PROGRAM PLAN

AERONAUTICS TECHNOLOGY THEME

AVIATION SAFETY AND SECURITY PROGRAM

INTRODUCTION

In response to the recommendations of the White House Commission on Aviation Safety and Security in 1997, NASA created the Aviation Safety Program to research and develop technologies focused on the National goal of reducing the fatal aircraft accident rate by 80% by 2007. In 2002, NASA released an Aeronautics Blueprint that identifies a new and revolutionary vision for aviation in the 21st Century that guides the Aerospace Technology Theme. With Security taking on new importance since the events of September 11, 2001, many potential technology solutions to Aviation Security issues are presented in the Aeronautics Blueprint. Many issues that were facing air travel prior to September 11 remain and require innovative technology solutions that are addressed by the Blueprint. These technologies can do more than resolve existing issues; they have the potential to open a whole new era in aviation and provide new opportunities in air transportation safety and efficiency, national defense, economic growth, and quality of life.

The Aviation Safety and Security Program (AvSSP) directly addresses the safety and security research and technology needs of the Nation's aviation system. While safety looks to avert unintentional life-threatening events, security looks to stop intrusions into the system that are intended to cause damage, harm, and loss of life. Safety research in AvSSP will develop prevention, intervention, and mitigation technologies and strategies aimed at one or more causal, contributory, or circumstantial factors associated with aviation accidents. High priority is given to strategies that address factors determined to be the largest contributors to accident and fatality rates, as well as those that address multiple classes of causal factors. The AvSSP will also develop and integrate information technologies needed to build a safer aviation system, to support pilots and air traffic controllers, as well as provide information to assess situations and trends that might indicate unsafe conditions before they lead to accidents. Security research in AvSSP will develop concepts and technologies that reduce the vulnerability of the aviation system to criminal and terrorist attacks while dramatically improving the efficiency of such protection.

PROGRAM OBJECTIVES

The goal and objectives of the AvSSP are established in the NASA Strategic Plan. In the NASA 2000 Strategic Plan, which was the governing document at the initiation of program implementation, OAT formulated a safety objective to "Make a safe air transportation system even safer." The plan further established the following safety performance metrics: Reduce the aircraft fatal accident rate 80% within 10 years and 90% within 25 years.

Based on this safety performance metric, the AvSSP goal for the FY 2000 through FY 2004 time period is the following: Develop and demonstrate technologies that contribute to a reduction in the aviation fatal accident rate by 50 percent from the FY 1991 – 1996 average.

With the vision for aeronautics research supplied by the Aeronautics Blueprint and the intent of addressing aviation security research and technology needs, the scope of the program was expanded in the NASA 2003 Strategic Plan to include activities targeted at the aviation security

applications beginning in FY 2004. Therefore, a new NASA objective was created to cover both safety and security research: Decrease the aircraft fatal accident rate and the vulnerability of the air transportation system to threats and mitigate the consequences of accidents and hostile acts.

Specific safety performance goals and metrics for activities beginning in FY 2006 are under formulation. Security performance goals and metrics are being developed in partnership with the Department of Homeland Security.

To address the existing and projected objectives in aviation safety and security, the AvSSP has established strategic foci within which all safety and security research activities will be conducted. These foci and the themes for research in each are as follows:

1. Aircraft Self-Protection and Preservation - Protect and prevent damage to aircraft due to abnormal operations and system failures
2. Hostile Act Intervention and Protection - Increase resiliency of the Air Traffic System against threats and hostile acts
3. Human Error Avoidance - Prevent unsafe flight situations due to breakdown between human and machine interface
4. Environmental Hazards Awareness and Mitigation - Detect and/or mitigate the effects of natural hazards that could compromise safe Air Traffic System operations
5. System Vulnerability Discovery and Management - Identify and inform users of potential Air Traffic System vulnerabilities

CUSTOMER ADVOCACY

NASA's role continues to be understanding the issues and challenges and developing the long-term technology base for the public good that industry and other agencies cannot address on their own. NASA works closely and partners with the Federal Aviation Administration (FAA), the Department of Transportation (DoT), the Transportation Security Administration (TSA), the Department of Homeland Security (DHS), the Department of Defense (DoD), academia, and industry to ensure that the NASA research results in useful and timely products and processes. For AvSSP, these partnerships also enable the application of NASA technical expertise and test facilities to support accident investigations and reconstructions, address in-service operation problems, and support system upgrades.

Partnerships

NASA has participated in numerous partnerships for aeronautics research and technology development including ones with the Commercial Aviation Safety Team (CAST) and the General Aviation Joint Steering Committee (GAJSC). CAST is a group of senior Government and industry commercial aviation leaders whose goal is to form a national safety agenda and a plan for making commercial aviation safer, defining implementation paths for safety enhancements and tracking progress on implementation. NASA is a voting member on the CAST Executive Committee. GAJSC is a general aviation organization similar to CAST.

A NASA/FAA Joint Working Group (JWG) has been established to ensure that NASA and FAA safety research and development activities are appropriately coordinated. This group sponsored the development of the FAA/NASA Joint Research and Development Plan (August 2000).

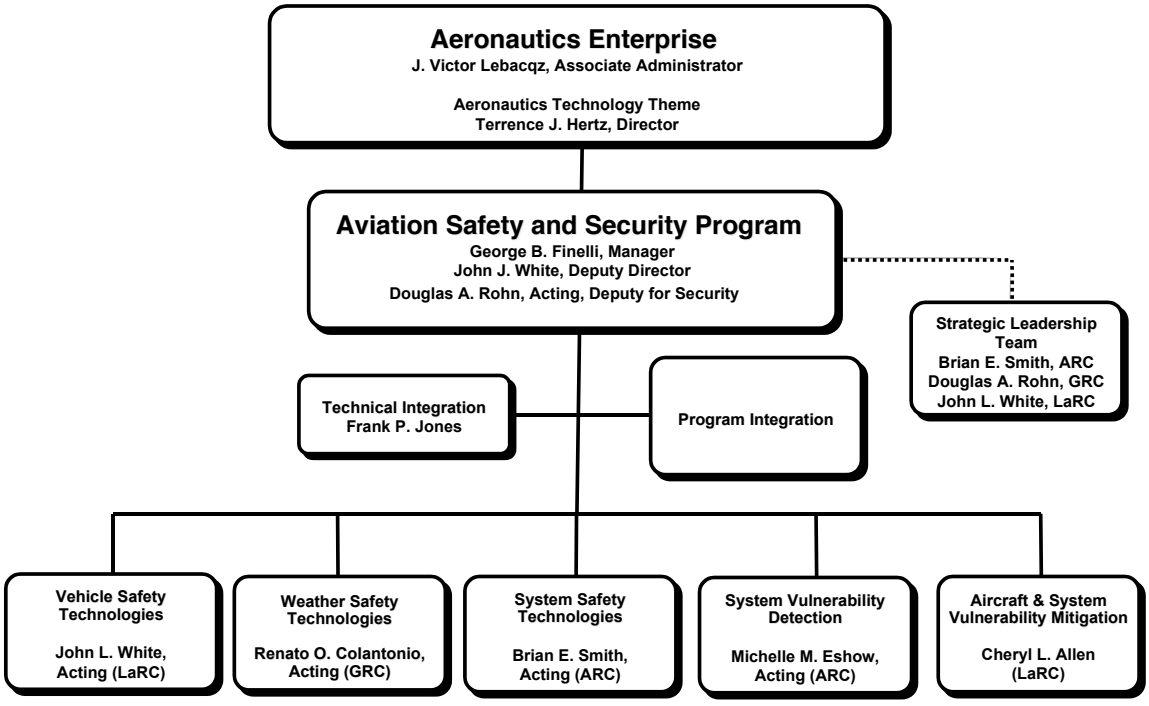
NASA is currently formalizing a partnership with the Transportation Security Administration through the Department of Homeland Security. This partnership will provide the framework for NASA's technology investment in aviation security.

PROGRAM AUTHORITY AND MANAGEMENT STRUCTURE

The AvSSP Program Manager reports to the Director for the Aeronautics Technology Theme, who resides in the Office of Aerospace Technology at NASA Headquarters. The Program Manager assumes full management control, responsibility, authority, and accountability for the Program as delegated by the Director of Aeronautics Technology and is responsible for determining the implementation of assigned activities and major staff functions, which include:

- Strategic Management Team comprised of senior program managers, one representative for each Center, that are responsible for ensuring the technical, schedule, and resource commitments of the respective Centers, as described in the Program Plan, are met.

- Project and Sub-Project Managers that are responsible for implementation of the AvSSP sub-projects with full authority to manage sub-projects within the defined objectives, technical scope, schedules, and resources.



		Center Participation
Focus	**Aircraft Self-Protection & Preservation**	
Project	• Vehicle Safety Technologies	LaRC, GRC
Subproject	- Synthetic Vision Systems	LaRC
	- Single Aircraft Accident Prevention	LaRC, GRC
	- Accident Mitigation	GRC
	- Technical Integration	LaRC, GRC
	• *Aircraft & Propulsion Systems Self-Diagnosis & Self-Reliance*	LaRC, GRC
	- Sensors for Self Diagnostics of Structural Components	LaRC
	- GA Envelope Protection	LaRC
	- Robust Control for Unstable Landing Conditions	LaRC
	- Hot Section Sensor Data for Real Time Engine Prognostics	GRC
Focus	***• Hostile Act Intervention & Protection***	
Project	• *Aircraft & Systems Vulnerability Mitigation*	LaRC,DFRC,ARC,GRC
Subproject	*- Protected Asset Flight System*	LaRC, ARC
	- Flight Evaluation for Aircraft Recovery	DFRC
	- EME Surveillance and Detection	LaRC
	- Damage Adaptive Control System	LaRC,GRC,ARC,DFRC
	- Secure Aircraft System for Information Flow	GRC
	- Database of Lightweight, Fire/Explosive Resistant New Materials	LaRC
	- Fuel Tank Inerting	GRC
Focus	***Human Error Avoidance***	
Project	• *Integrated Presentation of Safety Critical Flight Deck Information*	LaRC
	• *Training and Operations for Error Reduction*	ARC
Focus	**• Environmental Hazards Awareness & Mitigation**	
Project	• Weather Safety Technologies	GRC, LaRC, DFRC
Subproject	- Weather Accident Prevention	GRC, LaRC, DFRC
	- Aircraft Icing	GRC
	• *Icing Technologies for Regional Jets*	GRC
	• *Satellite Data for Real-time Aviation Weather Forecast*	LaRC, GRC
Focus	**• System Vulnerability Discovery & Management**	
Project	• System Safety Technologies	ARC
Subproject	- Aircraft System Monitoring & Modeling	ARC
	- System Wide Accident Prevention	ARC
	• *System Vulnerability Detection*	ARC, JPL
	- Integrated Safety Data for Tactical Response	ARC
	-Secure Airspace Decision Support Tool	ARC
	- Security Incidents Reporting System	ARC
	- Knowledge Discovery Tools for System Wide Security	ARC
	- Sensing of Onboard Chemical and Biological Contaminants	JPL
	• *Technical Integration*	LaRC, GRC
	- Aircraft & System Safety Remaining Risk Definition	LaRC, GRC
	-System Engineering & Program Assessment	LaRC, GRC
	- Air Transportation System Remaining Vulnerability Definition	LaRC, GRC

NOTE: Projects/Subprojects shown in italics are in formulation

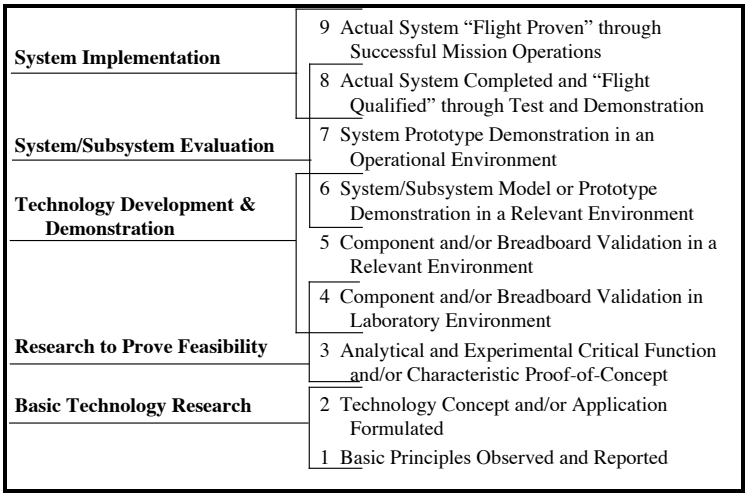
PROGRAM REQUIREMENTS

The AvSSP target success goal is for the developed technologies to contribute to an 80 percent (factor of 5) reduction in the fatal accident rate. The minimum success criterion for the program is to contribute to a 50 percent reduction in the fatal accident rate. Determination of success will be based on analysis of the AvSSP products against their targeted accident precursors, factors, causes, and categories--as captured in the Program's exit criteria--to quantify the projected impact on the aggregate fatal accident rate. Baseline data for this analysis are for the period 1990-1996 and were obtained from the National Transportation Safety Board (NTSB) Accident Statistics for

U.S. civil Aviation. Mission success criteria evaluations will project percentages of accident reduction based upon analysis of NTSB accident statistics and other relevant aviation safety data.

Aviation Security research and development is in the formulation stage at the time of the writing of this document. As such, the mission success criteria for Security-related activities are under development. In addition, Safety research and development for FY06 and beyond is in the formulation stage. Mission success criteria are under development.

Success of the technology development will be based on the demonstration of achievement of sufficient maturity of the technology to enable partners and customers to adopt and complete the technology application. The technology maturation process will be assessed using define Technology Readiness Levels (TRL's). In general, the AvSSP will develop technologies to TRL 6 (demonstrate a technology with a system or subsystem model or prototype in a relevant environment).



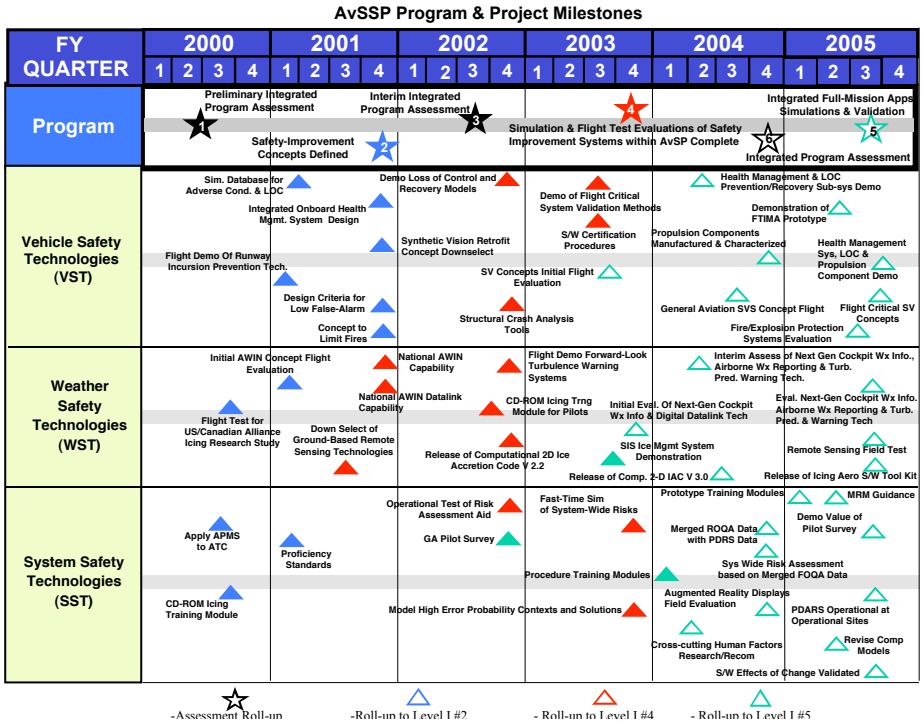
Along with the technology development efforts will be ongoing activities by NASA to promote the implementation of program outputs into the aviation community. NASA will work with and rely on, industry, FAA, and TSA partners to implement these technologies. Each project under AvSSP will have a product implementation plan that will include implementation risk assessment and mitigation plans. Program benefits will be identified through systems analysis where the input are defined as project technology products. The results of these analyses will be documented and reported as part of each of the Program Assessment milestones.

The Program mission success criteria are as follows:

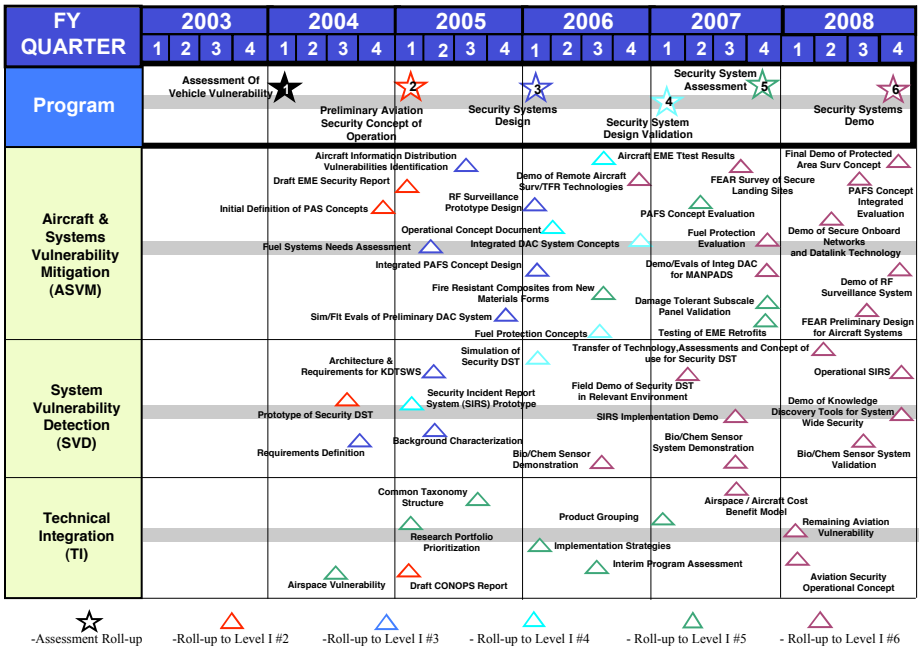
Product	Project	Target Performance	Exit Criteria (Minimum Sucess)
Runway incursion technologies and displays that provide intutive guidance and piloting decision support worldwide, at any runway, at any airport for both general and commercial aviation – demonstrated in flight	VST	Demonstrate and deliver certifiable precision approach and landing technologies highlighting 100% of potential surface conflicts with radar cross section greater than 1 meter squared, projected to eliminate runway incursion fatal accidents	Demonstrate and deliver certifiable precision approach and landing technologies highlighting selected runway and ground-identified potential conflicts, projected to reduce the number of runway incursion fatal accidents by 50%
Synthetic vision technologies and implementable, demonstrated system concepts that provide immediate, clear day-equivalent visual awareness and avoidance of worldwide terrain and obstacles in any weather or light condition – demonstrated in flight	VST	Demonstrate and deliver certifiable systhetic vision technologies with photo-realistic displays containing terrain resolutions under 5m (airport) to 100m (enroute), projected to eliminate CFIT fatal accidents worldwide (GA-50%)	Demonstrate and deliver certifiable synthetic vision technologies with wire-frame displays and terrain resolution of 100m for enroute operations, projected to reduce commercial CFIT fatal accidents by 50%
Health and usage monitoring technologies that enable realtime and trending status of critical on-board aircraft systems - demonstrated in flight	VST	Demonstrate and deliver certifiable health and usage monitoring technologies for commercial transport, projected to reduce failed equipment citings in fatal accident reports by 15%	Demonstrate and deliver certifiable health and usage monitoring technologies for commercial transport aircraft, projected to reduce failed equipment citings in fatal accident reports by 5%
Advanced structural and material designs that demonstrate improvement in crash survivability and fire hazard mitigation - demonstrated in ground-based tests	VST	Demonstrate and deliver advanced structures, materials, and system designs, projected to improve crash survivability and fire hazard mitigation in fatal accidents by 20%	Demonstrate and deliver advanced structures, materials, and system designs, projected to improve crash survivability and fire hazard mitigation in fatal accidents by 10%
Prototype System-wide Risk Assessment Capability	SST	Prototype a distributed simulation capability to assess safety risk using system data on the backbone of a secure internet.	Ability to support distributed client-based analyses of safety-risk with remote access to model and data sources is demonstrated and risk assessment accuracy is validated.
Human Performance Models	SST	Develop cognitive error models with diverse scenarios for multiple augmented displays	Evaluation report on advanced computational simulation models using diverse scenarios with and without and augmented display
Maintenance Resource Management (MRM) Training Program for Maintenance	SST	Develop advanced Maintenance Resource Management (MRM) training, guidance, and tools for industry. Deliver to safety and training departments with associated methods for tracking and comparison with current metrics.	Provide MRM guidance to industry.

Product	Project	Target Performance	Exit Criteria (Minimum Sucess)
Affordable technologies and systems for the data-linked communication (both nationally and internationally) and on-board graphical display of aviation weather information – demonstrated in flight	WST	Demonstrate and deliver at least 4 operational graphical weather products available at all flight levels over CONUS and oceanic routes via digital satellite broadcast, projected to reduce fatal weather-induced accidents by 50% (GA – 50%)	Demonstrate and deliver at least 2 operational graphical weather products available via VHF broadcast over CONUS at 5000 ft or greater altitude, projected to reduce fatal weather-induced accidents by 25% (GA – 25%)
Turbulence modeling and detection technologies that allow for predictive warning and/or avoidance of severe turbulence encounters – demonstrated in flight	WST	Demonstrate and deliver certifiable detection products providing at least 2 minutes advanced warning of severe turbulence, projected to reduce turbulence injuries by 50%	Demonstrate and deliver certifiable detection products providing at least 30 seconds advanced warning of severe turbulence, projected to reduce turbulence injuries by 25%
Aircraft icing design and analysis tools and aircraft ice protections system technologies–developed and validated in wind tunnel and flight tests	WST	Develop and validate aircraft icing tools and technologies for commercial and GA aircraft, which when implemented will eliminate currently known icing safety hazards to aircraft.	Develop and validate aircraft icing tools and technologies for commercial and GA aircraft, which when implemented will significantly reduce accidents and incidents for currently known icing safety hazards.

PROGRAM SCHEDULES



AvSSP Program & Project Milestones (In Formulation)



PROGRAM RESOURCES

Budget

	FY 04	FY 05	FY 06	FY 07	FY 08	FY 09
	Full Cost (Dollars in Millions)					
Vehicle Safety Technologies	72.5	77.1				
Weather Safety Technologies	47.0	41.8				
System Safety Technologies	26.9	21.6				
Aircraft and System Vulnerability Mitigation	17.2	32.4	46.0	46.4	34.2	36.2
Aircraft and Propulsion Systems Self-Diagnosis and Self-Reliance			40.0	39.2	40.8	44.5
Integrated Presentation of Safety Critical flight Deck Information			26.5	26.4	33.5	29.7
Training and Operations for Errors Reduction			8.1	8.8	8.9	8.9
Icing Technologies for regional Jets			10.2	11.2	12.6	12.3
Satellite Data for Real-Time Aviation Weather Forecasting			7.1	7.3	7.8	7.5
System Vulnerability Detection	2.2	9.2	22.1	22.7	22.0	21.3
Technical Integration	1.9	2.1	13.5	14.3	14.8	14.2
Total AvSSP	167.7	184.2	173.5	176.3	174.6	174.6

Facilities

AvSSP uses laboratories, simulators, and aircraft at all participating NASA Centers, including the following major facilities:

LaRC

- Research Flight deck (RFD) Simulator-Motion Base
- B757
- Singe-Engine General Aviation (GA) Airplane
- Integrated Flight Deck (IFD)
- Research Systems Integration Laboratory/Flight Systems Integration Laboratory (RSIL/FSIL)

GRC

- Combustion and Fuel Laboratory
- Sensor Laboratories
- On-board Inert Gas Generating System (OBIGGS) Laboratory

Specific facility requirements for Security research and development and for Safety research beginning in FY06 and beyond will be determined as part of project formulation.

CONTROLS

The Program Manager exercises control through the Configuration Management process, which records changes and maintains the current status of programmatic baseline documentation. Changes to the controlled documents will follow the configuration management process to assess the impacts and approve proposed changes, notify all affected parties, and verify/update designated documents. The Program Plan will be updated as required to maintain compatibility between the plan and changes in resource availability. A monthly report is prepared by the Sub-Project Managers to the Project and Program Managers. This report is an integrated assessment of technical, cost, and schedule progress versus plan and contains significant technical highlights as well. Issues and/or concerns (including potential impact and proposed action) and any major interactions with partners are also identified. Additionally, the Project/Sub-Project Managers support Agency, Enterprise, and Center Program Management Council meetings as required by the Program Manager or Center management.

RELATIONSHIPS TO OTHER PROGRAMS AND AGREEMENTS

No products are being received or delivered under formal agreement from any other NASA Programs and/or Projects. This Program is tracked as part of the FAA/NASA Joint Safety Research Plan (August 2000) that documents FAA and NASA efforts in a variety of safety-related research and development.

Internal Agreements:

The program is not dependent on other NASA activities outside of the control of the Associate Administrator, Office of Aerospace Technology.

External Agreements:

1. Umbrella agreement between the FAA and NASA concerning a Partnership to Achieve Goals in Aviation and Future Space Transportation; October 1998.
2. Memorandum of Understanding #FNA/05 between the FAA and NASA on Program Support; August 1990.

3. Memorandum of Agreement #FNA/05-97-01 between the FAA and NASA for support of FAA R&D Field Offices at NASA Centers, March 1997.
4. Memorandum of Understanding #FNA/08 between the FAA and NASA concerning Aviation Safety Research; July 1999.
5. Memorandum of Agreement #FNA/08-99-01 between the FAA and NASA concerning the Aviation Safety Reporting System; June 1999.
6. Memorandum of Agreement #FNA/08-00-01 between the FAA and NASA concerning Weather Accident Prevention R&D Activities; June, 2000.
7. Memorandum of Agreement #FNA/08-01-01 between the FAA and NASA concerning Accident and Incident Mitigation Research; June 2001.
8. Memorandum of Agreements #FNA/08-02-01 between the FAA and NASA concerning the Development and Evaluation of Enhanced Situational Awareness Technologies; June 2002. Cooperative Agreements with Rannoch, Research Triangle Institute, Ohio University, Rockwell Collins, Jeppesen, and Honeywell International
9. Memorandum of Agreement with Department of Energy (Los Alamos National Laboratory)
10. Memorandum of Agreement under development with Department of Homeland Security

ACQUISITION STRATEGY

Leverage NASA's R&D investments through the use of cooperative agreements and cost-shared contracts as much as possible. To maximize the impact of the deliverables, AvSSP's "business" objective is to use NASA R&D as a catalyst for a national (public and private) investment in key safety enabling technologies. Thus, the business philosophy is to not pay for the entirety of any technology development. By encouraging some amount of cost sharing in high-risk, longer-term R&D, NASA can both leverage the national investments in safety and accelerate the implementation of enabling technologies. This acceleration in implementation occurs when industry and other Government agencies invest their resources (funding and/or in-kind) earlier in the technology life cycle.

TECHNOLOGY ASSESSMENT

As mentioned in the Customer Advocacy section above, all technical deliverables will have performance metrics that include TRL as part of the exit criteria. In general, the Program develops technologies to TRL 6, demonstrating a technology through a system or subsystem model or prototype in a relevant environment. Typically, NASA will continue to work in support of its partners and customers to assist their subsequent roles in system or subsystem development as well as system test and operations (i.e., achieving TRL's 7 through 9). The exit criteria will also include projections of the expected outcomes of Project products, outputs, and results. These projections will be verified by system analyses of the products.

COMMERCIALIZATION OPPORTUNITIES

The Program will emphasize rapid and effective dissemination of the technology to the U.S. industry, FAA, and TSA. Technical Transfer mechanisms will include cost-shared R&D contracts and grants that help ensure direct transfer of technology to the U.S. industry and thus increase the likelihood of direct input into near-term products. Project implementation plans and NASA/FAA Roadmaps are being developed and utilized by each Sub-project. Technology exchange will also occur among the participants through special technical working group meetings, technical conferences sponsored by professional societies, written reports, cooperative programs, personnel exchanges, and technical demonstrations.

DATA MANAGEMENT
Project and Sub-Project Managers are responsible for the protection of the information generated within their projects and will take appropriate actions to protect it depending on its sensitivity.

SAFETY AND MISSION SUCCESS
In the conduct of all Program activities, AvSSP will maintain an awareness of and abide by the processes and procedures defined by implementing organizations (responsible for hardware and/or software) and as sited in NHB 7120.5B to ensure early identification, analysis, reduction, and/or elimination of hazards.

RISK MANAGEMENT
A Program Risk Management Plan, as defined in NHB 7120.5B, will be maintained as a document separate from the Program Plan. Risk management will be implemented across projects consistent with that plan. The Program level risks are defined in the table below.

Risk/Consequence	Mitigation Strategy
Loss of critical workforce/skills as new Programs/initiatives are planned and approved (e.g.Security and National Airspace System Transformation).	a. Work with Centers, Competencies, and Service Activities/Pools in planning of new initiatives and prioritizing work. b. Develop transition plans for workforce and facilities. c. Plan new initiatives with sufficient funds to augment workforce where needed.
Agency and Center funding requirements draw net funds away from R&D. a. Working through full-cost management issues. b. Being sole user of major facilities (757) strains Program's ability to fully fund work.	Maintain descope prioritization for Program and Projects. Leverage opportunities with other agencies and industry.
Loss of critical facilities: 757, Simulators, Icing Tunnel.	a. Work with implementing Centers to define requirements in advance to assure availability of facilities and to allocate appropriate funds. b. Identify backup options to other facilities.
Failure to gain acceptance of Program outputs with product users (e.g. FAA, Boeing, ATA).	a. Develop implementation plans. b. Develop joint FAA/NASA Roadmaps. c. Maintain commitment to cooperative agreements. d. Bring industry into joint FAA/NASA planning meetings.
Ability to demonstrate accomplishment of minimum success criteria.	a.Work with implementing Centers and industry partners/customers to define requirements in advance to assure availability of facilities and resources for meaningful demonstrations. b.Identify backup options to facilities.
Ability to demonstrate technology readiness in a relevant environment.	a.Work with implementing Centers and industry partners/customers to define relevant test environments sufficiently in advance to schedule and coordinate test facilities. b.Identify backup options.

ENVIRONMENTAL IMPACT
Environmental Management, as defined in NHB 7120.5B, is not directly applicable to a research and technology development Program such as AvSSP. However, in the conduct of all Program

activities, AvSSP will maintain an awareness of and abide by the processes and procedures defined by implementing organizations (responsible for hardware and/or software) to ensure compliance with environmental requirements.

LOGISTICS

This research and technology development Program does not provide mission, flight, or systems hardware intended for long-duration use and as such is exempt from logistics management.

TEST AND VERIFICATION

Software/hardware integration and independent verification and validation are not applicable to this research and technology development Program.

INDEPENDENT REVIEWS

Reviews will be conducted at the Program and Project level to accomplish three primary purposes:

1. Quality - Assess the scientific and technical quality of the AvSSP research and technology program against the current state of the art.
2. Performance - Assess the programmatic performance of the AvSSP against the approved program documentation.
3. Relevance - Assess the relevance of the AvSSP research and technology program to the potential Government and Industry user communities.

TERMINATION REVIEW CRITERIA

The original termination criteria for Safety Phase I were established as follows:

- Technical Performance: Assessment that the Program will be unable to meet an overall minimum success criteria of a 50 percent reduction of the aviation fatal accident rate from the 1991-1996 average.
- Cost Commitment: Projected cost to complete exceeds by $75 million the targeted development cost.
- Schedule Commitment: Projected schedule to complete extends beyond twelve months of the targeted completion date

Termination criteria for Security and Safety Phase II are in formulation.

TAILORING

This research and technology development Program is fully compliant with 7120.5B. Topic areas that are not applicable to AvSSP are identified throughout this Program Plan.

APPENDIX – CONFIGURATION MANAGEMENT CHANGE REQUEST LOG