for OEP and addresses multiple dimensions of technology development and insertion should be addressed in each research project.

FAA Response: The capabilities needed to enable NextGen are contained within several solution sets. This capability/solution set paradigm is new as part of the Operational Evolution Partnership (OEP) process and so has not yet been reflected in current research and development projects. However, starting in FY2009, all NextGen Research and Development is being organized by the OEP Solution Sets (*e.g.*, Trajectory Based Operations, High Density Terminal and Airport Operations, *etc.*) that are necessary to realize the NextGen concept of operations. Each solution set has a portfolio of capabilities, each of which in turn requires various Agency activities as illustrated (e.g., technology development, procedural development, airspace redesign, avionics, etc.). These various activities will be included in the R&D descriptions and plans up to implementation and investment decision points.

Finding 3: The NextGen paradigm implies different roles and responsibilities for the humans in the system, both in the air and on the ground, as well as new interactions among them. The briefings on Human Factors research relevant to NAS Ops in NextGen implied that the research was acting more as an integrator of concepts than in its critical role as an early definer of acceptable con-ops through focused research on human performance issues.

Recommendation: The RED and ATO-Cap HF program funding and organizational construct should be examined from the standpoint of NextGen implementation.

FAA Response: The Human Factors Research and Engineering Group is addressing both air-ground system integration and defining roles and responsibilities of people and automation in NextGen systems. The Air Traffic/Technical Operations Human Factors research and engineering program management is working closely with the Operations Planning Air Traffic Systems Concept Development Group as NextGen work plans are developed for FY 2008 and beyond. This collaboration began in the area of Staffed Virtual Towers where the Human Factors Research Program is responsible for defining the roles and responsibilities of the humans in the NextGen concept. We will apply this model of cooperation to the other NextGen concepts where human roles and responsibilities must be evaluated.

Finding 4: The Subcommittee views with alarm the move of FAA sponsorship of its weather R&D out of ATO. NAS OPS Subcommittee has a working group defining the important needs for Weather/ATM Integration, and the critical impact of this integration on solving the capacity problem. The change in FAA R&D sponsorship may hinder the changes needed in the R&D.

Recommendation: The FAA should evaluate carefully the recommendations of the Weather/ATM Integration Working Group that will be presented at this meeting. Some improved focus and integration of the weather R&D within the FAA should be implemented.

FAA Response: We agree with your recommendation and plan to carefully evaluate the recommendations of the Weather/ATM Integration Working Group. FAA has made two changes to better integrate research and development for weather with that of air traffic management (ATM). First, ATO-P has recently completed a reorganization to better align with NextGen. The Director of the newly created Aviation Weather Office reports directly to the ATO-P Vice President to ensure greater senior level attention to strategic weather issues. This office now incorporates all weather planning activity, including policy and requirements, research and development, and transitioning new weather concepts from prototype to investment decision. This change reflects the importance and priority placed on weather as part of NextGen development for ATM. Second, to support broader aviation corporate needs, a joint ATO/AVS Program Planning Team has been formed to recommend guidance and priorities for weather R&D. This collaboration is intended to reflect that weather is a critical cross-cutting need of FAA customers, requiring improvements in both safety and efficiency. The new Aviation Weather Office will execute the research program in a manner to provide a balance between the two major lines of business, ATO and AVS, in developing weather research requirements and in ensuring aviation weather research is integrated into future operational capabilities.

Finding 5: The routine integration of Unmanned Aircraft into the National Airspace System is transformational. Concepts in NextGen (e.g., Trajectory-based operations) may facilitate this transformation. Previously the subcommittee had observed that the funding level for UAS-related research did not reflect the complexity of the technical and operations issues associated with their routine integration into civil airspace. Funding appears to have decreased further. The subcommittee is concerned that there does not appear to be a direct tie among NextGen transformation activities and UAS R&D activities as outlined in the NARP. The subcommittee was not able to discern that the necessary research (e.g., economics and other drivers for UAS applications) is being done to inform policy decisions.

Recommendation: The FAA should review the magnitude and implementation of its UAS-related research investment to ensure that funded activities can best inform critical policy decisions and that the agency is positioned to integrate this transformational technology in the evolution towards NextGen.

FAA Response: The Office of Aviation Safety established the Unmanned Aircraft Program Office this past year and this office is close to completing a five-year program plan, which is yet to receive staffing or resources, for implementing UAS into the NAS. The plan includes the need to define any/all research projected to integrate this transformational technology in the evolution towards NextGen. The plan and this research activity will be evolving over the next few years.

2. *Guidance for the FAA Fiscal Year 2009 R&D*, November 13, 2006

Subcommittee on Airports

Recommendation: Recommends close cooperation between the FAA Technical Center and the Airports Cooperative Research Program for any and all projects that relate to airports so as to avoid duplication of effort and/or redundancies.

FAA Response: The Deputy Associate Administrator for Airports, Catherine Lang, is a member of the Airport Cooperative Research Program (ACRP) Board of Governors. She reviews each ACRP topic to avoid any duplication with the FAA Technical Center research on airport technology projects.

Recommendation: Continues to recommend an increase in staffing at AAR-410 (Airport Technology) in order to allow for the above cooperation to be thoroughly carried out, in addition to the tasking that is entailed in the increased funding levels that Congress has approved.

FAA Response: The FAA agrees. The Fiscal Year (FY) 2008 budget submission includes an increase of one engineer for the Airport Technology Research staff.

Recommendation: Among the many projects that the Technical Center organizations are carrying out, the Subcommittee especially supported the proposed research tasking on:

a) Foreign Object Damage (FOD) detection radar,
b) Fire fighting techniques for second level (upper deck) fires,
c) Wildlife hazard mitigation, and
d) Airfield pavement behavior and longevity research.

A number of added topics were discussed and considered during the summer meeting of the Subcommittee and a few were singled out for special attention.

(I) The results of the study of visual screens for applications at airports that are installing end-around taxiways, should be more widely disseminated in order to encourage the use of the excellent research that was performed by the Technical Center.

(II) The effort to instrument a section of concrete taxiway at the Atlanta airport to collect real-world data from a live-use installation was strongly encouraged.

(III) The installation of g-load sensors aboard the FAA-owned fleet of jet aircraft be considered for application to the surface ride quality (runway roughness) research task.

FAA Response: The FAA agrees that these are priority projects and intends to pursue them in FY 2007.

Subcommittee on Environment and Energy

Issue 1: The subcommittee members once more expressed their concern about the imbalance of FAA environmental investment in mitigation (via the Airport Improvement Program Noise/Emissions set aside) versus research to address better management of the environmental issues of aircraft noise and engine emissions.

Recommendation: Given the relative benefit of each investment, the subcommittee recommends that FAA seek ways of expanding the uses of noise/emissions mitigation funding activities through the upcoming reauthorization process. This expansion should include allowing airports to propose the demonstration of new operational procedures or technologies to mitigate environmental impacts.

FAA Response: The Administration's reauthorization proposal includes a request for substantial increases in research and development funding as well as several proposals to expand the uses of noise/emissions mitigation funding to address environmental impacts at the source. We are asking for authority to establish a research consortium for lower energy, emissions and noise (CLEEN) technology that can pursue technology goals to significantly reduce aviation noise, emissions, and fuel consumption**.** We will fully brief the subcommittee on all proposals at the spring 2007 meeting.

Issue 2: The subcommittee expressed a general sense that developing the NexGen system will require substantial additional environmental RE&D resources. The committee noted that there are program gaps (the termination of NASA's Quiet Aircraft Technology (QAT) and Ultra Efficient Engine Technology (UEET) efforts before meeting their goals) as well as funding gaps caused by new demands from NexGen. Members also noted that in view of Clean Sky (Europe's new initiative to invest in noise and emissions RE&D), which is funded $300M per year, the leadership goal of NexGen in the environment area was also in question if FAA does not step up and makes the necessary investments.

Recommendation: The subcommittee recommends that the Administrator seek budget authority through the upcoming FAA Reauthorization, and follows through with appropriations requests, to meet the RE&D needs of NexGen. This includes a potential additional investment of $40 million on environmental RE&D.

FAA Response: The FAA has asked for additional budget authority totaling nearly $40 million on environment research starting in Fiscal Year 2009. We have also have asked for the authority to establish a new pilot program to fund six projects at public-use airports that would take promising environmental research concepts proven in the laboratory into the actual airport environment for demonstration. The funding for this effort would come from the AIP noise and emissions set aside.

Issue 3: The subcommittee members noted that issues associated with aviation's impact on earth's climate are increasingly coming to the forefront worldwide. The US is frequently placed in a defensive position against European policy proposals that are not always based on scientific facts. Given that the U.S. is responsible for 40% of the world's aviation activity and needs aviation as a form of mass transit, the nation must have a robust research program to be in a position to ensure any actions undertaken to mitigate aviation's climate impact are based on solid science and will have the desired outcome.

Recommendation: The subcommittee recommends that the Administrator establish a robust RE&D effort toward addressing the uncertainties associated with aviation's impact on earth's climate. This effort should be accomplished not only by providing new FAA resources, but also by engaging the senior leadership of the Federal agencies participating in the U.S. Climate Change Science Program (CCSP) to ensure their investments address this important issue.

FAA Response: The FAA agrees that we need to address the many uncertainties associated with aviation's impact on earth's climate. The FAA held a workshop on "*Impacts of Aviation on Climate Change*" in June 2006 to assess the state of knowledge and identify key uncertainties and ongoing or needed research to help us address these uncertainties. Workshop participants also identified how some additional funding might be targeted to take advantage of current funded research programs to address aviation specific issues. We are currently holding discussions with CCSP participants to identify current, planned, and potential new research that may address these needs. We have also asked for budget authority starting in Fiscal Year 2009 to address this important issue.

Issue 4: Subcommittee members commended the FAA for actions taken in the last six months to address fuel availability/energy independence. The subcommittee feels this is a key strategic issue and needs continued focused attention and resources. Members also expressed that it is important to continue working this area, even if fuel prices drop in the short term.

Recommendation: The subcommittee recommends that the Administrator direct AEE to continue and augment its efforts to work with DoD, DoE, and NASA to advance the use of alternative fuels in aviation. The agency should also augment resources in this area and look beyond environmental issues to also address reliable energy supply and any safety issues associated with the use of aviation alternative fuels.

FAA Response: We agree with the subcommittee's views. My staff is engaged with the Departments of Defense and Energy, the National Aeronautics and Space Administration (NASA), the Air Transport Association, Aerospace Industries Association (AIA) and Airports Council International – North America in the Commercial Alternative Aviation Fuels Initiative. The group has drafted a national alternative fuels roadmap and is working on refining it. I have also allocated over half a million dollars to a study addressing outstanding questions about the use of alternative fuels in commercial aviation. We have also asked for budget authority starting in Fiscal Year 2009 to further develop alternative fuels for civil aviation.

Issue 5: The subcommittee commended recent efforts under the Airports Cooperative Research Program (ACRP) to address pressing particulate matter (PM) and hazardous air pollutants (HAPs) research issues. However, the subcommittee members feel that there are still many needs and that the ACRP efforts only scratch the surface.

Recommendation: The subcommittee recommends that the Administrator continue to seek additional resources to address PM and HAPs RE&D issues. This includes ensuring that ACRP efforts have a strategic long term view toward addressing PM and HAPs issues that affect airports beyond the present limited scope.

FAA Response: While we have been unable to increase investment in particulate matter (PM) and hazardous air pollutants (HAPs) research in our core budget, these issues are receiving attention through the Airports Cooperative Research Program. In the

Administration's reauthorization proposal, we have asked for an increase in Airports Cooperative Research Program (ACRP) funding from the Airports Improvement Program (AIP) from $10 million to $15 million per year, of which at least $5 million is specifically targeted to research related to the airport environment. We expect some of this funding will be targeted to address airport HAPs and PM issues.

Subcommittee on Aircraft Safety

Recommendation: System Safety Management TCRG: The Subcommittee on Aircraft Safety (SAS) has historically been supportive of the development of a systematic approach to safety management based on data; data mining and rigorous risk assessment because it believes that such an approach, if successfully implemented, would offer significant safety benefits in the long term. At the same time, SAS has been consistently critical of the lack of technical performance on past projects in this area as well as the lack of a clear definition of how such a system would be implemented.

Nevertheless, SAS cannot support at this time the plan of the System Management TCRG, as presented, for the following principal reasons:

1. The plan does not describe how such a system would be implemented and what the FAA's commitment is to full implementation.
2. Since the plan represents a key element of the future of the FAA's safety management, it needs to be coordinated with the Joint Planning and Development Office (JPDO). It was not apparent that such coordination was part of the plan.
3. The plan should include all aviation sectors, including GA.
4. The poor past technical performance record in this area – more than $35 million have been spent over the past 14 years on projects ranging from SPAS to SASO without major safety benefits having become visible.
5. Funding the plan would divert major resources from other areas of FAA aircraft safety research. The plan does not provide an argument for such a redirection of priorities based on a comparative cost-benefit analysis.

Because SAS suspects that a System Safety Management approach along the lines proposed, if properly conceived and executed, would provide major safety benefits long into the future, it recommends that the plan be subjected to an in-depth review by a competent review panel of experts. SAS suggests that such a review panel be established under the auspices of the National Academy of Sciences. A successful review would not only provide a solid basis upon which to make the needed difficult funding choices but it would also enhance the credibility of the entire program, which might result in stronger congressional support.

FAA Response: The System Safety Management TCRG research requirements were presented to the SAS. The research plans for those requirements are in the early stages of development. We intend to offer more detailed plans at the spring 2007 SAS meeting that will clarify the approach, goals, and realizable benefits of this important effort. The following paragraphs address each of the Subcommittee's comments on this recommendation.

1. The plan does not describe how such a system would be implemented and what the FAA's commitment is to full implementation.

   AVS has committed to deploying a Safety Management System, Safety Risk Management, and to supporting an FAA Aviation Safety Information Analysis and Sharing (ASIAS) initiative internally in 2007. Prior data sharing projects will be aligned and refocused to support this ASIAS initiative as reflected in the AVS 2007 Business Plan. The Commercial Aviation Safety Team (CAST), FAA, NASA, and MITRE have recently agreed to collaborate on demonstrations of ASIAS tactical projects in 2007 and begin implementation in 2008. These collaborative efforts represent significant budget and resource commitments. A basic ASIAS development plan has been approved by CAST based on this collaboration and an approved CAST information sharing requirements document.

2. Since the plan represents a key element of the future of the FAA's safety management, it needs to be coordinated with the Joint Program Development Office (JPDO). It was not apparent that such coordination was part of the plan.

   It has always been our intent to coordinate with the JPDO in this important effort, and we apologize if this was not evident in our presentation at the Subcommittee meeting. The JPDO Safety IPT contains an NGATS ASIAS sub-team that includes members from the SSM TCRG. This sub-team held a meeting in early December 2006 to further coordinate interdependencies between the AVS/CAST and NGATS ASIAS activities and identify any overlaps or gaps in safety risk analysis research requirements for ASIAS. The JPDO Safety IPT has developed Operational Improvements (OIs) proposing to implement an SMS across all member agencies based on the principles of prognostic safety risk management (SRM), Safety Culture, and the ASIAS system. These OIs were presented to the Senior Policy Committee (SPC) of the JPDO on January 4, 2007. We will provide an update on our coordination efforts at the next Subcommittee meeting and will clearly identify requirements where FAA safety research is addressing a JPDO need.

3. The plan should include all aviation sectors, including GA.

   It is our intent to include additional aviation sectors in the future, including general aviation, Department of Defense, Department of Homeland Security, etc., through our coordination within the JPDO. However, the large amount of data available from the commercial sector, as well as the quality of that data, provides major benefits during the development phase of the program.

4. The poor past technical performance record in this area – more than $35 million have been spent over the past 14 years on projects ranging from SPAS to SASO without major safety benefits having become visible.

AVS is committed to implementing a systems safety approach to oversight in an intelligent, orderly fashion. To do this, it is important to continually evaluate current capabilities and limitations, to design a set of steps to resolve those limitations and increase capabilities, and continue to learn at each step.

The two programs referenced, the Safety Performance Analysis System (SPAS) and the Systems Approach for Safety Oversight (SASO), are two steps in the process of implementing a systems safety approach. Started in the early 1990's, SPAS is the organization's primary source of comprehensive, integrated safety information that is used by inspectors, analysts, and managers in developing and adjusting field surveillance, investigation, and other oversight programs, and is now accessed worldwide by over 3,000 users. SPAS interfaces with key fielded oversight programs, such as Air Transportation Oversight System (ATOS) and the National Work Program Guidelines (NPG), collecting raw performance and operational data, and analyzing and summarizing the data. These outputs are used to: 1) identify safety hazard and risk areas; 2) target inspection efforts for air operator, repair station, pilot and mechanic schools to areas of greatest risk; and 3) monitor the effectiveness of targeted oversight actions. Using SPAS, aviation decision makers are now able to make proactive, targeted oversight decisions that eliminate safety hazards before accidents can take place. For example, in 1997 SPAS automated analysis of NPG data identified a large commuter air carrier that was having problems with aircraft maintenance. SPAS flagged the carrier as a high risk operator, and provided detailed information on the specific areas of concern. In addition, SPAS depicted the magnitude of the carrier's deviation from industry norms and indicated the negative effect that the carrier's excessive growth was having on its ability to maintain the airworthiness of its aircraft fleet.

The SASO program began in 2003 and is intended to develop an environment where existing safety management programs, such as the aforementioned SPAS, ATOS, and NPG operate collaboratively. Over the course of the multi-year program, the current suite of Flight Standards information systems and decision support tools will be evaluated, redesigned, and integrated to better support the information requirements of new "system safety based" business processes. Implementation of SASO is expected to begin in 2010, and, when fully implemented, SASO will provide a standard framework for safety oversight, using system safety methods, across all of the FAA's oversight responsibilities. The research for SASO will be completed in 2007, as the SASO Program Office begins development of these oversight tools under F&E funds.

5. Funding the plan would divert major resources from other areas of FAA aircraft safety research. The plan does not provide an argument for such a redirection of priorities based on a comparative cost-benefit analysis.

   The ASIAS System is aimed at reducing future risk, both through ensuring planned interventions against known risks are successful, as well as identifying (and then mitigating and monitoring) future risks. As such, AVS has deemed the research required to meet these challenges as the highest priority and has assigned funding accordingly. Every attempt has been made to adequately fund all areas of FAA aircraft safety R&D.

Recommendation: JPDO: The TCRGs should ensure that they remain informed about short-, medium- and long-term R&D needs. For the long-term component, they need to stay informed about the JPDO's plans. While the latter appeared to be generally accepted, some presentations did a more convincing job than others to describe how JPDO informed their requirements planning.

FAA Response: The FAA plays a leading role in the JPDO. FAA personnel participate in every aspect of the JPDO; in the safety area, this participation is extensive. An FAA Aviation Safety senior executive leads the JPDO's Safety Management Integrated Product Team (IPT), and personnel from the Aviation Safety Office and the Air Traffic Organization's safety research arm serve on that IPT. In addition, the JPDO provides the FAA, and other government agencies, annual guidance on research needed to support the various IPTs. We will take the action to more clearly identify requirements where our research is addressing a JPDO need at our next Subcommittee meeting.

Recommendation: Upset Recovery Simulator Software: Such software would undoubtedly bring safety benefits. However, in view of the severe shortfall in FAA R&D funding, the FAA should try to get the private sector to contribute to the development of such software.

FAA Response: We agree with your recommendation and will work with private industry as appropriate.

Recommendation: Human Factors: Head-up displays for synthetic vision should be capable of integrating enhanced vision information. Enhanced vision systems are about to enter regular service on transport aircraft; it would be impractical to have two separate head-up displays, one for synthetic vision, the other for enhanced vision.

FAA Response: We are not developing any displays. The research planned in that area will review what is being developed by industry with the goal of providing data on the sensitivity of pilot performance, workload, and decision-making on a variety of design parameters that can be used by FAA certification engineers to develop criteria and acceptable means of compliance for these systems.

Recommendation: Electrical Systems: All high-energy batteries should be included, not only lithium ion ones.

FAA Response: We agree with your recommendation; all high-energy batteries are being addressed.

Recommendation: Mil Handbook 17: Continued FAA support is necessary.

FAA Response: We agree with your recommendations and plan to continue supporting this effort.

Recommendation: UAS: The FAA needs to limit its activities to establishing standards and regulations and leave actual product development to the private sector.

FAA Response: We agree with your recommendation. It is not our intent to fund any product development for UAS.

Recommendation: Aging Aircraft: The term "Aging Aircraft" as a budget line item and program area needs to be changed to what it has de facto been for many years: "Continued Airworthiness" or something similar. The old term has outlived its usefulness in the congressional budget process. Instead of encouraging Members of Congress to consider funding a familiar program, it has turned into the negative connotation of an old program that should have completed its mission and should no longer be in need of funding.

FAA Response: We agree that the term Aging Aircraft no longer adequately describes the current focus of research towards more proactive research on continued airworthiness and operational safety. We will make every effort to change the name in the FY 2009 budget submission.

Subcommittee on Human Factors

Recommendation: Training: Simulator Motion Requirements. Reconsideration of motion standards in Part 60 rewrite & ICAO Doc. 9625 and extension of work to advanced maneuver simulations including upset recovery.

FAA Response: Reconsideration of motion standards in the Part 60 rewrite is among many flight simulation issues being addressed by an international working group of the Royal Aeronautical Society. The outcome of the working group's project will be standards to be referred to ICAO for ratification. The plan is that those standards, once ratified, would be reflected in Change 1 to the existing Part 60. There are ongoing research efforts addressing the development of data and the most effective training methods for upset recovery using existing flight simulators.

Recommendation: Safety Data. Review and coordination of databases & programs with reference to tracking and coordinating human factors issues.

FAA Response: The Human Factors Research and Engineering Group (HFRE) is actively developing methods to extract human factors issues in safety data bases such as the Aviation Safety Action Program (ASAP). Human factors are identified and addressed in safety programs under the Voluntary Aviation Safety Information Sharing (VASIS) Aviation Rulemaking Committee. Information is shared across government and industry programs including ASAP and National Aviation Operations Monitoring System (NAOMS).

Recommendation: Performance Measurement. Develop a transition plan for previously NASA funded databases and critical human factors efforts (e.g., LOSA, Flight Automation Issues, Team Performance Modeling, Concurrent Task Management) to industry or other FAA program support bases to avoid loss of critical information and expertise.

FAA Response: The Agency will assess NASA-funded databases and critical human factors efforts to ensure critical information is not lost. Potential impact on current and projected research requirements and associated activities will be evaluated and transition strategies will be implemented where appropriate.

Recommendation: Weather Research and Development Integration. A systematic study across domains of what weather related decisions need to be made to assure appropriate presentation of weather information to decision makers in current and future systems.

FAA Response: Research is underway to address cockpit and air traffic service provider weather information needs. This research will also identify currently available weather products and assess their maturity and usability. It will then address integrated air and ground utilization of weather products for enhanced decision making. This research will help establish a baseline from which future system needs can be effectively ascertained.

Recommendation: NGATS Policy and Procedures. Strongly recommends that the Human Factors Research and Engineering Group be involved in JPDO committees associated with the development of policy and procedure and the coordination of near term R&D to assure human performance capabilities integration, identify human-system failed-mode and safety issues, develop procedure requirements for training, and to assure appropriate functional allocation among human and automated systems.

FAA Response: The Human Factors Research and Engineering Group (HFRE) is working closely with the JPDO to ensure human factors concerns are appropriately addressed and coordinated. HFRE is represented on the NAS Enterprise Architecture Board developing the technical implementation plan to meet the JPDO pre-implementation plan requirements. They are also represented on the Operational Evolution Partnership Review Board overseeing the integrated transition to NextGen capabilities in coordination with JPDO. They are working with the NAS Operations Program Planning Team to identify and communicate human factors issues to the JPDO. The HFRE flight deck and air traffic services research programs have identified research and development gaps needed to transition from near term to NextGen capabilities. HFRE is also represented on the JPDO Agile Air Traffic Management Integrated Product Team.

3. ***Separation Standards Working Group Final Report,*** **September 20, 2006**

Separation Standards Working Group Findings 1- 5:

Recommendations:

Establish an R&D program that will lead to consistent and safe reduction of separation standards and that will support NGATS. The process outlined below for setting separation standards should be adopted. This R&D program should include, but not be limited to:

- Immediate
    - Establish a research program to develop an understanding of the nature and frequency of blunders.
        - Performance Data Analysis & Reporting System (PDARS) appears to be a possible source for needed data.
        - Develop new systems, if needed, for automated reporting of such anomalies.
    - Establish data needs for establishment of separation standards early in NGATS development so opportunities, such as demonstrations, can be used to collect data.
    - If conservative separation standards are put in place, such as RNP Parallel Approach Transition (RPAT), establish a data collection process early in the implementation so operational data's collected to reduce separations in the future.

- Longer Term
    - Conduct research to develop consistent approaches for the development of separation standards with all assumptions stated concisely.
    - Conduct research to improve the methodology for evaluating separation standards against an absolute threshold (target level of safety). In particular, there needs to be a consistent, credible way to take into account the response of humans to rare events.

FAA Response: The FAA supports your recommendations. Establishing data collection processes to identify the nature and frequency of blunders and improve the methodology for evaluating new standards is both rational and necessary. The National Aviation Research Plan (NARP) for 2007 presents the FAA's integrated and performance-based R&D plan that supports current and near operations, and our pathway to achieve the goals of the Next Generation Air Transportation System (NextGen). One long-term goal of NextGen is to achieve a three-fold increase in capacity by 2025. Our plans to achieve this goal while ensuring safety intersect with your recommendations. For example, the NARP sets a milestone in 2015 to demonstrate this 3x capacity increase. Interim activities to achieve this milestone include demonstrations of Traffic Management Advisor (TMA) and Required Area Navigation/Required Navigation Performance (RNAV/RNP) routing. The FAA Performance-Based Navigation Roadmap 2006-2025 (published August 2006) reflects development of additional concepts for dynamic re-routing and conflict probes of RNP routes as ideas we will pursue as near-term (2006-2010) commitments.

Separation Standards Working Group Finding 6:

The next generation air transportation system will have:

- new roles and responsibilities for pilots and controllers and the automation that supports them,
- increased shared situational awareness on board the aircraft that will provide more timely and accurate information including intent of nearby vehicles,
- the potential, through good system design, for fewer unexpected deviations, and
- new backup systems to deal with system/subsystem failures, possibly accepting lesser performance capability than the system being backed up.

As surveillance, navigation, and communication performance increases, including communication of intent, separation standards will be driven more by the need to accommodate system failures than by variations in nominal system performance.

Recommendations:

- Longer Term
  - Establish a research program to develop an understanding of the roles of the human and automation in dealing with failures and the implication of those roles on separation standards.
  - Managing failure gracefully is perhaps the most difficult design aspect of the NGATS. Specific and intense research into the human and automated alternatives will be required.

FAA Response: We agree with the recommendation to establish a research program as suggested. Human Factors Research and Engineering (HFRE) efforts are addressing human and automation performance issues of importance to separation standards in both current and next generation systems. Ongoing R&D efforts will augment human factors guidelines for the design of instrument procedures including the development of future procedures based on RNAV and RNP capabilities. Longer term, HFRE program managers, in conjunction with Aviation Safety (AVS), Air Traffic Organization (ATO) and the Joint Planning and Development Office (JPDO), are helping define effective roles for pilots and controllers in next generation systems and how those roles are best supported by allocation of functions between human operators and automation.

Failure detection and recovery will be difficult design challenges in NextGen. Ongoing planning efforts address graceful failure management by understanding failure modes in the design of equipment and procedures as well as human and automation alternatives for failure detection and recovery. New research efforts must also address how pilots and controllers should be trained on the proper management of failure modes.

Separation Standards Working Group Finding 7:

New technologies (e.g. GPS, ADS-B, CDTI, Datalink) offer the potential for reducing required separations. In particular, GPS-based RNP, together with the concept of containment, provides much more precise control and knowledge of an aircraft's intended trajectory, and ADS-B permits the pilot of other aircraft, as well as the air traffic controller, to monitor the flight path of a proximate aircraft and rapidly sense deviations from its intended path.

Recommendations:

- Immediate
    - As more and more aircraft use RNP-based navigation, monitor their performance, and gather and analyze data to develop a statistical understanding of the performance of RNP-based systems in various flight regimes.
    - Re-examine the design of parallel and converging approaches and departures based on an appropriate probability distributions (may not be Gaussian) or on data gathered using RNP-based navigation.
    - The Performance-Based Advisory Rulemaking Committee (PARC) should redefine the definition of "established on approach" to include LNAV and VNAV. The requirement to be aligned with the runway centerline should be studied for possible elimination.
    - Research into potential reduction of Arrival/Departure and Departure/Departure separations due to RNP guided missed approaches and departures should be pursued.

- Longer term
    - Develop (recommendations for) new separation standards based on the improved navigation, surveillance, communication, control, and automation technologies, which will be part of NGATS. Utilize lessons learned during the analysis of other standards.
    - When the nature and frequency of blunders off an ILS course are better understood using data, ILS/RNP parallel runway separation should be reevaluated. RNP/RNP parallel approach separation should be established.
    - The No-Transgression Zone (NTZ) role for ILS operations should be re-defined based on real blunder information. Then, if still required, appropriate dimensions and shapes should be established.
    - The role of the NTZ in RNP/RNP separations should be established. The NTZ may not be needed.

FAA Response: The FAA supports your recommendations. Radar services already monitor terminal operation performance at major airports. We saw significant increases in flight path repeatability and predictability when RNAV procedures were introduced and similar results with an increasing number of RNP Special Aircraft and Aircrew Authorization Required (SAAAR) approaches. JPDO identified numerous Operational Improvements that focus on your findings related to new technologies. AVS is formulating an effort to support implementation of advanced avionics. Consequently, we intend to fully involve the Performance-Based Operations Aviation Rulemaking Committee (PARC) in this area. Further, we will coordinate PARC recommendations with the R&D milestones identified in the NARP. We look forward to continued industry dialogue and cooperation to develop target performance goals with respect to minimum runway separation.

Separation Standards Working Group Finding 8:

In designing NGATS, an air-based independent (from ATM system) backup collision avoidance system (similar to TCAS or perhaps a modified TCAS) will be required.

Back-up safety systems in the aircraft and air traffic control facilities have been set to prevent collision while minimizing false alerts when aircraft are operating at today's separation standards. As separation standards are reduced, procedures and alerting logic must be reexamined to optimize the balance between collision avoidance and false alerts.

Recommendations

- Longer Term
    - Research is required for the future independent airborne collision avoidance system in the context of the ATM system construct and the associated separation standards.
    - Research and analysis of alerting systems, such as Traffic Alert and Collision Avoidance System (TCAS), Terrain Awareness and Warning Systems (TAWS), Minimum Safe Altitude Warning (MSAW), and Conflict Alert (CA) function, should be initiated to minimize false alerts as separation standards are reduced and revised.

FAA Response: The FAA is active on two RTCA Special Committees that address and support these recommendations: Special Committee 147, Minimum Operational Performance Standards for Traffic Alert and Collision Avoidance Systems (TCAS) Airborne Equipment and Special Committee 186, Automatic Dependent Surveillance Broadcast (ADS-B) Revision 10).

Separation Standards Working Group Finding 9:

Evaluating the controllers' performance by distribution (stochastic control) rather than a hard limit may be able to increase capacity and effective throughput without compromising safety.

Recommendation:

Immediate
Research into the practicality of stochastic control in terminal operations (specifically landing spacing) should be initiated. Research should pursue the question of practicality and unintended consequences. This is an important area for research because it offers the prospect of some near term improvement in landing rates, and because stochastic control is more appropriate than deterministic control in automated systems such as NGATS.

FAA Response: The FAA will take this recommendation under consideration for the short term. However, in a longer view, one of the FAA's R&D goals for the 2015 timeframe is to demonstrate initial standards and procedures for self separation. This goal would enable multiple aircraft occupancy for single runway arrivals and single runway departures. These activities are also identified as Operational Improvements 174 and 175 in the JPDO Roadmap. Research related to stochastic control in these terminal operations may become an important component towards achieving the 2015 goal.

Separation Standards Working Group Finding 10:

In considering the possibilities for reducing separation standards, wake turbulence becomes the driving consideration. For NGATS, wake turbulence could become the primary limiter of capacity.

Recommendations:

- Immediate
  - Full support of existing research and implementation program should continue
  - Commission a team to conduct in-depth annual technical and programmatic reviews of the wake research and implementation program. The reviews should include the objectives, technical approach, schedule, and funding. The team should be composed of external experts knowledgeable in the areas of wake vortices in normal operating configurations, advanced Light Detection and Ranging (LIDAR) and other sensors that may be useable in detecting the strength of a wake vortex, aircraft behavior in the presence of wakes, and how this information can be used in the flight deck and air traffic facilities. This team should be structured along the lines of the Department of Defense Science Board and report to ATO Leadership.

FAA Response: The FAA agrees with the recommendation to support existing research. The FAA has augmented the original FAA/NASA joint research program to begin addressing the wake turbulence related NGATS operational improvements that were not a part of its original joint FAA/NASA research and implementation plans.

Regarding the second immediate recommendation, external review of the Federal Government's progress in wake turbulence research has been a very useful component of the Wake Turbulence Program. Specific technical workshops are convening Government, industry, and academia to provide input on the technical state of the art of wake science, modeling, and sensing as well as aircraft design, flight simulator development, and training related to wake encounter recovery. A series of semi-annual program reviews (WakeNet USA) have been held that includes the FAA's wake research, the development of wake mitigation air traffic control decision support tools, NASA's development of more advanced air traffic decision support tools, and the European progress in their wake research enhanced mitigation concepts. A related set of semi-annual reviews are held through the forum of WakeNet Europe where the U.S. participation is used to ensure U.S. program alignment with international harmonization of standards and operations as well as leveraging resources in both continents to expedite capacity enhancing solutions. In addition, the wake turbulence program has initiated a coordination activity to look across technology and procedures programs (e.g., surveillance, navigation, communications, procedures) that contribute to opportunities for separation reduction.

- Longer Term
  - Investigate advanced instrumentation such as LIDAR or other sensing methods to obtain direct measurements of vortex strength.
  - Investigate the feasibility and practicality of wake vortex sensing/tracking to provide the flight crew an indication of encroaching wake vortex location, strength and upset risk.

FAA Response: FAA agrees with the recommendation regarding advanced instrumentation and is actively working in this area with existing research quality sensors (e.g., LIDAR, windlines, SODARS) and is using wake strength measurements in building the safety arguments for near-term procedural changes. Additional sensors will be necessary to realize the operational improvements defined by NGATS. The FAA is evaluating options to close this gap.

APPENDIX E: Mapping FAA R&D Programs to JPDO R&D Requirements and OEP Solution Sets

In the *JPDO R&D Plan*, R&D requirements are organized into 12 categories, similar to the *OEP Version 1.0* domains and solution sets. Each of these categories is comprised of R&D requirements, decomposed further into specific R&D needs. Below we show the mapping of the FAA's NextGen R&D programs to the JPDO's R&D requirements. Some milestones indicate a schedule difference; the scheduled completion date in the *NARP* may be later than the *JPDO R&D Plan* target completion date.

Below is also shown the mapping of the FAA NextGen R&D program budget for Fiscal Year 2009, by appropriation and line item, to the OEP Air Traffic Operations Domain solution sets.

JPDO R&D Plan		**NARP**	
Trajectory Based Operations: Performance-Based Separation R-0500 OI-0329, OI-0343 Required Completion Date: 2012	Complete applied research on options for procedures, standards specification, decision-support aids, and displays to support an alternative selection to enable variable separation standards based on performance levels in all airspace.	By 2015, demonstrate reduced longitudinal separations for arrival and departure operations.	Chapter 2.1 Goal: Fast, flexible and efficient. Program: *NextGen - Wake Turbulence (Re-categorization) (1A09H)* *No funding applied – Coordination only.*
Trajectory Based Operations: Performance-Based Separation R-0820 OI-0357 Required Completion Date: 2013	Define 4DT intent data outputs and associated precision requirements for fixed and variable separation procedures (e.g., aircraft- and ground-based operations) to support implementation decisions on TBOs in performance-based airspace.	By 2013, develop a transition plan to implement pilot separation responsibility integrated with change in controller role.	Chapter 2.4 Goal: Human-centered design. Program: *NextGen - Air Traffic Control/Technical Operations Human Factors (Air/Ground Integration) (1A09B)*
Trajectory Based Operations: Performance-Based Separation R-1600 OI-0359 Required Completion Date: 2016	Complete applied research on aircraft-based communications, navigation, and surveillance (CNS) performance levels to develop requirements for self-separation.	By 2010, explore the use of digital data link to reduce controller workload in the terminal area including data entry requirements and workload benefits.	Chapter 2.3 Goal: High quality teams and individuals. Program: *NextGen - Air Traffic Control/Technical Operations Human Factors (Controller Efficiency) (1A09A)*
		By 2013, develop a transition plan to implement pilot separation responsibility integrated with change in controller role.	Chapter 2.4 Goal: Human-centered design. Program: *NextGen - Air Traffic Control/Technical Operations Human Factors (Air/Ground Integration) (1A09B)*

JPDO R&D Plan		NARP	
		By 2016, conduct research to support the development of standards, procedures, training, and policy to implement these milestones.	Chapter 2.7 Goal: Self-separation. Program: *NextGen – Self Separation (A12.d)*
		By 2016, full mission demonstration – demonstrate integrated NextGen air and ground capabilities for pilot separation responsibility and controller efficiency.	Chapter 2.4 Goal: Human-centered design. Program: *NextGen – Air Ground Integration (A12.c), NextGen – Self Separation (A12.d)*
Trajectory Based Operations: Manage Complexity and Demand Volume R-0530 OI-0355, OI-0362, OI-0363 Required Completion Date: 2012	Complete applied research on ground and aircraft automated separation management options to guide the selection of technology and procedures development for TBOs in performance-based airspace.	By 2012, demonstrate the transition of self-separation responsibility to pilots.	Chapter 2.4 Goal: Human-centered design. Program: *NextGen – Air Ground Integration (A12.c), NextGen - Air Traffic Control/Technical Operations Human Factors (Air/Ground Integration) (1A09B)*
Trajectory Based Operations: Manage Complexity and Demand Volume R-1630 OI-0361, OI-0368 Required Completion Date: 2016	Complete applied research on technologies and procedures for flow corridors to support alternatives selection on the use of flow corridors and the associated air and ground technologies	By 2010, measure efficiency improvements during limited self-separation, where aircraft are grouped and en route controllers communicate to the group as a whole.	Chapter 2.3 Goal: High quality teams and individuals. Program: *NextGen - Air Traffic Control/Technical Operations Human Factors (Controller Efficiency) (1A09A)*
		By 2016, redefine the controllers' role in terms of the services they provide during a given phase of flight as the differences between en route and terminal begin to blur.	Chapter 2.3 Goal: High quality teams and individuals. Program: *NextGen - Air Traffic Control/Technical Operations Human Factors (Controller Efficiency) (1A09A)*
		By 2016, increase efficiency given the need to manage multiple airport streams for the terminal phases of flight in large metropolitan areas given a mixed-equipage environment.	Chapter 2.3 Goal: High quality teams and individuals. Program: *NextGen - Air Traffic Control/Technical Operations Human Factors (Controller Efficiency) (1A09A)*

JPDO R&D Plan		NARP	
Trajectory Based Operations: Manage Complexity and Demand Volume D-1200 OI-0360, OI-0369 Required Completion Date: 2015	Complete development of trajectory-based procedures to support a national policy decision on liabilities related to changes in roles and responsibilities among automation and humans, and among air traffic service providers and flight operators.	By 2012, demonstrate the transition of self-separation responsibility to pilots.	Chapter 2.4 Goal: Human-centered design. Program: *NextGen – Air Ground Integration (A12.c)*, *NextGen - Air Traffic Control/Technical Operations Human Factors (Air/Ground Integration) (1A09B)*
		By 2013, develop a transition plan to implement pilot separation responsibility integrated with change in controller role.	Chapter 2.4 Goal: Human-centered design. Program: *NextGen – Air Ground Integration (A12.c)*, *NextGen - Air Traffic Control/Technical Operations Human Factors (Air/Ground Integration) (1A09B)*
		By 2014, functional demonstration – demonstrate integrated pilot and controller functional capabilities.	Chapter 2.4 Goal: Human-centered design. Program: *NextGen – Air Ground Integration (A12.c)*, *NextGen - Air Traffic Control/Technical Operations Human Factors (Air/Ground Integration) (1A09B)*
		By 2016, full mission demonstration – demonstrate integrated NextGen air and ground capabilities for pilot separation responsibility and controller efficiency.	Chapter 2.4 Goal: Human-centered design. Program: *NextGen – Air Ground Integration (A12.c)*, *NextGen - Air Traffic Control/Technical Operations Human Factors (Air/Ground Integration) (1A09B)*
Trajectory Based Operations: Airspace Configuration R-0280 OI-0307 Required Completion Date: 2011	Complete applied research on airspace structure elements to reduce controller training time, to support an alternative selection on the airspace elements and related controller tasks.	By 2013, define the new role for the controller that is more strategic in nature in the en route and terminal domains.	Chapter 2.3 Goal: High quality teams and individuals. Program: *NextGen - Air Traffic Control/Technical Operations Human Factors (Controller Efficiency) (1A09A)*

JPDO R&D Plan		NARP	
Reduced Impact of Weather: Observation and Forecast Qualities R-0580 OI-2010, OI-2020 Required Completion Date: 2012	Complete development of the first generation of probabilistic weather forecasts (e.g., convective and winter storms, icing, turbulence, ceiling, and visibility) to support interagency implementation decisions.	By 2010, develop design approval guidance for hardware and software standards.	Chapter 2.8 Goal: Situational awareness. Program: *NextGen – Weather Technology in the Cockpit (A12.e)*
		By 2010, develop design approval guidance for archiving data.	Chapter 2.8 Goal: Situational awareness. Program: *NextGen – Weather Technology in the Cockpit (A12.e)*
		By 2010, develop guidance for airman training and evaluation criteria.	Chapter 2.8 Goal: Situational awareness. Program: *NextGen – Weather Technology in the Cockpit (A12.e)*
		By 2010, develop guidance for operational approval of new products and products from non-government vendors.	Chapter 2.8 Goal: Situational awareness. Program: *NextGen – Weather Technology in the Cockpit (A12.e)*
Flexible Terminal Airspace and Expanded Airport Access: Access to Terminal Airspace for Arrivals and Departures D-0870 OI-0311, OI-0329 Required Completion Date: 2013	Complete development of mixed equipage trajectory-based routes (e.g., RNAV/RNP) and advanced CDA operations to support an implementation decision for flexible trajectory-based routing between cruise and the top 100 airports.	By 2012, determine mixed equipage trajectory-based routes for RNAV/RNP and continuous decent (CDA) operations	Chapter 2.1 Goal: Fast, flexible & efficient. Program: *NextGen - New Air Traffic Management Requirement (1A09E)*
		By 2013, develop training and procedural requirements for corrective mechanisms to compensate for pilot skills degradation or automation failure.	Chapter 2.4 Goal: Human-centered design. Program: *NextGen – Air Ground Integration (A12.c)*
Flexible Terminal Airspace and Expanded Airport Access: Maintain Terminal Airspace and Surface Operations in Low Visibility R-0120 OI-0321, OI-0322 Required Completion Date: 2010	Complete applied research on increased operator situational awareness for low-visibility terminal and airport surface operations to support an alternative selection for increasing surface movement efficiency.	By 2013, determine system requirements for separation in low-visibility on the airport surface.	Chapter 2.1 Goal: Fast, flexible & efficient. Program: *NextGen - New Air Traffic Management Requirement (1A09E)*
		By 2011, conduct research to support the development of standards, procedures, training, and policy to implement these milestones, specifically, low-visibility terminal and airport surface operations.	Chapter 2.7 Goal: Self-separation. Program: *NextGen – Self Separation (A12.d)*

JPDO R&D Plan		NARP	
Flexible Terminal Airspace and Expanded Airport Access: Maintain Terminal Airspace and Surface Operations in Low Visibility R-0350 OI-0322 Required Completion Date: 2011	Complete applied research of complementary air- and ground-based runway incursion prevention and detection systems, to support an alternative selection.	By 2011, conduct research to support the development of standards, procedures, training, and policy to implement these milestones, specifically, runway incursion prevention and detection systems	Chapter 2.7 Goal: Self-separation. Program: *NextGen – Self Separation (A12.d)*
Flexible Terminal Airspace and Expanded Airport Access: Maintain Terminal Airspace and Surface Operations in Low Visibility D-0360 OI-0321, OI-0322 Required Completion Date: 2011	Complete development of digital transmission and onboard display of taxi instructions to support an implementation decision on low-visibility taxi guidance.	By 2011, conduct research to support the development of standards, procedures, training, and policy to implement these milestones, specifically, onboard display of taxi instructions.	Chapter 2.7 Goal: Self-separation. Program: *NextGen – Self Separation (A12.d)*
		By 2011, identify data communications requirements for low-visibility operations.	Chapter 2.1 Goal: Fast, flexible & efficient. Program: *NextGen - New Air Traffic Management Requirement (1A09E)*
Flexible Terminal Airspace and Expanded Airport Access: Maintain Terminal Airspace and Surface Operations in Low Visibility D-0880 OI-0321, OI-0322 Required Completion Date: 2013	Complete development of limited visibility operations to support implementation decisions for terminal and surface operations.	By 2013, conduct research to support the development of standards, procedures, training, and policy to implement these milestones, specifically, limited visibility operations.	Chapter 2.7 Goal: Self-separation. Program: *NextGen – Self Separation (A12.d)*
Flexible Terminal Airspace and Expanded Airport Access: Overly Conservative Wake Vortex Separations D-1640 OI-0323, OI-0324 Required Completion Date: 2012	Complete development of wind-dependent wake vortex arrival procedures and associated controller decision support tools to support an FAA investment decision on a ground-based capability to reduce wake separation for arriving aircraft following 757 or heavier aircraft at closely spaced parallel runways.	By 2015, demonstrate reduced longitudinal separations for arrival and departure operations.	Chapter 2.1 Goal: Fast, flexible, and efficient. Program: *NextGen - Wake Turbulence (Re-categorization) (1A09H)*
Flexible Terminal Airspace and Expanded Airport Access: Overly	Complete applied research on safety nets (e.g., wake sensing) to support an alternatives	By 2015, demonstrate reduced longitudinal separations for arrival and departure	Chapter 2.1 Goal: Fast, flexible, and efficient. Program: *NextGen -*

JPDO R&D Plan		NARP	
Conservative Wake Vortex Separations D-1680 OI-0324, OI-0328 Required Completion Date: 2015	decision for dynamic wake spacing.	operations.	*Wake Turbulence (Re-categorization) (1A09H)*
Flexible Terminal Airspace and Expanded Airport Access: Overly Conservative Wake Vortex Separations R-1230 OI-0343, OI-0358 Required Completion Date: 2015	Complete applied research on weather effects and wake vortex impacts on en route separations to support an alternatives decision on reduced separation standards for en route operations.	By 2015, demonstrate reduced longitudinal separations for arrival and departure operations.	Chapter 2.1 Goal: Fast, flexible, and efficient. Program: *NextGen - Wake Turbulence (Re-categorization) (1A09H)*
Flexible Terminal Airspace and Expanded Airport Access: Overly Conservative Wake Vortex Separations R-1230 OI-0324, OI-0328 Required Completion Date: 2016	Complete applied R&D of a weather-dependent wake vortex arrival and departure capability that incorporates weather measurements and predictions to support an FAA investment decision on dynamic wake separations for single runway operations.	By 2015, demonstrate reduced longitudinal separations for arrival and departure operations.	Chapter 2.1 Goal: Fast, flexible, and efficient. Program: *NextGen - Wake Turbulence (Re-categorization) (1A09H)*
Flexible Terminal Airspace and Expanded Airport Access: Overly Conservative Wake Vortex Separations R-0600 OI-0328, OI-0336 Required Completion Date: 2016	Complete applied research to assess and predict the severity of aircraft wake encounters based on aircraft parameters and wake geometry to support an alternatives selection decision on dynamic wake spacing based on wake persistence and decay.	By 2015, demonstrate reduced longitudinal separations for arrival and departure operations.	Chapter 2.1 Goal: Fast, flexible, and efficient. Program: *NextGen - Wake Turbulence (Re-categorization) (1A09H*)
High-Density Terminal and Airport Operation: Maximizing Individual Runway Capacity R-0370 OI-0326, OI-0329, OI-0330 Required Completion Date: 2011	Complete applied research on traffic spacing management (e.g., complementary time-based metering, management by 4DT, and sequence-based, pair-wise spacing) for transition, arrival, and departure operations to support alternative selection and policy decisions on high-throughput delivery of	By 2011, assess approaches for time-based metering.	Chapter 2.1 Goal: Fast, flexible & efficient. Program: *NextGen - New Air Traffic Management Requirement (1A09E)*
		By 2011, conduct research to support the development of standards, procedures, training, and policy to implement these milestones, specifically, pair-wise spacing.	Chapter 2.7 Goal: Self-separation. Program: *NextGen – Self Separation (A12.d)*

JPDO R&D Plan		NARP	
	aircraft to the runway threshold and high-throughput departure operations.	By 2013, define procedural requirements for controllers to manage and introduce change into the four dimensional (position plus time) dynamic environment.	Chapter 2.3 Goal: High quality teams and individuals. Program: *NextGen - Air Traffic Control/Technical Operations Human Factors (Controller Efficiency) (1A09A)*
		By 2014, develop methods to optimize runway assignments.	Chapter 2.1 Goal: Fast, flexible & efficient. Program: *NextGen - Operations Concept Development (Validation Modeling) (1A09F)* *No funding applied – Coordination only.*
High-Density Terminal and Airport Operation: Maximizing Individual Runway Capacity R-0910 OI-0341 Required Completion Date: 2013	Complete applied research on overlapping aircraft runway occupancy to support alternative selection and policy decisions on simultaneous runway operations.	By 2014, conduct research to support the development of standards, procedures, training, and policy to implement these milestones, specifically, overlapping aircraft runway occupancy.	Chapter 2.7 Goal: Self-separation. Program: *NextGen – Self Separation (A12.d)*
High-Density Terminal and Airport Operation: Maximizing Multiple Runway Capacity R-0930 OI-0334 Required Completion Date: 2013	Complete applied research on cockpit technologies and procedures to support an alternative selection for independent parallel and converging runway procedures in low visibility.	By 2011, validate operational assumptions of the concept of use for independent closely spaced parallel runway operations.	Chapter 2.1 Goal: Fast, flexible, and efficient. Program: *NextGen - Operations Concept Development (Validation Modeling) (1A09F)*
		By 2011, conduct research to support the development of standards, procedures, training, and policy to implement these milestones, specifically, display aircraft and ground vehicles in the cockpit to guide surface movement during low visibility conditions.	Chapter 2.7 Goal: Self-separation. Program: *NextGen – Self Separation (A12.d)*
		By 2012, determine procedures and technologies to support operations for additional closely spaced parallel runways in IMC.	Chapter 2.1 Goal: Fast, flexible, and efficient. Program: *NextGen - New Air Traffic Management Requirement (1A09E)*

JPDO R&D Plan		NARP	
High-Density Terminal and Airport Operation: Maximizing Multiple Runway Capacity R-1240 OI-0335 Required Completion Date: 2015	Complete applied research on technologies and procedures to support an alternative selection for very closely spaced parallel runway procedures in low visibility.	By 2011, validate operational assumptions of the concept of use for independent closely spaced parallel runway operations.	Chapter 2.1 Goal: Fast, flexible, and efficient. Program: *NextGen - Operations Concept Development (Validation Modeling) (1A09F)*
		By 2012, determine procedures and technologies to support operations for additional closely spaced parallel runways in IMC.	Chapter 2.1 Goal: Fast, flexible, and efficient. Program: *NextGen - New Air Traffic Management Requirement (1A09E)*
High-Density Terminal and Airport Operation: Manage Ramp Operations, Surface Traffic, and Runway Assignments R-0610 OI-0340 Required Completion Date: 2012	Complete applied research on safe taxi operations in low visibility conditions to support an alternative selection on options for appropriate operator and air traffic management roles in low visibility operations.	By 2011, conduct research to support the development of standards, procedures, training, and policy to implement these milestones, specifically, display aircraft and ground vehicles in the cockpit.	Chapter 2.7 Goal: Self-separation. Program: *NextGen – Self Separation (A12.d)*
		By 2013, define the changes in roles and responsibilities, between pilots and controllers and between humans and automation, required to implement NextGen.	Chapter 2.4 Goal: Human-centered design. Program: *NextGen – Air Ground Integration (A12.c), Air Traffic Control/Technical Operations Human Factors (Air/Ground Integration) (1A09B)*
		By 2013, develop requirements for surface traffic management with conformance monitoring.	Chapter 2.1 Goal: Fast, flexible, and efficient. Program: *NextGen - New Air Traffic Management Requirement (1A09E)*
		By 2014, develop second level concepts for surface traffic management with conformance monitoring.	Chapter 2.1 Goal: Fast, flexible, and efficient. Program: *NextGen - Operations Concept Development (Validation Modeling) (1A09F)*

JPDO R&D Plan		NARP	
High-Density Terminal and Airport Operation: Manage Ramp Operations, Surface Traffic, and Runway Assignments D-0620 OI-0321, OI-0327 Required Completion Date: 2012	Complete development of onboard display of taxi instructions to support an implementation decision on performance requirements and procedures.	By 2011, conduct research to support the development of standards, procedures, training, and policy to implement these milestones, specifically, display aircraft and ground vehicles in the cockpit.	Chapter 2.7 Goal: Self-separation. Program: *NextGen – Self Separation (A12.d)*
		By 2012, determine requirements for and demonstrate data messaging for flow and taxi assignments.	Chapter 2.1 Goal: Fast, flexible, and efficient. Program: *NextGen - Operations Concept Development (Validation Modeling) (1A09F), NextGen - New Air Traffic Management Requirement (1A09E)*
High-Density Terminal and Airport Operation: Manage Ramp Operations, Surface Traffic, and Runway Assignments R-0630 OI-0321, OI-0327 Required Completion Date: 2012	Complete applied research on effective management of ground operations to support an alternatives selection and decision on interoperable surface and ramp traffic management capabilities for all-weather operations.	By 2013, develop requirements for surface traffic management with conformance monitoring.	Chapter 2.1 Goal: Fast, flexible, and efficient. Program: *NextGen - New Air Traffic Management Requirement (1A09E)*
		By 2014, develop second level concepts for surface traffic management with conformance monitoring.	Chapter 2.1 Goal: Fast, flexible, and efficient. Program: *NextGen - Operations Concept Development (Validation Modeling) (1A09F)*
High-Density Terminal and Airport Operation: Manage Ramp Operations, Surface Traffic, and Runway Assignments D-1250 OI-0340 Required Completion Date: 2015	Complete development of safe taxi operations in low visibility conditions to support an implementation decision on surface operations in near all-weather conditions.	By 2015, conduct research to support the development of standards, procedures, training, and policy to implement these milestones, specifically, enable surface movement guided by cockpit display in all weather conditions.	Chapter 2.7 Goal: Self-separation. Program: *NextGen – Self Separation (A12.d)*
Collaborative Air Traffic Management: Shared Situational Awareness D-0420 OI-0303, OI-0305	Complete development of an NAS-wide aggregate flow model to support an implementation decision on capabilities supporting	By 2011, determine weather information required for imbedded decision making in flow related operations.	Chapter 2.1 Goal: Fast, flexible, and efficient. Program: *NextGen - New Air Traffic Management Requirement (1A09E)*

JPDO R&D Plan		NARP	
Required Completion Date: 2011	common situational awareness of current and forecast congestion and mitigation options among ATM personnel, flight operators, and flight crews.	By 2011, develop operational concept and conduct in-lab validation of managing airspace to flow.	Chapter 2.1 Goal: Fast, flexible, and efficient. Program: *NextGen - Operations Concept Development (Validation Modeling) (1A09F)*
		By 2012, identify requirements for use of probabilistic weather information by pilots and controllers, supporting collaborative ATM.	Goal: Human-centered design. Program: *NextGen – Air Ground Integration (A12.c)*, *NextGen - Air Traffic Control/Technical Operations Human Factors (Air/Ground Integration) (1A09B)*
Collaborative Air Traffic Management: Shared Situational Awareness R-0660 OI-0303 Required Completion Date: 2012	Complete applied research on automated integration of weather, environmental, aeronautical, security, and emergency information and on demand and capacity information to support an alternative selection and policy decision for tailored information services to meet specific needs.	By 2012, test initial requirements in partial collaborative decision making application.	Chapter 2.1 Goal: Fast, flexible, and efficient. Program: *New Air Traffic Management Requirement (1A09E)*
		By 2013, demonstrate in field shadow mode conditions, managing airspace to flow.	Chapter 2.1 Goal: Fast, flexible, and efficient. Program: *NextGen - Operations Concept Development (Validation Modeling) (1A09F)*
Collaborative Air Traffic Management: Trajectory and Flow Management R-1130 OI-0306 Required Completion Date: 2014	Complete applied research on automated capacity problem detection, notification, coordination, and resolution to support an alternative selection for capacity management capabilities.	By 2013, define procedural requirements for controllers to manage and introduce change into the four dimensional (position plus time) dynamic environment.	Chapter 2.3 Goal: High quality teams and individuals. Program: *NextGen - Air Traffic Control/Technical Operations Human Factors (Controller Efficiency) (1A09A)*
Collaborative Air Traffic Management: Trajectory and Flow Management R-1140 OI-0306, OI-3010, OI-3012 Required Completion Date: 2014	Complete applied research on integration of probabilistic information (e.g., weather, congestion), management of uncertainty, what-if analysis, and integrated incremental resolutions to support an alternative selection for how to achieve agile and effective incremental decisions.	By 2013, demonstrate in field shadow mode conditions managing airspace to flow.	Chapter 2.1 Goal: Fast, flexible, and efficient. Program: *NextGen - Operations Concept Development (Validation Modeling) (1A09F)*

JPDO R&D Plan		NARP	
Safety: Identify Proactively Safety Risks and Safety Assurance Processes R-0020 OI-3004 Required Completion Date: 2009	Complete applied research on vulnerability discovery to support an alternatives selection decision for the NextGen Aviation Safety Analysis and Information Sharing (ASAIS) capability.	By 2009, evaluate current information protection and assurance models and potential conflicts with privacy and consumer advocacy groups.	Chapter 2 Goal: System knowledge. Program: *NextGen - System Safety Management Transformation (1A09G)*
Safety: Identify Proactively Safety Risks and Safety Assurance Processes D-0160 OI-3004 Required Completion Date: 2010	Complete development of a national safety management system framework for an implementation decision for NextGen agencies and stakeholder organizations to use in assessing operational safety of advanced concepts and technologies.	By 2011, develop proof of concept for NextGen including a safety management system prototype to implement on a trial basis with selected participants that involve a cross-section of air service providers.	Chapter 2.9 Goal: System knowledge. Program: *NextGen - System Safety Management Transformation (1A09G)*
Safety: Identify Proactively Safety Risks and Safety Assurance Processes D-0170 OI-3004 Required Completion Date: 2010	Complete development of the support environment for safety information sharing and analysis to support a policy decision for the NextGen prognostic safety culture.	By 2012, validate the Net Enabled Operations (NEO) Architecture proof-of-concept for the sharing of aviation safety information among JPDO member agencies, participants, and stakeholders.	Chapter 2.9 Goal: System knowledge. Program: *NextGen - System Safety Management Transformation (1A09G)*
Safety: Identify Proactively Safety Risks and Safety Assurance Processes D-2100 OI- NOT LISTED Required Completion Date: 2013	Complete development of methods for verification and validation of complex systems to support alternative NextGen risk assessment and certification decisions.	By 2013, complete the Aviation Safety Information Analysis and Sharing (ASIAS) pre-implementation activities, including concept definition, with other JPDO member agencies, participants, and stakeholders.	Chapter 2.9 Goal: System knowledge. Program: *NextGen - System Safety Management Transformation (1A09G)*
Safety: Identify Proactively Safety Risks and Safety Assurance Processes R-0690 OI-3004 Required Completion Date: 2012	Complete applied research on a holistic safety baseline of the entire air transportation system to support an alternative selection for a transformed SMS process for evaluating proposed operational changes, including the treatment of whole concept changes such as introduction of probabilistic operations planning.	By 2014, demonstrate a National Level System Safety Assessment capability that will proactively identify emerging risk across the NextGen.	Chapter 2.9 Goal: System knowledge. Program: *NextGen - System Safety Management Transformation (1A09G)*

JPDO R&D Plan		NARP	
Environment: Keeping Air Transportation Clean and Quiet R-1750 OI-0358 Required Completion Date: 2010	Complete applied research of potential policies and procedures for aircraft surface movement, arrival and departure, and en route procedures specifically designed to reduce noise and local air quality impacts, and fuel burn.	By 2013, demonstrate optimized airport and terminal area operations that reduce or mitigate aviation impacts on noise, air quality or water quality in the vicinity of the airport.	Chapter 2.2 Goal: Clean and quiet. Program: *NextGen - Environment and Energy (Noise and Emissions Reduction) (1A09C), NextGen - Environment and Energy (Validation Modeling) (1A09D)*
Environment: Keeping Air Transportation Clean and Quiet R-0200 OI-6006, OI-6010, OI-6014, OI-6019 Required Completion Date: 2011	Complete applied research on the relationship between noise and emissions and different types of emissions to implement next generation analysis tools for data-driven decision-making as part of an environmental management system.	By 2012, establish the relationship between aviation engine exhaust and the gases and particulate matter that are deposited in the atmosphere.	Chapter 2.2 Goal: Clean and quiet. Program: *NextGen Environmental Research - Aircraft Technologies, Fuels, and Metrics (A13.b)*
		By 2012, complete tests and data collection to determine if the right metrics are being used to assess the impact of aircraft noise.	Chapter 2.2 Goal: Clean and quiet. Program: *NextGen Environmental Research - Aircraft Technologies, Fuels, and Metrics (A13.b)*
Environment: Keeping Air Transportation Clean and Quiet R-1760 OI-0358 Required Completion Date: 2011	Complete applied research on measurement methodologies and metrics to determine how aviation generated particulate matter and hazardous air pollutants impact local health, visibility, and global climate.	By 2012, determine how aviation generated particulate matter and hazardous air pollutants impact local health, visibility, and global climate.	Chapter 2 Goal: Clean and quiet. Program: *NextGen Environmental Research - Aircraft Technologies, Fuels, and Metrics (A13.b), NextGen - Environment and Energy (Validation Modeling) (1A09D)*
Environment: Keeping Air Transportation Clean and Quiet R-1770 OI-0358 Required Completion Date: 2011	Complete development of metrics to assess aviation's impact on climate change.	By 2012, complete tests and data collection to determine if the right metrics are being used to assess the impact of aircraft noise.	Chapter 2.2 Goal: Clean and quiet. Program: *NextGen Environmental Research - Aircraft Technologies, Fuels, and Metrics (A13.b)*
		By 2014, update environmental assessments models to incorporate new noise metrics.	Chapter 2.2 Goal: Clean and quiet. Program: *NextGen Environmental Research - Aircraft Technologies, Fuels, and Metrics (A13.b)*

JPDO R&D Plan		NARP	
Environment: Keeping Air Transportation Clean and Quiet R-0740 OI-6010, OI-6017, OI-6019 Required Completion Date: 2012	Complete the applied research on "drop-in" alternative aviation fuels (i.e., fuels that can be used in place of current fuels) to support the selection of candidates for further development by flight operators, aircraft manufacturers, and fuel producers to address both environmental and economic considerations.	By 2011, complete detailed feasibility study, including economic feasibility, measure environmental impacts, and demonstrate "drop in" potential for alternative fuels.	Chapter 2.2 Goal: Clean and quiet. Program: *NextGen Environmental Research - Aircraft Technologies, Fuels, and Metrics (A13.b)*
Environment: Keeping Air Transportation Clean and Quiet D-0750 OI-6010, OI-6017, OI-6019 Required Completion Date: 2013	Complete the development of drop-in turbine engine fuel alternatives, including the identification of implementation plans, supporting an implementation decision by flight operators, aircraft manufacturers, and fuel providers.	By 2011, complete detailed feasibility study, including economic feasibility, measure environmental impacts, and demonstrate "drop in" potential for alternative fuels.	Chapter 2.2 Goal: Clean and quiet. Program: *NextGen Environmental Research - Aircraft Technologies, Fuels, and Metrics (A13.b)*
		By 2014, conduct significant demonstration of CLEEN mitigation technologies and NAS infrastructure integration.	Chapter 2.2 Goal: Clean and quiet. Program: *NextGen Environmental Research - Aircraft Technologies, Fuels, and Metrics (A13.b)*
Environment: Keeping Air Transportation Clean and Quiet D-1010 OI-6006, OI-6010, OI-6014, OI-6019 Required Completion Date: 2013	Complete development of vehicles technologies that reduce community noise, fuel burn, and local and greenhouse gas emissions to allow rapid integration into the commercial large and regional jet fleet.	By 2012, identify and pursue the development of engine and airframe technologies that will be the most effective at producing environmental benefits.	Chapter 2.2 Goal: Clean and quiet. Program: *NextGen Environmental Research - Aircraft Technologies, Fuels, and Metrics (A13.b), NextGen - Environment and Energy (Noise and Emissions Reduction) (1A09C)*
		By 2013, expand noise data collection to very light jets, and supersonic aircraft.	Chapter 2.2 Goal: Clean and quiet. Program: *NextGen Environmental Research - Aircraft Technologies, Fuels, and Metrics (A13.b)*

JPDO R&D Plan		NARP	
		By 2013, establish engine design sensitivities by measuring particles emitted from combustor engine systems.	Chapter 2.2 Goal: Clean and quiet. Program: *NextGen Environmental Research - Aircraft Technologies, Fuels, and Metrics (A13.b)*
		By 2013, demonstrate airframe and engine technologies to reduce noise and emissions.	Chapter 2.2 Goal: Clean and quiet. Program: *NextGen Environmental Research - Aircraft Technologies, Fuels, and Metrics (A13.b)*
Environment: Keeping Air Transportation Clean and Quiet D-1020 OI-6010, OI-6014, OI-6019 Required Completion Date: 2013	Complete development of a suite of robust environmental management control system approaches and analytical tools that provide a better understanding of the health and welfare impacts from local air quality and emissions, and translate these impacts into improved decision support to construct environmental management systems that mitigate these effects. The completion of development will support implementation decisions by stakeholder agencies, flight operators, and airport operators.	By 2011, determine how aviation generated particulate matter and hazardous air pollutants impact local health, visibility, and global climate.	Chapter 2.2 Goal: Clean and quiet. Program: *NextGen Environmental Research - Aircraft Technologies, Fuels, and Metrics (A13.b)*
		By 2011, develop algorithms to optimize ground and airspace operations by leveraging communication, navigation and surveillance technology in the short- to medium-term to optimize aircraft sequencing and timing on the surface and in the terminal area.	Chapter 2.2 Goal: Clean and quiet. Program: *NextGen Environmental Research - Aircraft Technologies, Fuels, and Metrics (A13.b)*
		By 2014, update environmental assessments models to incorporate new noise metrics.	Chapter 2.2 Goal: Clean and quiet. Program: *NextGen Environmental Research - Aircraft Technologies, Fuels, and Metrics (A13.b)*
Environment: Keeping Air Transportation Clean and Quiet R-1030 OI-6006, OI-6010, OI-6012, OI-6014, OI-6019 Required Completion Date: 2013	Complete applied research of environmental metrics for new and alternative vehicle classes, including unmanned air vehicles (UAV), very light jets, rotorcraft, and supersonic business jets likely to be	By 2013, expand noise data collection to very light jets, and supersonic aircraft.	Chapter 2.2 Goal: Clean and quiet. Program: *NextGen Environmental Research - Aircraft Technologies, Fuels, and Metrics (A13.b)*

JPDO R&D Plan		NARP	
	in operation as part of NextGen to support regulation decisions where either no environmental regulation exists today or where current regulatory metrics may be inadequate to assess operational impacts.		
Environment: Keeping Air Transportation Clean and Quiet R-1780 OI-0358 Required Completion Date: 2013	Complete development of robust databases to enable assessment of environmental impacts resulting from particulate matter and hazardous air pollutant emissions from commercial aviation operations.	By 2012, establish the relationship between aviation engine exhaust and the gases and particulate matter that are deposited in the atmosphere.	Chapter 2.2 Goal: Clean and quiet. Program: *NextGen Environmental Research - Aircraft Technologies, Fuels, and Metrics (A13.b)*
Environment: Keeping Air Transportation Clean and Quiet D-1730 OI-0324, OI-0328 Required Completion Date: 2013	Complete development of aircraft operational control technologies and operational approaches to enable maximum use by the commercial fleet of air terminal and air space operational procedures that reduce noise and local air quality and greenhouse gas emissions.	By 2011, develop algorithms to optimize ground and airspace operations by leveraging communication, navigation and surveillance technology in the short- to medium-term to optimize aircraft sequencing and timing on the surface and in the terminal area.	Chapter 2.2 Goal: Clean and quiet. Program: *NextGen Environmental Research - Aircraft Technologies, Fuels, and Metrics (A13.b)*
		By 2013, demonstrate optimized airport and terminal area operations that reduce or mitigate aviation impacts on noise, air quality or water quality in the vicinity of the airport.	Chapter 2.2 Goal: Clean and quiet. Program: *NextGen - Environment and Energy (Noise and Emissions Reduction) (1A09C)*
		By 2012, demonstrate optimized enroute operations that enhance fuel efficiency and reduce emissions.	Chapter 2.2 Goal: Clean and quiet. Program: *NextGen - Environment and Energy (Noise and Emissions Reduction) (1A09C)*

JPDO R&D Plan		NARP	
		Develop method, metrics, and models to demonstrate that aviation noise and emissions can be significantly reduced in absolute terms to enable the air traffic system to handle growth in demand up to three times current levels. 2009: Demonstrate no environmental constraints at 130% capacity. 2011: Demonstrate no environmental constraints at 166% capacity. 2013: Demonstrate no environmental constraints at 230% capacity. 2016: Demonstrate no environmental constraints at 300% capacity.	Chapter 2.2 Goal: Clean and quiet. Program: *NextGen - Environment and Energy (Validation Modeling) (1A09D)*
Environment: Keeping Air Transportation Clean and Quiet D-1740 OI-0324, OI-0328 Required Completion Date: 2013	Complete development of capabilities to dynamically manage environmental impacts while addressing the needs of the NAS (including metrics, performance goals, and operational controls for automated systems) to support an FAA decision to implement environmental management systems.	By 2013, demonstrate optimized airport and terminal area operations that reduce or mitigate aviation impacts on noise, air quality or water quality in the vicinity of the airport.	Chapter 2.2 Goal: Clean and quiet. Program: *NextGen - Environment and Energy (Noise and Emissions Reduction) (1A09C)*
		By 2012, demonstrate optimized enroute operations that enhance fuel efficiency and reduce emissions.	Chapter 2.2 Goal: Clean and quiet. Program: *NextGen - Environment and Energy (Noise and Emissions Reduction) (1A09C)*
Environment: Keeping Air Transportation Clean and Quiet D-2110 OI- NOT LISTED Required Completion Date: 2015	Complete development of environmental metrics for new and alternative vehicle classes, including UAVs, very light jets, rotorcraft, and supersonic business jets likely to be in operation as part of NextGen to support regulation decisions where either no	By 2012, expand noise data collection to very light jets, and supersonic aircraft.	Chapter 2.2 Goal: Clean and quiet. Program: *NextGen Environmental Research - Aircraft Technologies, Fuels, and Metrics (A13.b)*

JPDO R&D Plan		NARP	
	environmental regulation exists today or where current regulatory metrics may be inadequate to assess operational impacts.		
Environment: Keeping Air Transportation Clean and Quiet R-1330 OI-6006, OI-6010, OI-6014, OI-6019 Required Completion Date: 2015	Complete applied research on first-principles noise and emissions analysis tools for all classes of air vehicles to provide a higher-fidelity capability to data-driven decision-making environmental management system tool suites.	By 2012, establish the relationship between aviation engine exhaust and the gases and particulate matter that are deposited in the atmosphere.	Chapter 2.2 Goal: Clean and quiet. Program: *NextGen Environmental Research - Aircraft Technologies, Fuels, and Metrics (A13.b)*
		By 2012, complete development of first generation ground plume model for aircraft engine exhaust.	Chapter 2.2 Goal: Clean and quiet. Program: *NextGen Environmental Research - Aircraft Technologies, Fuels, and Metrics (A13.b)*
		By 2014, update environmental assessments models to incorporate new noise metrics.	Chapter 2.2 Goal: Clean and quiet. Program: *NextGen Environmental Research - Aircraft Technologies, Fuels, and Metrics (A13.b)*
Environment: Keeping Air Transportation Clean and Quiet R-1340 OI-6006, OI-6010, OI-6014, OI-6019 Required Completion Date: 2015	Complete development of aircraft surface movement, arrival and departure, and en route procedures to maintain throughput while reducing environmental impacts to support an implementation decision on procedures and associated technologies by air navigation service providers and flight operators.	By 2011, develop algorithms to optimize ground and airspace operations by leveraging communication, navigation and surveillance technology in the short- to medium-term to optimize aircraft sequencing and timing on the surface and in the terminal area.	Chapter 2.2 Goal: Clean and quiet. Program: *NextGen Environmental Research - Aircraft Technologies, Fuels, and Metrics (A13.b)*
		By 2013, demonstrate optimized airport and terminal area operations that reduce or mitigate aviation impacts on noise, air quality or water quality in the vicinity of the airport.	Chapter 2.2 Goal: Clean and quiet. Program: *NextGen - Environment and Energy (Noise and Emissions Reduction) (1A09C)*

JPDO R&D Plan		NARP	
		By 2012, demonstrate optimized enroute operations that enhance fuel efficiency and reduce emissions.	Chapter 2.2 Goal: Clean and quiet. Program: *NextGen - Environment and Energy (Noise and Emissions Reduction) (1A09C)*
		Develop method, metrics, and models to demonstrate that aviation noise and emissions can be significantly reduced in absolute terms to enable the air traffic system to handle growth in demand up to three times current levels. 2009: Demonstrate no environmental constraints at 130% capacity. 2011: Demonstrate no environmental constraints at 166% capacity. 2013: Demonstrate no environmental constraints at 230% capacity. 2016: Demonstrate no environmental constraints at 300% capacity.	Chapter 2.2 Goal: Clean and quiet. Program: *NextGen - Environment and Energy (Validation Modeling) (1A09D)*
Transformed Facilities: Expanded Tower Services and Increased Tower Staff Productivity R-1040 OI-0313, OI-0315 Required Completion Date: 2013	Complete applied research on staffed and automated virtual tower options and other mechanisms to support selection of alternatives for expanding service to more airports.	By 2014, develop integrated staffed virtual tower work stations.	Chapter 2.3 Goal: High quality teams and individuals. Program: *NextGen - Air Traffic Control/Technical Operations Human Factors (Controller Efficiency) (1A09A)*
Transformed Facilities: Expanded Tower Services and Increased Tower Staff Productivity D-1360 OI-0313, OI-0315 Required Completion Date: 2015	Complete development of the virtual tower alternative(s) to support an implementation decision.	By 2014, develop integrated staffed virtual tower work stations.	Chapter 2.3 Goal: High quality teams and individuals. Program: *NextGen - Air Traffic Control/Technical Operations Human Factors (Controller Efficiency) (1A09A)*

JPDO R&D Plan		NARP	
Transformed Facilities: Air Traffic Management Workforce Skills and Training R-0780 OI-0307 Required Completion Date: 2012	Complete applied research on strategic job analysis of new roles and responsibilities of air traffic service providers to support decisions on personnel selection and training.	By 2012, complete a strategic job analysis of the new roles of air traffic service providers using a highly automated system, sharing separation responsibilities with pilots, and moving toward performance-based services.	Chapter 2.3 Goal: High quality teams and individuals. Program: *Air Traffic Control/Technical Operations Human Factors (A11.i)* (Legacy Program)
Transformed Facilities: Air Traffic Management Workforce Skills and Training R-1050 OI-0307 Required Completion Date: 2013	Complete development of methods for assignment of airspace to the workforce for operations in the NextGen environment.	By 2011, conduct demonstrations of high altitude “generic” controllers.	Chapter 2.1 Goal: Fast, flexible, and efficient. Program: *NextGen - Operations Concept Development (Validation Modeling) (1A09F)*
Transformed Facilities: Air Traffic Management Workforce Skills and Training R-1060 OI-0307, OI-0342, OI-0365 Required Completion Date: 2013	Complete applied research and development to understand NextGen optimal team sizes and skill sets compositions to support implementation of policies and procedures for staff management and facility design in 2015.	By 2015, develop the selection procedures to transform the workforce into a new generation of service providers that can manage traffic flows in a highly automated system.	Chapter 2.3 Goal: High quality teams and individuals. Program: *Air Traffic Control/Technical Operations Human Factors (A11.i)* (Legacy Program)
Transformed Facilities: Air Traffic Management Workforce Skills and Training R-1470 OI-0307, OI-0342, OI-0365 Required Completion Date: 2014	Complete applied research on air traffic management training methods, team compositions, and allocation of responsibilities needed to achieve NextGen objectives.	By 2014, determine what ATSP training is needed to assure adequate understanding of functions and limitations of automation and decision aides.	Chapter 2.3 Goal: High quality teams and individuals. Program: *NextGen - Air Traffic Control/Technical Operations Human Factors (Controller Efficiency) (1A09A)*
Aircraft, Operator, and Air Transportation User Requirements: Reduce Time to Introduce Airframe, Avionics, and Procedure Changes R-1670 OI-0358 Required Completion Date: 2014	Complete applied research and development of operator personnel training capabilities and methods, team compositions, and allocation of responsibilities needed to enable flight crews and dispatch personnel to more efficiently achieve proficiency in NextGen operations.	By 2014, conduct research to support the development of standards, procedures, training, and policy to implement these milestones.	Chapter 2.7 Goal: Self-separation. Program: *NextGen – Self Separation (A12.d)*

JPDO R&D Plan		NARP	
Cross-Cutting Research and Development: Human Error Mitigation and Risk Management D-1690 OI-0324, OI-0328 Required Completion Date: 2011	Complete development of human-system performance models that accurately capture human variability and human error in highly automated NextGen systems to support applied research on high-level roles and responsibilities of human operators and automation in NextGen systems.	By 2010, model collision risk for surface movement.	Chapter 2.7 Goal: Goal: Self-separation. Program: *NextGen – Self Separation (A12.d)*
		By 2013, continue to populate the information model of advanced concepts into mass interface requirements.	Chapter 2.4 Goal: Human-centered design. Program: *NextGen - Operations Concept Validation (Validation Modeling) (1A09F)*
Cross-Cutting Research and Development: Human Error Mitigation and Risk Management D-1700 OI-0324, OI-0328 Required Completion Date: 2012	Complete development of system risk assessment and management models to applied research on the allocation of capabilities across flight operator and ANSP automation.	By 2013, develop a transition plan to implement pilot separation responsibility integrated with change in controller role.	Chapter 2.4 Goal: Human-centered design. Program: *NextGen – Air Ground Integration (A12.c), NextGen - Air Traffic Control/Technical Operations Human Factors (Air/Ground Integration) (1A09B)*
		By 2013, develop and apply risk management techniques to understand and predict human error vulnerability and hazards.	Chapter 2.4 Goal: Human-centered design. Program: *NextGen - Air Traffic Control/Technical Operations Human Factors (Air/Ground Integration) (1A09B)*
Cross-Cutting Research and Development: Human Error Mitigation and Risk Management D-1710 OI-0324, OI-0328 Required Completion Date: 2015	Complete applied research on risk-reducing systems interfaces, procedures, and training to reduce human error and complement the development of automation procedures for the range of NextGen stakeholders.	By 2013, develop guidance to reduce cognitive errors.	Chapter 2.4 Goal: Human-centered design. Program: *NextGen - Air Ground Integration (A12.c), NextGen - Air Traffic Control/Technical Operations Human Factors (Air/Ground Integration) (1A09B)*
		By 2013, develop and apply risk management techniques to understand and predict human error vulnerability and hazards.	Chapter 2.4 Goal: Human-centered design. Program: *NextGen - Air Traffic Control/Technical Operations Human Factors (Air/Ground Integration) (1A09B)*

Table E.1 – FAA NextGen R&D Program FY 2009 Budget by OEP Domains and Solution Sets

		Air Traffic Operations Domain Solution Sets							
R&D NextGen Program FY 2009		Collaborative ATM	Transform Facilities	Flexible Terminals and Airports	High Density Airports	Increase Safety, Security, and Environment	Initiate Trajectory-Based Operations	Reduce Weather Impact	
A12.b	Wake Turbullence			7,370					7,370
A12.c	NextGen - Air Ground Integration	375		300	879		1,000		2,554
A12.d	NextGen - Self Separation			1,700	2,600		3,725		8,025
A12.e	NextGen - Weather Technology in the Cockpit							8,049	8,049
A13.b	NextGen - Environmental Research - Aircraft Technologies, Fules, and Metrics					16,050			16,050
	Subtotal R,E&D	375	0	9370	3479	16050	4725	8049	42048
1A09A	NextGen - ATC/Tech Ops Human Factors (Controller Efficiency)	250	750	1,300	1,000		300	200	3,800
1A09B	NextGen - ATC/Tech Ops Human Factors (Air/Ground Integration)	400		900	800		800		2,900
1A09C	NextGen - Environment and Noise and Emission Reduction)					2,500			2,500
1A09D	NextGen - Environment and Energy (Validation Modeling)					4,500			4,500
1A09E	NextGen - New ATM Requirement				2,700		2,700		5,400
1A09F	NextGen - Operations Concept Development (Validation Modeling)	1,100		1,400	1,000		500		4,000
1A09G	NextGen - System Safety Management Transformation					16,300			16,300
1A09H	NextGen - Wake Turbulence (Re-categorization)			2,000					2,000
	Subtotal ATO Capital	1,750	750	5,600	5,500	23,300	4,300	200	41,400
	TOTAL R&D	2,125	750	14,970	8,979	39,350	9,025	8,249	83,448

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APPENDIX F: Acronyms and Abbreviations

4DT	Four Dimensional Trajectory
A	
AAAE	American Association of Airport Executives
AACE	Airworthiness Assurance Center of Excellence
AA-IADS	Aircraft Accident/Injury and Autopsy Data System
AC	Advisory Circular
ACB	Former Office of Innovations and Solutions
ACCRI	Aviation-Climate Change Research Initiative
ACEE	Aircraft Energy Efficiency
ACER	Armored Combat Engineer Robot
ACES	Airspace Conflict Evaluation Simulator
ACI	Airports Council International
ACI-NA	Airports Council International—North America
ACO	Aircraft Certification Office
ACR	Air Certification Office
ACRP	Airport Cooperative Research Program
ADDS	Aviation Digital Data Service
ADS-B	Automatic Dependent Surveillance – Broadcast
AEC	Aircraft Emissions Characterization
AED	Automatic External Defibrillators
AEDT	Aviation Environmental Design Tool
AEE	[FAA – AEP] Office of Environment and Energy
AEEA	ASIAS Environment Enterprise Architecture
AEP	[FAA – Staff Office] Aviation Policy, Planning and Environment
AEPMT	Aviation Environmental Portfolio Management Tool
AFCB	Arc-Fault Circuit Breaker
AFRL/HE	Air Force Research Laboratory/Human Effects Directorate
AFS	[FAA – AVS] Flight Standards Service

AFSS	Automated Flight Service Station
AI	Aeronautical Information
AIA	Aerospace Industries Association
AIM	Airspace and Aeronautical Information Management
AIP	Airport Improvement Program
AiRE	Aviation Interoperability Initiative to Reduce Emissions
AIXM	Aeronautical Information Exchange Model
AJP-6	[FAA] Research and Technology Development Office
ALPA	Air Line Pilot Association
AMT	Aviation Maintenance Technician
AMTAS	Advanced Materials in Transport Aircraft Structures
ANSP	Air Navigation Service Provider
AOC	ACRP Oversight Committee
AOPA	Aircraft Owners and Pilots Association
AOS	Former office code for Airway Facilities Operational Support
AOV	[FAA – AVS] Air Traffic Safety Oversight Service
APA	Allied Pilots Association
APMT	Aviation Environmental Portfolio Management Tool
AQP	Advanced Qualification Program
ARAC	[FAA] Aviation Rulemaking Advisory Committee
ARFF	Aircraft Rescue and Fire Fighting
ARINC	Aeronautical Radio Incorporated
ARP	[FAA – Line of Business] Airports
ARTCC	Air Route Traffic Control Center
ARTS	Automated RADAR Terminal System
ASAP	Aviation Safety Action Program
ASB	Aviation Science Board
ASDE-X	Airport Surface Detection Equipment – Model X
ASEB	National Academy Aeronautics and Space Engineering Board

ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers
ASI	Aviation Safety Inspector
ASIAS	Aviation Safety Information Analysis & Sharing
AST	[FAA – Line of Business] Associate Administrator for Commercial Space Transportation
ASTM	American Society for Testing and Materials
ATA	Air Transport Association
ATC	Air Traffic Control
ATCOTS	Air Traffic Control Optimum Training Solution
ATCS	Air Traffic Control Specialist
ATCT	Air Traffic Control Tower
ATC/TO	Air Traffic Control/Technical Operations
ATD&P	Advanced Technology Development and Prototyping
ATM	Air Traffic Management
ATO	[FAA – Line of Business] Air Traffic Organization
ATO Capital	[FAA Budget Appropriation]
ATO-P	[FAA – ATO] Office of Operations Planning
ATOP	Advanced Technology for Oceanic Procedures
ATOS	Air Transportation Oversight System
ATR	EADS and Alenia Aircraft
ATS	Air Traffic Services
AT-SAT	Air Traffic Selection and Training
ATSP	Air Traffic Service Provider
ATTE	Air Traffic Teamwork Enhancement
avgas	aviation gasoline
AVS	[FAA – Line of Business] Aviation Safety
AVSSI	Aerospace Vehicle Systems Institute
AVT	Autonomous Virtual Tower
AWTT	Aviation Weather Technology Transfer

B	
BA	Big Airspace
C	
C3	Command, Control and Communications
CAA	Civil Aviation Authority
CAAFI	Commercial Aviation Alternative Fuels Initiative
CAAR	Center for Applied ATM Research
CAASD	[MITRE] Center for Advanced Aviation System Development
CAEP	[ICAO] Committee on Aviation Environmental Protection
CAMI	Civil Aerospace Medical Institute
CANSO	Civil Air Navigation Services Organization
CARI-6	The name of a radiobiological computer program
CAST	Certification Authorities Software Team
CATM	Collaborative Air Traffic Management
CBR	California Bearing Ratio
CBT	Computer Based Training
CC4	Construction Cycle Four
CCCEF	Center for Climate Change and Environmental Forecasting
CCSP	Climate Change Science Program
CDA	Continuous-Descent Approach
CDTI	Cockpit Display of Traffic Information
CEAT	Center of Excellence for Airport Technology
CECAM	Center of Excellence for Composite and Advanced Materials
CEH	Complex Electronic Hardware
CFIT	Controlled Flight into Terrain
CFR	Code of Federal Regulations
CGAR	Center of Excellence for General Aviation Research
CIP	Current Icing Product
CLEEN	Continuous Low Energy, Emissions, and Noise

CMAQ	Congestion Mitigation and Air Quality
CNS	Communications, Navigation, and Surveillance
CO	Carbon Monoxide
COE	Center of Excellence
COI	Communities of Interest
COMSTAC	[FAA] Commercial Space Transportation Advisory Committee
ConOps	Concept of Operations
CONUS	Continental United States
CoSPA	Consolidated Storm Product for Aviation
COTS	Commercial Off-The-Shelf
CPC	Certified Professional Controller
CRC	Coordinating Research Council
CRD	Concepts and Requirements Definitions
CRDA	Cooperative Research and Development Agreement
CRM	Crew Resource Management
CRREL	U.S. Army Cold Regions Research and Engineering Lab
CSPR	Closely Spaced Parallel Runways
CTAS TMA	Center TRACON Automation System Traffic Management Advisor
CTI	Collegiate Training Initiative
C&V	Ceiling and Visibility
CVM	Comparative Vacuum Monitoring
CWIAP	Controller Workforce Integrated Action Plan
D	
DARWIN™	Design Assessment for Reliability with Inspection
DEFORM™	A patented system used to analyze titanium alloy defects in turbine rotor disks
DER	Designated Engineering Representative
DFW	Dallas/Ft. Worth International Airport
DHS	Department of Homeland Security
DLT	Development Liaison Team

DME	Distance Measuring Equipment
DNL	Day-Night-Level
DOC	Department of Commerce
DOD	Department of Defense
DOE	Department of Energy
DOT	Department of Transportation
DRG	Design Review Group
DRVSM	Dynamic Vertical Reduced Separation Minima
DSA	Detect, Sense, and Avoid
DSR	Display System Replacement
DSS	Digital Safety System
E	
EA	Enterprise Architecture
EASA	European Aviation Safety Agency
EC	European Community
ECAC	European Civil Aviation Conference
EDA	En Route Descent Advisor
EDMS	Emissions and Dispersion Modeling System
EDS	Environmental Design Space
E&E	Environment and Energy
EFB	Electronic Flight Bag
EFDI	Electronic Flight Data Interface
EFG	[ICAO North Atlantic] Economic and Financial Group
EIPT	Environmental Integrated Product Team
ELV	Expendable Launch Vehicles
EMAS	Engineered Materials Arresting System
EMI	Electromagnetic Interference
EMS	Environmental Management System
EPA	Environmental Protection Agency

EPACT	Energy Policy Act of 2005
ERAM	En Route Automation Modernization
ERAU	Embry-Riddle Aeronautical University
ETBE	An ethanol fuel blend
EUROCAE	European Organization for Civil Aviation Equipment
EUROCONTROL	European Organization for the Safety of Air Navigation
E-WG	Environmental Working Group
EWIS	Electrical Wiring Interconnect Systems
F	
FAA	Federal Aviation Administration
FAARFIELD	FAA Rigid and Flexible Iterative Elastic Layered Design
FACT	Future Airport Capacity Task
FAROS	Final approach runway occupancy signal
F&E	Facilities and Equipment
FEA	Federal Enterprise Architecture
FEIS	Final Environmental Impact Statement
FEWS	Future En Route Workstation
FFRDC	Federally Funded Research and Development Center
FFT	Full Flight Trainer
FICAN	Federal Interagency Committee on Aviation Noise
FIP	Forecast Icing Product
FIS-B	Flight Information Service-Broadcast
FOD	Foreign Object Debris
FOM	AviationSimNet Federation Object Model
FOQA	Flight Operations Quality Assurance
FPI	Fluorescent Penetrant Inspections
FSS	Flight Service Station
FTF	Federal Transition Framework
FY	Fiscal Year

G	
GA	General Aviation
GAMA	General Aviation Manufacturers Association
GAO	General Accounting Office
GCNSS	Global Communications Navigation and Surveillance System
GEG	Spokane International Airport
GEOSS	Global Earth Observation System of Systems
GNSS	Global Navigation Satellite Systems
GPS	Global Positioning System
GSG	Government Steering Group
GTG2	Graphical Turbulence Guidance 2 Weather Product
H	
HAATS	Houston Area Air Traffic System
HAP	Hazardous Air Pollutant
HAZMAT	Hazardous Material
HCS	HOST Computer System
HAD	High-Density Airport
HF	Human Factors
HFAS	Human Factors Analysis and Classification System
HFIX	Human Factors Interaction Matrix
HFRE	Human Factors Research and Engineering Group
HLA	High-Level Architecture
HITL	Human-In-The-Loop
HNM	Heliport Noise Model
HRET	High Reach Extendable Turret
HUMS	Health and Usage Monitoring System
HVAC	Heating, Ventilation, and Air Conditioning
I	
IA	Interagency Agreements

IAH	George Bush Intercontinental Airport, Houston, TX
IATA	International Air Transport Association
ICAO	International Civil Aviation Organization
iCMM®	Integrated Capability Maturity Model
IEEE	Institute of Electrical and Electronics Engineers
IFR	Instrument Flight Rules
ILS	Instrument Landing System
IMA	Integrated Modular Avionics
IMC	Instrument Meteorological Conditions
INM	Integrated Noise Model
IOT&E	Independent Operational Test and Evaluation
IPRF	Innovative Pavement Research Foundation
IPT	Integrated Product Team
ISG	Industry Steering Group
IR	Infrared
IRG	Independent Review Group
IRP	Integrated Risk Picture
IWP	Integrated Work Plan
J	
JAMS	Joint COE for Advances Materials
JAWS	Juneau Area Wind System
JPDO	Joint Planning and Development Office
JRC	[FAA] Joint Resources Council
JUP	Joint University Program
L	
LAAS	Local-Area Augmentation System
LAHSO	Land and Hold Short Operations
LAS	McCarran International Airport, Las Vegas, NV
LAX	Los Angeles International Airport

LCGS	Low-Cost Ground Surveillance
LCSS	Low-Cost Surface Surveillance
LEA	Layered Elastic Analysis
LED	Layered Elastic Design
LED	Light Emitting Diode
LEQ	Life Experiences Questionnaire
LFN	Low-Frequency Noise
LGF	LAAS Ground Facility
LIDAR	Light Detection and Ranging
LL	Low-Lead
LLNL	Lawrence Livermore National Laboratory
LNAV	Lateral Navigation
LOSA	Line Operations Safety Audit
LSDYNA	A proprietary finite element code
LTO	Landing and Takeoff
M	
MANPADS	Man-Portable Air-Defense Systems
MAGENTA	Modeling System for Assessing Global Noise Exposure
MAPoD	Model-Assisted Probability of Detection
MASPS	Minimum Aviation System Performance Standards
MCDC	Modified Condition Decision Coverage
MCI	Mode-C Intruder
MEM	Memphis International Airport
MIA	Miami International Airport
MIA	Minimum IFR Altitude
MIT	Massachusetts Institute of Technology
MITRE	A private, independent, not-for profit organization (not an acronym)
MMIR	Maintenance Malfunction Information Reporting
MMPDS	Metallic Materials Properties Development and Standardization

MOA	Memorandum of Agreement
MoC	Memorandum of Cooperation
ModTF	Modeling and Database Task Force
M&S	Merging and Spacing
M&S	Modeling and Simulation
MOU	Memorandum of Understanding
MPO	Metropolitan Planning Organization
MSAW	Minimum Safe Altitude Warning
MSD	Multiple-Site Damage
MTS	MITRE Technical Staff
MVA	Minimum Vector Altitude
MVMC	Marginal Visual Meteorological Conditions
N	
NABSAS	North American Bird Strike Advisory System
NAOMS	National Aviation Operations Monitoring System
NAPA	National Academy of Public Administration
NAPTF	National Airport Pavement Test Facility
NARP	National Aviation Research Plan
NAS	National Airspace System
NASA	National Aeronautics and Space Administration
NASAO	National Association of State Aviation Officials
NASR	National Airspace System Resources
NAT	[ICAO] North Atlantic
NATPRO	National Air Traffic Professionalism Program
NAWC	Naval Air Warfare Center
NCAR	National Center for Atmospheric Research
NCT	Northern California Terminal RADAR Approach Control
NCVA	National Ceiling and Visibility Analysis
NDB	Non-Directional Beacon

NDI	Nondestructive Inspection
NDI	Non-Developmental Item
NDT	Nondestructive Testing
NEO	Net-Enabled Operations
NEXRAD	Next-Generation Weather Radar
NextGen	Next Generation Air Transportation System
NEXTOR	National Center of Excellence for Aviation Operations Research
NGATS	Next Generation Air Transportation System
NLA	New Large Aircraft
NLR	Dutch National Aerospace Laboratory
NOAA	[DOC] National Oceanic and Atmospheric Administration
NOTAM	Notice to Airmen
NOVEC	A 3M fire protection fluid
NOx	Oxides of Nitrogen
NPG	National Work Program Guidelines
NSLA	NextGen Service Level Agreement
NSS	NAS Strategy Simulator
NRC	National Research Council
NTSB	National Transportation Safety Board
NTZ	No Transgression Zone
NWS	[DOC] National Weather Service
O	
OBIGGS	On Board Inert Gas Generating System
OEP	Operational Evolution Partnership
OI	Operational Improvements
OJT	On the Job Training
OMB	Office of Management and Budget
ONR	Office of Naval Research
OOOI	Out, Off, On, and In

OOT	Object-Oriented Technology
Ops	[FAA Budget Appropriation] Operations
ORD	Chicago O'Hare International Airport
OSED	Operational Suitability and Environmental Description
OSTP	[Executive Office of the President] Office of Science and Technology Policy
P	
PARC	Performance-Based Advisory Rulemaking Committee
PARTNER	Partnership for AiR Transportation Noise and Emissions Reduction
P-ATM	Performance-Based Air Traffic Management
PBM	Performance-Based Navigation
PCC	Portland Cement Concrete
PDARS	Performance Data Analysis and Reporting System
PHMSA	Pipeline and Hazardous Materials Safety Administration
PHX	Sky Harbor International Airport, Phoenix, AZ
PIREP	Pilot Weather Report
PITTT	Propulsion Indications Task Team
PM	Particulate Matter
ProFAA	Computer program for computing pavement elevation profile roughness indexes
Q	
QAT	Quiet Aircraft Technology
R	
RAA	Regional Airlines Association
RADAR	Radio Detection and Ranging
RALS	Remote Airport Lighting System
R&D	Research and Development
RDHFL	Research and Development Human Factors Laboratory
REB	[FAA] Research and Development Executive Board
R,E&D	[FAA Budget Appropriation] Research, Engineering and Development
REDAC	[FAA] Research, Engineering and Development Advisory Committee

RFI	Radio Frequency Interference
RFID	Radio Frequency Identification
RIL	Runway Intersection Light
RIRP	Runway Incursion Reduction Program
RITE	[COE] Research in Intermodal Transport Environment
RLV	Reusable Launch Vehicle
RLVWG	Reusable Launch Vehicle Working Group
RNAV	Air Navigation
RNP	Required Navigation Performance
RPAT	RNP Parallel Approach Transition
RPD	Research Project Description
RPM	Revolutions Per Minute
R-SAT	Rapidly-Deployable Stand-Alone ATC Trainer
RTCA	Company name (no longer an acronym)
RTOS	Real-Time Operating System
RTSP	Real-Time Streamlining Protocol
RTVS	Real-Time Verification System
RWI	Reduce Weather Impact
RWSL	Runway Status Light
S	
SAAAR	Special Aircraft and Aircrew Authorization Required
SAE	Society of Automotive Engineers
SAGE	System for Assessing Aviation Global Emissions
SAMA	Small Aircraft Manufacturers Association
SAS	[REDAC] Subcommittee on Aircraft Safety
SASO	System Approach for Safety Oversight
SBIR	Small Business Innovation Research
SCPI	System Capacity, Planning, and Improvement
SDAT	Sector Design and Analysis Tool

SDP	Service Delivery Point
SEMP	Systems Engineering Management Plan
SERC	Structural Engineering Research Centre
SESAR	Single European Sky Air Traffic Management Research
SF	Safe Flight
SFO	San Francisco International Airport
SLD	Supercooled Large Droplet
SMP	Strategic Management Process
SMS	Safety Management System
S&O	[FAA Budget Appropriation] Safety and Operations
SPAS	Safety Performance Analysis System
SPC	[JPDO] Senior Policy Committee
SRM	Safety Risk Management
SSM	[TCRG] System Safety Management
SSRI	Selective Serotonin Reuptake Inhibitor
SSRWG	System Safety Research Working Group
STARS	Standard Terminal Automation Replacement System
STFM DST	Surface Traffic Flow Management Decision Support Tools
STL	Lambert-St. Louis International Airport
SUA	Special Use Airspace
SVT	Staffed Virtual Tower
SWIM	System Wide Information Management
SwRI	Southwest Research Institute
T	
TA	Tailored Arrival
TAA	Technically Advanced Aircraft
TAWS	Terrain Awareness and Warning System
TBM	Trajectory Based Management
TBO	Trajectory Based Operations

TCAS	Traffic Alert and Collision Avoidance System
TCRG	[FAA] Technical Community Representative Group
TCO	Terminal Course Objectives
TERPS	Terminal Instrumentation Procedures
TFM	Traffic Flow Management
TFMS	Traffic Flow Management System
THL	Takeoff Hold Lights
TIS-B	Traffic Information Service-Broadcast
TMA	Traffic Management Advisor
TMI	Traffic Management Initiatives
TMU	Traffic Management Unit
TO	Technical Operations
TRACON	Terminal Radar Approach Control
TRB	Transportation Research Board
TRL	Technology Readiness Level
TSA	Transportation Security Administration
TSO	Technical Standard Orders
U	
UAS	Unmanned Aircraft Systems
UAV	Unmanned Aerial Vehicle
UAV	Uninhabited Aerial Vehicle
UEDDAM	Uncontained Engine Debris Damage Assessment Model
UEET	Ultra Efficient Engine Technology
UPS	United Parcel Service
USDA	United States Department of Agriculture
V	
VAAC	Volcanic Ash Advisory Center
VARTM	Vacuum Assisted Resin Transfer Molding
VASIP	Voluntary Aviation Safety Information – Sharing Process

VASIS	Voluntary Aviation Safety Information Sharing
VFR	Visual Flight Rules
VLJ	Very Light Jets
VLTA	Very Large Transport Aircraft
VMC	Visual Meteorological Conditions
VNAV	Vertical Navigation
VORS	Very High Frequency Omni Range Stations
VT	Virtual Tower
W	
WAAS	Wide-Area Augmentation System
WIDA	Weather Information Decision Aid
WJHTC	William J. Hughes Technical Center
WRF	Weather Research and Forecast
WTMD	Wake Turbulence Mitigation for Departures
WTP	Wake Turbulence Program
WxIPT	Weather Integrated Product Team
Z	
ZID	Indianapolis Air Route Traffic Control Center
ZAB	Albuquerque Air Route Traffic Control Center
ZHU	Houston Air Route Traffic Control Center
ZJX	Jacksonville Air Route Traffic Control Center
ZKC	Kansas City Air Route Traffic Control Center
ZLA	Los Angeles Air Route Traffic Control Center
ZMA	Miami Air Route Traffic Control Center
ZME	Memphis Air Route Traffic Control Center
ZOA	Oakland Air Route Traffic Control Center

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