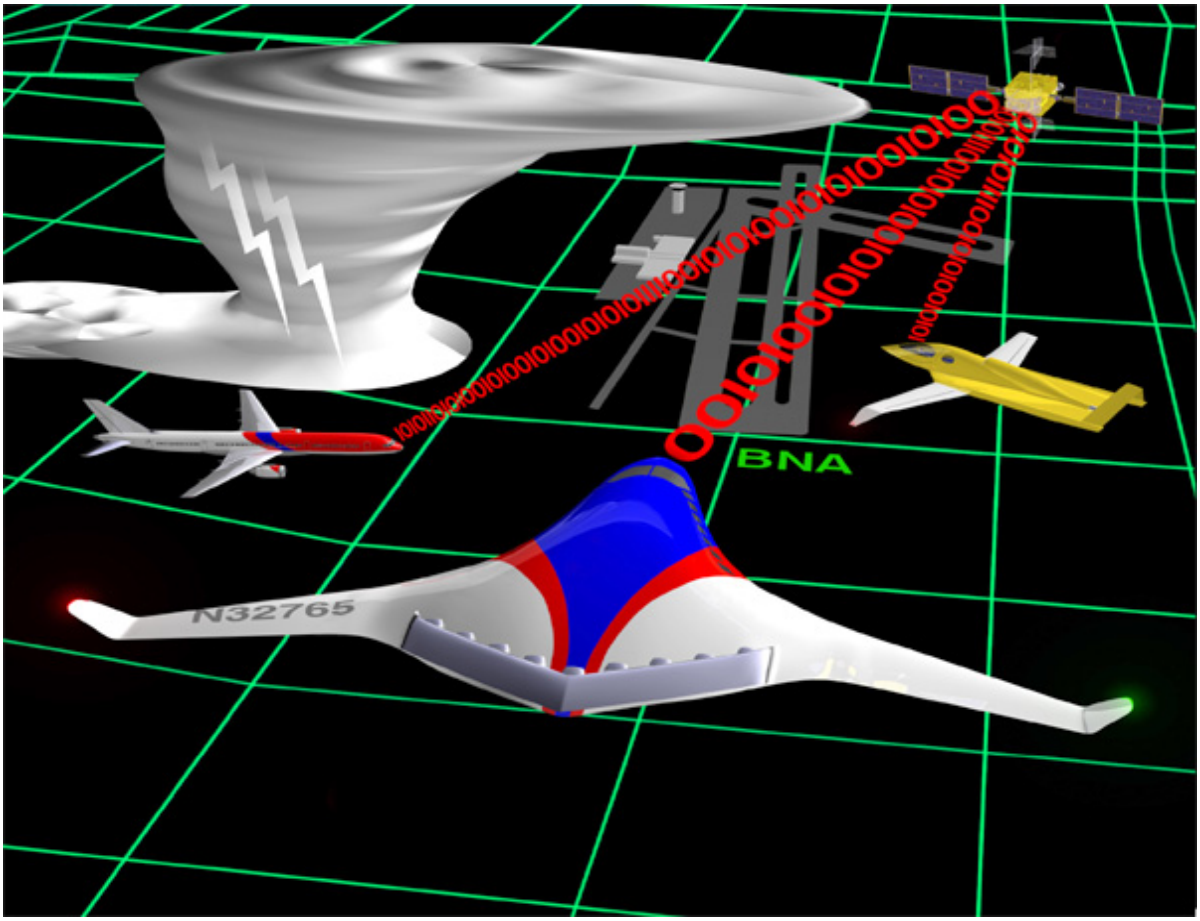
**THEME: Aeronautics Technology**




Research to provide precise knowledge of vehicles and weather conditions, optimized interactions between humans and automated systems, advanced vehicle technologies, and more, will enable a safe, secure, efficient, environmentally-friendly air transportation system.

# AERONAUTICS TECHNOLOGY

## MAJOR EVENTS IN 2004

- Experimentally demonstrate a highly-efficient, light-weight compressor to decrease engine emissions.
- Complete validation and assessment of NASA-developed decision-support air traffic controller aids in support of the FAA's Operational Evolution Plan.
- Prototype inherently failure resistant engine components to improve aircraft safety.

## THEME: Aeronautics Technology (AT)

### OVERVIEW

From the Wright Flyer in 1903 to the current modern aircraft, we have progressed from a single flight to over 25,000 departures a day in the United States alone. Aviation technology has made astounding progress toward providing safe, affordable transportation and has transformed our society by creating global economic growth, providing unrivaled national security, and promoting a remarkable quality of life. From enhancing our military capability to moving millions of people and goods worth billions of dollars to markets around the world, aviation has become an indispensable part of our lives. The research and technology developments that NASA and its predecessor, the National Advisory Committee for Aeronautics (NACA), have been instrumental in achieving this level of performance.

Growth and international issues have also brought significant challenges, from airline delays, to community noise and environmental emissions, to new security threats. Technology will continue to be a necessary and significant force in addressing these challenges. In partnership with other Government agencies, industry and academia, NASA's role continues to be understanding the issues and challenges and developing the long-term technology base for the public good that industry cannot address on its own.

Last year, NASA released an Aeronautics Blueprint in that identifies a new and revolutionary vision for aviation in the 21st Century which guides the Aerospace Technology Theme. The blueprint primarily addresses the challenges that confronted aviation in the United States before the terrorist attacks of September 11, 2001. Safety and security have taken on a new perspective since that event, but many of the technology solutions to these 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 addresses how new technologies can be brought to bear on these issues. 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.

NASA will work closely and partner with the Department of Defense (DoD), the Department of Transportation (DoT), the Federal Aviation Administration (FAA), academia, and industry to ensure that the research pursued by NASA finds it way into useful and timely products and processes. This partnership also enables the application of NASA technical expertise and test facilities to support air vehicle development and system upgrades, address in-service operation problems, support accident investigations and reconstructions, and develop high-payoff technologies for military air vehicles.

| **Missions** | Goals supported by this theme | Objectives supporting those goals | Reference 2003 Strategic Plan |
|---|---|---|---|
| To understand and protect our home planet | 2 - Enable a safer, more secure, efficient, and environmentally friendly air transportation system. | 2.1 | 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. |
| | | 2.2 | Protect local and global environmental quality by reducing aircraft noise, emissions and other contaminants. |
| | | 2.3 | Enable more people and goods to travel faster and farther, with fewer delays. |
| | 3 - Create a more secure world and improve the quality of life by investing in technologies and collaborating with other agencies, industry , and academia. | 3.1 | Enhance the Nation's security by developing and demonstrating critical access-to-space technologies that benefit NASA, DOD, and other government agencies. |
| To inspire the next generation of explorers | 6 - Inspire and motivate students to pursue careers in science, technology, engineering, and mathematics. | 6.3 | Enhance science, technology, engineering and mathematics instruction with unique teaching tools and experiences that only NASA can provide, that are compelling to teachers and students. |
| | 7 - Engage the public in shaping and sharing the experience of exploration and discovery. | 7.3 | Increase public awareness and understanding of how research and innovations in aerospace technology affect and improve the quality of life. |
| Space Flight Capabilities | 10 - Enable revolutionary capabilities through new technology. | 10.5 | Create novel aerospace concepts to support Earth and space science missions. |

## THEME: Aeronautics Technology (AT)

### RELEVANCE

Over the last century, aviation has evolved to become an integral part of our economy, a cornerstone of our national defense, and an essential component of our way of life. Aviation generates more than $1 trillion of economic activity in the United States every year. Military aviation forms the backbone of the U.S. security strategy.

Just as the Nation (and the world) has become more dependent on moving people and goods faster and more efficiently via air, important obstacles have emerged. The air traffic and airport systems in both the U.S. and overseas are reaching full capacity. Legitimate concerns over environmental issues like aircraft noise and emissions are preventing additions to physical capacity (more airports and runways). In 1998, airline delays in the U.S. cost industry and passengers $4.5 billion—the equivalent of a 7 percent tax on every dollar collected by all the domestic airlines combined. Several key airports are unable to gain approval for expansion because they are in non-attainment areas, where National objectives to reduce emissions have not been met. These constraints to growth that could threaten the commercial prospects of our aerospace industry as well as impact the integrity of our transportation system.

Advances in technology have paced aviation's evolution throughout its first century. Human investment and ingenuity, once the only bounds to growth in aviation, have produced a highly complex, integrated, and regulated aviation system. To move aviation ahead, we will need to capitalize on the convergence of a broad front of multidisciplinary advances in technology. Pursuing technology fields that are in their infancy today, developing the knowledge necessary to design radically new aerospace systems, and enabling efficient, high-confidence design and development of revolutionary vehicles are challenges that face us in innovation. These challenges are intensified by the demand for safety and increased capacity in our highly complex aerospace systems while reducing the environmental impact of aviation operations.

NASA's investment in the Aeronautics Technology Theme plays a key role in developing the technologies that are necessary for a safer, more secure, environmentally friendly and efficient national aviation system and increased performance of military aircraft. Advances in information technologies are already being used to enable major changes in aviation. Further, advances in aviation materials have improved dramatically over the last century and the coming revolution in nanotechnologies promises to accelerate that progress. Likewise, biological sciences are providing a new way to look at machines. Mimicking nature will enhance flight safety and result in more reliable air vehicles.

| Education and Public Benefits |
| --- |
| The technologies that are being developed by the Office of Aerospace Technology (OAT) will enable a future where individuals have on-demand as well as scheduled air mobility that will allow traveling where we want, when we want, faster, safer, without delays to both rural and urban areas. This is a future where the noise associated with aviation operations will be confined to within the airport perimeter, where aircraft emissions will be below objectionable limits, where avoidable aircraft accidents will be a thing of the past, and the where security of commercial aircraft operations is not a concern.<br>NASA's national leadership role in aeronautics research offers unique opportunities to inspire student interest and promote academic success at all levels of education. NASA's aeronautics research programs conduct a wide range of education and outreach activities to capture the imagination of students, provide unique teaching tools for educators, supplement school curricula, and support the national standards for math, science and technology education. |

### IMPLEMENTATION

This theme is comprised of three separate programs which work together to achieve the aforementioned goals and objectives. The Aviation Safety and Security Program (AvSSP) develops and demonstrates technologies and strategies to improve aviation safety by reducing both aircraft accident and fatality rates and reducing the vulnerability of the aviation system to terrorist and criminal threats. The Airspace Systems program will enable new aircraft system capabilities and air traffic technology to increase the capacity and mobility of the nation's air transportation system. The Vehicle Systems (VS) program is focused on the development of breakthrough technologies for future aircraft and air vehicle systems.

## THEME: Aeronautics Technology (AT)

**IMPLEMENTATION** (Continued)

The OAT Enterprise Program Management Council (EPMC) has governing responsibility. The NASA Official is Dr. Jeremiah F. Creedon, Associate Administrator (AA). Office of Aerospace Technology. The Aeronautics Technology Theme Director is Mr. Terrence J. Hertz, Director, Aeronautics Technology, Office of Aerospace Technology.

| Strategy | Schedule by Fiscal Year FY02 FY03 FY04 | Purpose |
|---|---|---|
| **AVIATION SAFETY AND SECURITY** | | |
| 2.1.1. - Develop & demonstrate technologies that will enable the reduction of the aviation fatal accident rate by 50% from the 1991 - 1996 average. | | Develop technologies that will make a safe air transportation system even safer. |
| 2.1.2 - Develop & demonstrate technologies for ground-based and air/ground air traffic management systems that detect and manage threatening aircraft (in formulation). | | Develop concepts and technologies to reduce the vulnerability of aircraft and the National Airspace System to terrorist and criminal attacks. |
| **AIRSPACE SYSTEMS** | | |
| 2.3.1. - Develop & demonstrate technologies that enable an 50% increase in the aviation system throughput. | | Develop technologies that will enable the movement of more air passengers with fewer delays. |
| 2.3.2 - Provide the technologies and processes for conducting trade-off analyses amongst future air transportation system's concepts and technologies. | | Model and simulate the National Airspace System, and explore the next generation of advanced operational concepts. |
| 2.3.3 - Develop and demonstrate technologies to enable increased utilization of local & regional airports to enhance mobility. | | Provide technical and economic basis for national investment and policy decisions to develop a small aircraft transportation system. |
| 2.3.4 - Develop and demonstrate NASA exploratory technologies for the National Airspace System (NAS) to meet projected growth in passenger demand beyond 2010 (in formulation). | | Develop technologies, procedures, and information infrastructure to enable further system capacity/throughput improvements. |
| **VEHICLE SYSTEMS** | | |
| 2.2.1. - Validate aircraft component technologies and advanced operations for reducing noise by 10dB (re: CF 1997 SOA) in laboratory and relevant environment to reduce community noise impact. | | Develop technologies to enable the reduction of perceived aircraft noise to improve the quality of life for airport neighbors. |
| 2.2.2. - Demonstrate combustor configurations for reducing NOx emission by 70% (re. to 1996 ICAO standard) to reduce smog and lower atmospheric ozone. Demonstrate airframe and engine component technologies for reducing the green-house gas, CO2, emissions by 25% (re. to 2000 SOA) . | | Improve local air quality and our global environment by enabling a significant reduction in emissions from aviation operations. |
| 3.1.1. - Develop and conduct tests of innovative technologies that contribute to the superiority of air vehicles in support of the National defense. | | Development of technologies, in partnership with the DoD, to enhance National defense. |
| 10.5.1 - Develop technologies that will enable solar powered vehicles to be used as platforms for emergency management and telecommunications missions. | | Develop technologies that enable solar powered Aero-Space Technology (AST) to remain aloft for weeks. |
| 10.5.2 - Develop and demonstrate technologies required for routine Unmanned Aerial Vehicle operations in the National Airspace System at and above the 18,000 ft. Flight Level. (in formulation) | | Enable routine NAS access for UAVs in pursuit of homeland security, disaster management and economic growth. |
| Demonstrate the feasibility of hypersonic flight with air breathing propulsion. **(X-43A Hyper-X)** | | Develop and demonstrate the world's first flight of a scramjet-powered vehicle (X-43 A) to Mach 7. |
| Develop civil UAV technologies capable of performing science missions. **(ERAST)** | | Validate technologies that will enable the use of very long endurance UAVs for science and commercial missions. |

Tech. & Adv. Development Operations

Tailoring: No exceptions to NPG 7120.5B have been taken.

## THEME: Aeronautics Technology (AT)

### STATUS

**Aviation Safety Program**

- Conducted flight demonstration of a forward looking turbulence warning system to provide advance warning of severe turbulence. Data analysis (using human judgment) indicated excellent performance with probability of detection of severe turbulence with a lead time greater than 30 seconds.

- Demonstrated a National Aviation Weather Information Network and data link capability to bring aerospace weather information into the cockpit that improves aviation safety and on time performance by providing the aircrew with the real time information necessary for the aircraft to avoid areas of hazardous weather and turbulence.

**Airspace Systems Program**

- Developed and evaluated inter-operability of decision support tools Surface Management System (SMS) and Traffic Management Advisor that address arrival, surface , and departure operations. SMS information helps to more effectively manage the tradeoff between arrival and departure capacities, to reduce total delay at airport.

**Vehicle Systems Program.**

- Demonstrated a 67% reduction in NOX emissions during sector tests of a combustor that when fully developed will reduce NOX emissions by 70%.

- Identified and initiated development of a suite of noise reduction technologies that would meet the Enterprise 10 year goal (10dBA).

### PERFORMANCE MEASURES

**Annual Performance Goals**

| | |
|---|---|
| | **OUTCOME:** A well managed program in accordance with Agency implementing strategies. |
| 4AT1 | Each Development project will complete its current phase within 10% of total life-cycle cost shown on the table below. |
| 4AT2 | The Theme will allocate 75% of its procurement funding competitively during FY 2004. |
| 4AT3 | The Theme will complete 90% of the major milestones planned for FY 2004. |
| **2.1.1** | **OUTCOME:** Develop & demonstrate technologies that will enable the reduction of the aviation fatal accident rate by 50% from the FY 1991 - 1996 average. |
| 4AT4 | Utilizing results of component testing, simulations, and analyses, complete an integrated program assessment of the suite of aviation safety technologies to determine their synergistic effect on reducing the fatal accident rate. (AvSSP) |
| 4AT5 | Propulsion system malfunctions are cited in 25% of fatal accidents, with disk and/or fan blade component failures being attributed to about 15% of these malfunctions. In FY 2004 NASA will provide deliver prototype disks, and engine containment materials wit inherent failure resistant characteristics that will be ready for a full scale engine system integration test to be conducted jointly with the FAA in FY 2005. (AvSSP) |
| 4AT6 | Controlled Flight into Terrain (CFIT) accounts for 30% of General Aviation fatal accidents. During FY 2004, NASA will complete the flight evaluation of a synthetic vision system that improves pilot situational awareness by providing a display of "out-the–window" information that is not effected by adverse metrological conditions. This system when fully implemented has the potential to eliminate 90% of CFIT accidents. (AvSSP) |
| **2.1.2** | **OUTCOME:** Develop & demonstrate decision support technologies for ground-based and air/ground air traffic management |
| 4AT7 | Complete a preliminary demonstration, in a realistic operational environment, of an automated system to provide real-time identification of flight path deviations and a means to alert authorities in a prompt and consistent manner. (AvSSP) |
| **2.2.1** | **OUTCOME:** Validate aircraft component technologies and advanced operations for reducing noise by 10dB (re: CF 1997 SOA) in laboratory and relevant environment to enable air traffic growth. |
| 4AT8 | Laboratory validate initial concepts for engine and airframe source noise reduction by 5dB (re: to CY 2001 SOA). (Vehicle Systems) |
| **2.2.2** | **OUTCOME:** Demonstrate combustor configurations for reducing NOx emission by 70% (re. to 1996 ICAO standard) to reduce smog and lower atmospheric ozone. Demonstrate airframe and engine component technologies for reducing the green-house gas, CO2, emissions by 25% (re. to 2000 SOA). |
| 4AT9 | Experimentally demonstrate a 2-stage highly loaded compressor for increasing pressure rise per stage. (Vehicle Systems) |
| **2.3.1** | **OUTCOME:** Develop & demonstrate technologies that enable an 50% increase in the aviation system throughput. |
| 4AT10 | Complete validation and assessment of the Advanced Air Transportation Technologies products (tools/concepts) through field and laboratory demonstrations, analyses, evaluations, and assessments on a tool-by-tool basis to demonstrate an increase in terminal throughput by 35 percent and an increase in en route throughput by 20 percent. (Airspace Systems) |
| **2.3.2** | **OUTCOME:** Provide the technologies and processes for conducting trade-off analyses amongst future air transportation system's concepts and technologies. |

***Chart continued on Next Page***

## THEME: Aeronautics Technology (AT)

### PERFORMANCE MEASURES

**Annual Performance Goals**

4AT11 Develop a non-real-time Virtual Airspace Simulation Technology environment that will model the National Airspace System and provide the capability to conduct trade-off analyses amongst future air transportation system's concepts and technologies. (Airspace Systems)

**2.3.3 OUTCOME:** Develop and demonstrate technologies to enable increased utilization of local & regional airports to enhance mobility.

4AT12 Flight demonstrate the ability to double the operations rate at non-towered, non-radar airports in low-visibility conditions using self-separation and flight-path guidance technologies for general aviation aircraft. (Airspace Systems)

**2.3.4 OUTCOME:** Develop and demonstrate NASA exploratory technologies for the National Airspace System (NAS) to meet projected growth in passenger demand beyond 2010.

4AT13 Based on research completed under AATT project and current work under VAMS project, provide preliminary analysis and assessment of distributed air/ground traffic management (DAG/TM) operational concept. (Airspace Systems)

**3.1.1 OUTCOME:** Develop and conduct tests of innovative technologies that contribute to the superiority of air vehicles in support of the National defense.

4AT14 Conduct and obtain flight test data of Autonomous Aerial refueling technologies. (Vehicle Systems)

**6.3.1 OUTCOME:** Improve quality and stature of science, technology, engineering, and mathematics (STEM) instruction.

4AT15 To improve student proficiency in STEM, develop and disseminate education standards-based curriculum support products that deliver science and engineering content based on Aeronautics Technology research. Progress toward improvement will be assessed by feedback on the disseminated support products.

**7.3.1 OUTCOME:** Increase public awareness and appreciation of the benefits made possible by NASA research and innovation in aerospace technology.

4AT16 Partner with external organizations to celebrate the centennial of powered flight highlighting NASA's accomplishments & activities in advancement of flight.

4AT17 Partner with museums & other cultural organizations and institutions to promote NASA achievements to non-traditional audiences, develop and implement a series of traveling exhibitions highlighting NASA activities, develop and distribute informational material related to accomplishments and plans.

**10.5.1 OUTCOME:** Develop technologies that will enable solar powered vehicles to be used as platforms for telecommunications and emergency management missions.

4AT18 Demonstrate the efficient performance of a flight-prototype regenerative energy storage system in an altitude chamber. (Vehicle Systems)

**10.5.1 OUTCOME:** Develop and demonstrate technologies required for routine Unmanned Aerial Vehicle operations in the National Airspace System at and above 18,000 ft. Flight Level.

4AT19 Deliver a validated set of requirements for UAV access at and above FL400, and a preliminary set of requirements for access at and above the 18,000 ft flight level. (Vehicle Systems)

### INDEPENDENT REVIEWS

| Types of Review | Performer | Last Review | Next Review | Purpose |
|---|---|---|---|---|
| Quality | NRC / AESB | | FY 2003 | Assess the scientific and technical quality. |
| Relevance | ATAC | FY 2002 | FY 2003 | Assess the relevance of the AT research. |
| Performance | N/A | N/A | N/A | Conducted at Program and Project levels. |

### BUDGET

| Budget Authority ($millions) | FY02 | FY03 | Chng | FY04 | Comments |
|---|---|---|---|---|---|
| **Aeronautics Technology (AT)** | **645.8** | **541.4** | **+417.9** | **959.3** | Ongoing program |
| Development | 47.0 | 47.0 | -47.0 | 0.0 | Devl'mt totals are LCC |
| Hyper-X (X-43A) | 25.0 | 27.0 | -27.0 | 0.0 | Planned End of Program |
| ERAST | 22.0 | 20.0 | -20.0 | 0.0 | Planned End of Program |
| Technology and Advanced Concepts | 598.8 | 494.4 | +464.9 | 959.3 | |
| Aviation Safety & Security | 96.1 | 95.0 | +73.5 | 168.5 | New Initiative (Pg AS-10) |
| Airspace Systems (AS) | 133.9 | 125.1 | +92.1 | 217.2 | New Initiative (Pg AS-10) |
| Vehicle Systems (VS) | 368.8 | 274.3 | +299.3 | 573.6 | New Initiative (Pg AS-10) |

Indicates budget numbers in Full Cost.

Indicates changes since the FY 2003 Presidents Budget Submit.

*Note: For all formats, the FY02 column reflects the FY02 Congressional Operating Plan dated 9/30/02. The FY03 column reflects the FY03 President's Budget Submit (PBS) as Amended. The Change column includes both programmatic and full cost adjustments. The FY04 column is in full cost.*

**THEME:** Aeronautics Technology

# DEVELOPMENT: Environmental Research Aircraft and Sensor Technology (ERAST)

## PURPOSE

| Objectives | Reference 2003 Strategic Plan | Performance Measures |
|---|---|---|
| 10.5 | Create novel aerospace concepts to support Earth and space science missions | Project will be concluded in FY 03 |

The ERAST project has the following performance characteristics:

1) Demonstrate solar powered UAV flight operations to 100,000 feet.

2) Demonstrate consumable fueled UAV technologies and capabilities that enable flight altitudes greater than 40,000 feet with a 660 pound payload with a flight endurance of at least 24 hours. Requirements were established by the Earth Science Enterprise (July 02, 1997).

3) Develop and safely fly a prototype solar powered UAV capable of sustaining 96 hrs above 50,000 feet.

## OVERVIEW

NASA initiated the ERAST project in 1994. ERAST was envisioned as a means to jump start a fledgling OVA industry in the United States. In 2000, EAST was reformulated to meet the performance characteristics outlined below. To date the EAST project has been very successful in achieving the goals originally set out in 1994. In 2001 the Helios aircraft flew to a record setting altitude of 96,863 feet above sea level, effectively achieving a primary goal of the project. Several science demonstration missions have been flown in the National Airspace (NAS) on ERAST developed platforms in support of NASA and Department of Energy science campaigns. A hydrogen fuel cell powered aircraft will be flown to demonstrate the technology required for a 96 hour flight above 50,000 feet.

## PROGRAM MANAGEMENT

ERAST is a project within the Vehicle Systems Program in the Aeronautics Technology Theme with responsibility delegated to the Dryden Flight Research Center (DFRC). The OAT Enterprise Program Management Council (EPMC) has governing responsibility. The NASA Official is Jeremiah F. Creedon, Associate Administrator, Office of Aerospace Technology (OAT). The Aeronautics Technology Theme Director and Point of Contact is Mr. Terrence Hertz, Director, Aeronautics Technology Division at NASA HQ. The project manager is Mr. Jeff Bauer of DFRC. The program is compliant with NPG 7120.5A.

## TECHNICAL COMMITMENT

| Technical Specifications | FY04 President's Budget | Change from Baseline |
|---|---|---|
| Demonstrate solar powered UAV flight operations to 100,000 feet. | Completed Q4FY01. | - - |
| Demonstrate UAV technologies and capabilities that meet the *in-situ* requirements established by the Earth Science Enterprise. | Completed Q1FY02. | Exceeded all technical parameters. |
| Develop and safely fly a prototype solar powered UAV capable of sustaining 96 hrs above 50,000 feet. | Solar powered UAV capable of sustaining 14 hrs of operation above an altitude of 50,000 ft is planned for completion Q4FY03. | Baseline objective of a 96 hour flight was established under the original ERAST plan. The revision to a 14 hour flight was rebaselined in FY 2002 for night time flight capability of the solar powered aircraft using tanked hydrogen to power the fuel cell component of the Energy Storage System (ESS). This change revises the endurance flight test minimum success objective to 14 hours above 50,000 ft. -- which doubles the state of the art for electric powered aircraft. This fight test will validate the core (non-fuel cell) technologies that would enable extreme duration flights. |

| Schedule | FY04 President's Budget | Change from Baseline |
|---|---|---|
| Extended altitude flight demonstration | 8/02 | -- |
| Demonstrate Earth Science mission | 12/02 | -- |
| Extended day / night flight demonstration | 9/03 | -- |

**THEME:** Aeronautics Technology

# DEVELOPMENT: Environmental Research Aircraft and Sensor Technology (ERAST)

## ACQUISITION STRATEGY & PERFORMING ORGANIZATIONS

Data current as of 1/23/2003

| Current Acquisitions | Actual * | Selection Method | Actual * | Performer | Actual * |
|---|---|---|---|---|---|
| Cooperative Agreements | 0 % | Full & Open Competition | 0 % | Industry | 98% |
| Cost Reimbursable | 0 % | Sole Source | 100% | Government | % |
| Fixed Price | 100% | | 100% | NASA Extramural | % |
| Grants | 0 % | | | University | 2% |
| Other (JSRA) | 100% | Sci Peer Review | 0% | Non Profit | 0% |
| * as % of FY02 direct procurement | 100% | * as % of FY02 direct procurement | | * as % of FY02 direct | 100% |

### Future Acquisitions - Major

The ERAST project is executed through a Joint Sponsored Research Agreement (JSRA). The JSRA is a "non-procurement cooperative agreement" between NASA and its partners established to advance state-of-art in a specific area of technology -- unmanned aerial vehicles (UAV). The ERAST project was initiated between NASA and four small UAV companies all with aircraft that had the potential of achieving the altitude and duration requirements specified in the agreement. These four companies are Aurora Flight Sciences, AeroVironment, General Atomics, and Scaled Composites. Since its inception, the JSRA has added members with specific capabilities to enhance the potential to achieve ERAST goals.

## AGREEMENTS

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

*External:* JSRA.

## INDEPENDENT REVIEWS

| Types of Review | Performer | Last Review | Next Review | Purpose |
|---|---|---|---|---|
| External Management Review | SRS Tech. | 10/99 | | Management review of fuel cell maturation work. |
| Independent Implementation Review | IPAO | | 3/03 | Management review of overall Vehicle Systems program. |
| External Quality Review | NRC / ASEB | | 2/03 | Technical review of program content. |

## BUDGET/LIFE CYCLE COST

| Budget Authority ($ in millions) | Prior | FY02 | FY03 | FY04 | FY05 | FY06 | FY07 | FY08 | BTC | Total | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| FY 2004 President's Budget | 131.0 | 22.0 | 20.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 173.0 | |
| Development | 131.0 | 22.0 | 20.0 | 0.0 | | | | | | 173.0 | |
| Changes since FY 03 Pres. Budget | +0.0 | +0.0 | +0.0 | +0.0 | +0.0 | +0.0 | +0.0 | +0.0 | +0.0 | +0.0 | ***Reason for Change:*** |
| Development | +0.0 | +0.0 | +0.0 | +0.0 | +0.0 | +0.0 | +0.0 | +0.0 | | +0.0 | |
| FY 2003 President's Budget | 131.0 | 22.0 | 20.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 173.0 | |
| Development | 131.0 | 22.0 | 20.0 | | | | | | | 173.0 | |
| Initial Baseline | 110.7 | 20.0 | 20.0 | 20.0 | 20.0 | 0.0 | 0.0 | 0.0 | 0.0 | 190.7 | Baselined FY 1998 |
| Development | 110.7 | 20.0 | 20.0 | 20.0 | 20.0 | | | | | 190.7 | President's Budget |

Indicates budget numbers in Full Cost

Indicates changes since the FY 2003 Presidents Budget Submit

*Note: For all formats, the FY02 column reflects the FY02 Congressional Operating Plan dated 9/30/02. The FY03 column reflects the FY03 President's Budget Submit (PBS) as Amended. The Change column includes both programmatic and full cost adjustments. The FY04 column is in full cost.*

**THEME:** Aeronautics Technology (AT)

# DEVELOPMENT: Hyper - X (X-43-A)

## PURPOSE

| Objectives | | Reference 2003 Strategic Plan | Performance Measures |
|---|---|---|---|
| 10.5 | Create novel aerospace concepts to support Earth and space science missions. | | Project will be concluded in FY 03 |

The X-43-A project supports this objective by demonstrating and validating the technology, experimental techniques, computational methods, and tools for design and performance predictions of hypersonic aircraft with airframe-integrated dual-mode scramjet propulsion systems. Systems studies of scramjet powered access-to-space vehicles show that these vehicles have the potential to reduce the cost of access to space by orders of magnitude over the current generation of rocket powered vehicles.

## OVERVIEW

NASA initiated the Hyper-X project in 1996 to advance hypersonic air-breathing propulsion and related technologies from laboratory experiments to the flight environment. This project was designed to be a high-risk, high-payoff program. Key objectives included:

- Evaluate the performance of an airframe-integrated, hydrogen-fueled, dual-mode scramjet-powered research vehicle at Mach 7.
- Demonstrate controlled, powered airbreathing and unpowered hypersonic aircraft flight.
- Provide ground (Mach 5, 7, and 10) and flight (Mach 7 & 10) data to validate computational methods, prediction analyses, and test techniques that comprise a set of design tools and methodologies for future hypersonic cruise and space-access vehicles.

On June 2, 2001, the first flight (planned for Mach 7) was terminated by the Range Safety Officer after the booster departed controlled flight. The Mishap Investigation Board submitted its report to Office of Aerospace Technology in March 2002 and the project's Corrective Action Plan was submitted in April 2002. As a result of the projected project costs, the M-10 flight was eliminated from the Vehicle System Program. This M-10 flight will be based upon a determination of the requirements of the Next Generation Launch Technology Program.

## PROGRAM MANAGEMENT

The Hyper-X is a project within the Vehicle Systems Program in the Aeronautics Technology Theme with responsibility delegated to the Langley Research Center (LaRC). The OAT Enterprise Program Management Council (EPMC) has governing responsibility. The NASA Official is Jeremiah F. Creedon, Associate Administrator, Office of Aerospace Technology (OAT). The Aeronautics Technology Theme Director and Point of Contact is Mr. Terrence Hertz, Director, Aeronautics Technology Division at NASA HQ. Project Manager is Mr. Vince Rausch of LaRC. The program is compliant with NPG 7120.5A.

## TECHNICAL COMMITMENT

The Baseline for this technical commitment is the FY03 President's Budget.

| Technical Specifications | FY04 President's Budget | Change from Baseline |
|---|---|---|
| Flight Velocity | Mach-7 | M10 has been deleted |
| Flight Dynamic Pressure | 1000 psf | -- |
| Engine test time | 5-7 seconds | -- |

| Schedule | FY04 President's Budget | Change from Baseline |
|---|---|---|
| First Mach-7 Flight | 9/03 | +50 months |
| Second Mach-7 flight | -- | -- |
| Mach-10 Flight | -- | -- |
| Data Validation Period | 1 yr after receipt by investigators | |
| ***Changes since FY03 Pres. Budget:*** | The second Mach-7 and the Mach-10 flight has been deleted due to insufficient funding resulting from the additional costs associated with recovery from the Mach-7 flight mishap. | |

**THEM** Aeronautics Technology (AT)

# DEVELOPMENT: Hyper - X (X-43-A)

## ACQUISITION STRATEGY & PERFORMING ORGANIZATIONS

Data current as of 1/23/2003

| Current Acquisitions | Actual * |
|---|---|
| Cooperative Agreements | 0% |
| Cost Reimbursable | 0% |
| Fixed Price | 2% |
| Grants | 2% |
| Other (JSRA) | 40% |
| * as % of FY02 direct procurement | 100% |

| Selection Method | Actual * |
|---|---|
| Full & Open Competition | 13% |
| Sole Source | 87% |
| | 100% |
| | |
| Sci Peer Review | % |
| * as % of FY02 direct procurement | |

| Performer | Actual * |
|---|---|
| Industry | 54% |
| Government | 0% |
| NASA Extramural | 44% |
| University | 2% |
| Non Profit | 0% |
| * as % of FY02 direct procurement | 100% |

| Future Acquisitions - Major |
|---|
| Launch Vehicle (Allied Aerospace Industries) |

## AGREEMENTS

*Internal:* The program is not dependent on other NASA activities outside of the control of the Associate Administrator, Office of Aerospace Technology.
*External:* None.

## INDEPENDENT REVIEWS

| Types of Review | Performer | Last Review | Next Review | Results |
|---|---|---|---|---|
| Mishap Investigation Board (MIB) | MIB | 02-Jan-02 | | Booster deficiencies identified & being addressed in return to flight plan. |
| Cost Validation Review | Rand Corp | 02-Jul-02 | | Finding was schedule is optimistic. Schedule being scrubbed. |
| Others | Various | | | Prior to first flight there were 18 separate independent reviews. The project responded to all findings. |

## BUDGET/LIFE CYCLE COST

| Budget Authority ($ in millions | Prior | FY02 | FY03 | FY04 | FY05 | FY06 | FY07 | FY08 | BTC | Total | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| FY 2004 President's Budget | 175.0 | 25.0 | 27.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 227.0 | |
| Development | 175.0 | 25.0 | 27.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 227.0 | |
| Changes since FY 03 President's Budget | +0.0 | +0.0 | +10.0 | +0.0 | +0.0 | +0.0 | +0.0 | +0.0 | +0.0 | +10.0 | **Reason for Change:** |
| Development | | | +10.0 | | | | | | | +10.0 | Provide funding for return to flight. |
| FY 2003 President's Budget | 175.0 | 25.0 | 17.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 217.0 | |
| Development | 175.0 | 25.0 | 17.0 | | | | | | | 217.0 | |
| Initial Baseline | 167.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 167.0 | **Baseline: FY98 President's Budget** |
| Development | 167.0 | 0.0 | 0.0 | | | | | | | 167.0 | |

Indicates budget numbers in Full Cost.
Indicates changes since the FY 2003 Presidents Budget Submit.

*Note: For all formats, the FY02 column reflects the FY02 Congressional Operating Plan dated 9/30/02. The FY03 column reflects the FY03 President's Budget Submit (PBS) as Amended. The Change column includes both programmatic and full cost adjustments. The FY04 column is in full cost.*

**THEME:** Aeronautics Technology

**TECHNOLOGY AND ADVANCED CONCEPTS:** Aviation Safety & Security Program (AvSSP)

## PURPOSE

| Objectives | | Reference 2003 Strategic Plan | Perf. Measures |
|---|---|---|---|
| 2.1 | 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. | | 4AT4, 4AT5, 4AT6, & 4AT7 |
| 6.3 | Enhance science, technology, engineering and mathematics instruction with unique teaching tools and experiences that only NASA can provide, that are compelling to teachers and students. | | 4AT15 |
| 7.3 | Increase public awareness and understand of how research and innovations in aerospace technology affect and improve the quality of life. | | 4AT16, 4AT17 |

AvSSP directly addresses the safety and security needs of the National Airspace System (NAS) and the aircraft that fly in the NAS. 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 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. AvSSP will also be developing concepts and technologies which reduces the vulnerability of aircraft and the NAS to criminal and terrorist attacks while dramatically improving the efficiency of security.

## OVERVIEW

Research and technology will address accidents involving hazardous weather, controlled flight into terrain, human-error-caused accidents and incidents, and mechanical or software malfunctions. The program will also develop and integrate information technologies needed to build a safer aviation system and provide information for the assessment of situations and trends that indicate unsafe conditions before they lead to accidents. NASA will develop, validate and transfer these advanced concepts, technologies and procedures through a partnership with the Federal Aviation Administration (FAA) and in cooperation with the U.S. aeronautics industry.

The AvSSP activities for achieving these goals will occur in three phases: 1). Aviation Safety (FY 2000 through FY 2005) focusing on (a) system monitoring and modeling which develops technologies for using the vast amounts of data available within the aviation system to identify, understand, and correct aviation system problems before they lead to accidents; (b) accident prevention which identifies interventions and develops technologies to eliminate types of accidents that can be categorized as recurring; and, (c) accident mitigation which develops technologies to reduce the risk of injury in the unlikely event of an accident; 2). aviation security (FY 2004 through FY 2008) focusing on vulnerability reduction which develops airborne and ground-based technologies to eliminate terrorist or criminal actions to the airplane and the NAS; and 3). Integrated Aviation System Safety Enhancements (FY 2006 through FY 2010) focusing on developing safety-enhanced concepts of operation for the future aviation system and develops technologies to transition the current system to the future state, while improving on current levels of safety.

## PROGRAM MANAGEMENT

AvSSP is a multiple-project program within the Aeronautics Technology Theme. The Office of Aerospace Technology (OAT) Enterprise Program Management Council (EPMC) has AvSSP governing responsibility. The NASA Enterprise official is Dr. Jeremiah F. Creedon, Associate Administrator (AA), Office of Aerospace Technology. The Aeronautics Technology Theme Director is Mr. Terrence J. Hertz, Director, Aeronautics Technology Division, OAT. Acting Program Manager is Mr. George Finelli, OAT, hosted at the Langley Research Center. The program is compliant with NPG 7120.5A.

## TECHNICAL COMMITMENT

The baseline for this technical commitment is the FY2002 budget reflected in the FY2002 NASA Appropriation.

| Technical Specifications<br>* Identified by Project (see budget chart for detail). | | FY04 President's Budget<br>FY02 | FY03 | FY04 | FY05 | Change from Baseline |
|---|---|---|---|---|---|---|
| Develop enabling technologies that will provide accurate, timely, and intuitive information during the en-route phases of flight to the flight deck to enable the detection and avoidance of atmospheric hazard. (WST) | TRL | 3 | 4 | 5 | 6 | -- |
| | $M | 11.3 | 15.6 | 18.0 | | -- |
| Develop enabling technologies that will present accurate and timely (as verified by flight and ground experimentation) atmospheric turbulence hazard products to pilots, dispatchers, and air traffic controllers. (WST) | TRL | 3 | 4 | 5 | 6 | -- |
| | $M | 4.2 | 6.8 | 8.6 | | -- |
| Current TRL status relative to FY03 plan (R/Y/G/B) | | | | | | Planned TRL status to FY03 plan |

**THEME:** Aeronautics Technology

## TECHNOLOGY AND ADVANCED CONCEPTS: Aviation Safety & Security Program (AvSSP)

| Technical Specifications | | FY04 President's Budget FY02 | FY03 | FY04 | FY05 | Change from Baseline |
|---|---|---|---|---|---|---|
| Develop for General Aviation a situational awareness enhancement system utilizing database with display symbology and precise GPS navigational information to create synthetic views of the current external environment for display to flight crew. (VST) | TRL | 4 | 5 | 5 | 6 | Funding realigned for higher priority work. |
| | $M | 12.2 | 2.0 | 3.1 | | |
| Develop for commercial and business aircrafts a situational awareness enhancement system utilizing database, sensor and hazard (terrain, traffic-surface and airborne, etc.) detection technologies merged with display symbology and precise GPS navigational. (VST, SST) | TRL | 4 | 5 | 5 | 6 | Funding realigned for higher priority work |
| | $M | 12.6 | 13.7 | 26.7 | | |
| Demonstrate improved training modules, maintenance procedures, projected to reduce targeted human errors. (VST, SST, WST) | TRL | 3 | 4 | 5 | 6 | Funding |
| | $M | 8.8 | 9.4 | 12.5 | | |
| Demonstrated in flight Health and Usage Monitoring technologies for commercial transport aircraft. (VST) | TRL | 4 | 4 | 5 | 6 | Work revectored to Aviation Security |
| | $M | 17.3 | 22.4 | 34.3 | | |
| Develop advanced structures, materials, and system designs, projected to improve crash survivability and fire hazard mitigation. (VST) | TRL | 5 | 5 | 5 | 6 | -- |
| | $M | 9.8 | 3.9 | 14.0 | | |
| Develop design and analysis tools, aircraft ice protection systems technologies, and education and training tools for use by aircraft manufacturers, operators and pilots, and regulators for design, certification, and operation of aircraft. (VST, SST, WST) | TRL | 3 | 3 | 3 | 4 | -- |
| | $M | 7.4 | 7.5 | 14.9 | | |
| Demonstrate integrated aviation system monitoring tools and infrastructure design accessible both nationally and international to provide advanced indication of conditions that could lead to accidents. (VST, SST) | TRL | 3 | 3 | 5 | 6 | -- |
| | $M | 12.4 | 13.7 | 15.5 | | |
| Design and demonstrate ground-based threat management decision support technologies and aircraft-based threat protection and mitigation systems (in formulation). (AST) | TRL | | -- | 2 | 3 | New |
| | $M | | | 21.0 | | |
| Current TRL status relative to FY03 plan (R/Y/G/B) | | | | | | Planned TRL status to FY03 plan |

| Schedule | FY04 President's Budget | Change from Baseline |
|---|---|---|
| Interim Integrated Program Assessment | Jun-02 | -- |
| Simulations and Flight Test Evaluations of Safety-Improvement Systems within AvSSP Completed. | Mar-03 | -- |
| Development of Aviation Security System Concepts | Jul-04 | New project to enhance aviation security. In Formulation. |
| Integrated Program Assessment | Sep-04 | -- |
| Integrated Full-Mission Applications, Simulations, and Validation of AvSSP technologies ability to enable a 50% reduction in the fatal accident rate. | Jun-05 | -- |

### ACQUISITION STRATEGY & PERFORMING ORGANIZATIONS

Data current as of 1/21/2003

The AvSSP's acquisition strategy is to leverage NASA's R&D investments through the use of cooperative agreements and cost-shared contracts whenever 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 enhancing technologies. Thus, the program business philosophy is to not pay for the entirety of any technology development. AvSSP will use standard competitive procurements when purchasing items where required specifications are known. NASA Research Announcements (NRA) are a solicitation tool that can be used to encourage new and creative approaches to technology challenges. AvSSP will use NRAs to solicit competing, cost-shared, cooperative R&D proposals, when it is difficult to define detailed specifications. A team of procurement, legal, and research personnel will formulate the AvSSP NRA's. Multiple awards of grants, contracts, cost-shared contracts, and cooperative agreements may result from one solicitation. AvSSP will use the competitive NRA process to (1) stimulate cost-sharing from industry, (2) leverage public and private R&D Programs and resources, and (3) accelerate technology commercialization through broad technical teams capable of solving both the technical hurdles and the implementation and certification issues. In FY02, direct procurement represented 100% of budget authority.

## ACQUISITION STRATEGY & PERFORMING ORGANIZATIONS (Continued)

Data current as of 1/21/2003

| Current Acquisitions | Actual * | Selection Method | Actual * | Performer | Actual * |
|---|---|---|---|---|---|
| Cooperative Agreeme | 30% | Full & Open Competition | 95% | Industry | 53% |
| Cost Reimbursable | 40% | Sole Source | 1% | Government | 2% |
| Fixed Price | 25% | Govt | 4% | NASA Intramural | 30% |
| Grants | 5% | | 100% | University | 5% |
| Other | 0% | Sci Peer Review | 0% | Non Profit | 10% |
| * as % of FY02 direct procurement | 100% | * as % of FY02 direct procurement | | * as % of FY02 direct procurement | 100% |

| Future Acquisitions - Major | Selection | Goals |
|---|---|---|
| 2. Annual NASA Research Announcement | FY 04/05 | 100% Open Competition seeking cost and technology |
| 3. Grants | FY 04/05 | 100% Open Competition seeking universities research studies |
| 4.Interagency Agreements | FY 04/05 | Increase use of other government agencies expertise |

## AGREEMENTS

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

**External:**

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 Research Centers, March 1997.
4. Memorandum of Understanding #FNA/08 between the FAA and NASA concerning Aviation Safety Reserch; 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 between the FAA and NASA for Weather Information Network, and the Development and Evaluation of Enhanced Situational Awareness Technologies; currently pending.
9. Agreements with Rannoch, Research Triangle Institute, Ohio University, BAE Systems Aerospace, Rockwell Collins, Jeppenson-Sanderson, Inc., Barron Associates, Delta, Honeywell International, ARINC, ARNAV, and Honeywell.

## INDEPENDENT REVIEWS

Data current as of 1/23/2003

| Types of Review | Performer | Last Review | Next Review | Purpose |
|---|---|---|---|---|
| Quality | NRC / ASEB | N/A | Feb-03 | Assess the scientific and technical quality of the AvSSP research and technology program against the current state of the art. |
| Performance | IPAO | Nov-01 | Jun-03 | Assess the programmatic performance of the AvSSP against the approved program plan. |
| Relevance | ATAC | Oct-02 | Feb-03 | Assess the relevance of the AvSSP research and technology program to the potential Government and Industry user communities. |

**THEME:** Aeronautics Technology

**TECHNOLOGY AND ADVANCED CONCEPTS:** Aviation Safety & Security Program (AvSSP)

## BUDGET

| Budget Authority ($ in mil | FY02 | FY03 | FY04 | Comments |
|---|---|---|---|---|
| FY 2004 Budget Submit (Technology) | 96.1 | 95.0 | 168.5 | |
| Vehicle Safety Technologies (VST) | 58.0 | 49.8 | 74.5 | |
| System Safety Technologies (SST) | 20.2 | 24.3 | 31.1 | |
| Weather Safety Technologies (WST) | 17.9 | 20.9 | 42.3 | |
| Aviation Securities Technologies (AST) | -- | -- | 20.6 | New initaitive. |
| Changes since FY 03 Pres. Budget | +0.0 | +0.0 | +73.5 | |
| Vehicle Safety Technologies (VST) | | | +24.7 | Full cost implications. |
| System Safety Technologies (SST) | | | +6.8 | Full cost implications. |
| Weather Safety Technologies (WST) | | | +21.4 | Full cost implications. |
| Aviation Securities Technologies (AST) | | | +20.6 | New Initiative (See Page AS-10). |

Indicates budget numbers in Full Cost.

Indicates changes since the FY 2003 Presidents Budget Submit.

*Note: For all formats, the FY02 column reflects the FY02 Congressional Operating Plan dated 9/30/02. The FY03 column reflects the FY03 President's Budget Submit (PBS) as Amended. The Change column includes both programmatic and full cost adjustments. The FY04 column is in full cost.*

**THEME:** Aeronautics Technology

**TECHNOLOGY AND ADVANCED CONCEPTS:** Airspace Systems Program

## PURPOSE

| Objectives | | Reference 2003 Strategic Plan | Perf. Measures |
|---|---|---|---|
| 2.3 | Enable more people and goods to travel faster and farther, with fewer delays. | | 4AT10, 4AT11, |
| 6.3 | Enhance science, technology, engineering and mathematics instruction with unique teaching tools and experiences that only NASA can provide, that are compelling to teachers and students. | | 4AT15 |
| 7.3 | Increase public awareness and understanding of how research and innovations in aerospace technology affect and improve the quality of life. | | 4AT16, 4AT17 |

The primary goal of the Airspace Systems (AS) Program is to enable new aircraft system capabilities and air traffic technology to increase the capacity and mobility of the nation's air transportation system. The objectives are to maximize operational throughput, predictability, efficiency, flexibility, and access into the airspace system while maintaining safety and environmental protection. The resultant benefit to the user will be reduced flight delays and reduction to doorstep-to-destination trip duration.

## OVERVIEW

The AS Program will enable the development of revolutionary improvements to, and modernization of, the National Airspace System, as well as the introduction of new systems for vehicles whose operation can take advantage of the improved, modern ATM system. The customers for this technology are the FAA, state and local airport authorities, and their systems suppliers, existing and new commercial and personal aviation operators, and the aircraft developers and their system suppliers. An Inter-Agency Integrated Product Team provides the management and coordination at the working level. Annually this team develops a National Plan for ATM Research approved by both agencies. This plan provides the details for the development and transition of ATM R&D from NASA to the FAA. The public is the beneficiary of this program from an improved quality of life through enhanced freedom of mobility as well as economic opportunity. The major challenges are: to accommodate projected growth in air traffic while preserving and enhancing safety; provide all airspace system users more flexibility, efficiency and access in the use of airports, airspace and aircraft; enable new modes of operation that support the FAA commitment to "Free Flight" and the Operational Evolution Plan (OEP); and maintain pace with a continually evolving technical environment.

The AS program is composed of the following projects: Advanced Air Transportation Technology (AATT), Virtual Airspace Modeling and Simulation (VAMS), Small Aircraft Transportation System (SATS), and Airspace Operations Systems (AOS). The AATT project develops decision-making technologies and procedures to provide all airspace users with more flexibility and efficiency, as well as enable new modes of operation supporting the FAA commitment to "Free Flight." The VAMS project, initiated in FY02, develops and assesses advanced system-level air transportation concepts to meet demand through 2025, and evaluates those concepts and other enhancements to the NAS. The AOS project develops fundamental knowledge, models, and tools for the efficient and safe operation of aviation systems by their human operators. The SATS project develops technology to enable small aircraft to operate at non-towered, non-radar small airports. Also, in FY02, the Airspace Systems Program Office began project formulation for a NASA Exploratory Technologies for the National Airspace System (NExTNAS) initiative. The NExTNAS is developing technologies to enable a future concept of operations for a more flexible and efficient airspace system.

As elements of the precursor Aviation System Capacity (ASC) Program, the Terminal Area Productivity (TAP) and Short Hall Civil Tiltrotor (SHCT) Projects were successfully completed in 2000 and 2001, respectively, and contributed technology for a combined 30% throughput increase to the overall performance measures for the AS Program. Similarly, the Advanced General Aviation Transport Experiments (AGATE) Program, a precursor to the SATS Project, established the cockpit system architectures into which the SATS applications can be integrated.

## PROGRAM MANAGEMENT

The NASA Enterprise official is Dr. Jeremiah F. Creedon, Associate Administrator (AA) for Aerospace Technology. The Aeronautics Technology Theme is the responsibility of Mr. Terrence J. Hertz, Director, Aeronautics Technology Division, OAT. The Program Manager is Mr. Robert Jacobsen, OAT, hosted at the Ames Research Center. The program is compliant with NPG 7120.5A.

**THEME:** Aeronautics Technology

# TECHNOLOGY AND ADVANCED CONCEPTS: Airspace Systems Program

## TECHNICAL COMMITMENT

The baseline for this technical commitment is the FY2002 budget reflected in the FY2002 NASA Appropriation.

| | Technical Specifications **(Project Deliverables)** | | FY04 President's Budget FY02 | FY03 | FY04 | FY05 | Change from Baseline |
|---|---|---|---|---|---|---|---|
| AATT | Complete operational concept definition (AATT). | TRL | 4 | 5 | 6 | | -- |
| | | $M | 18.6 | 18.2 | 22.7 | | -- |
| | Complete decision support tool benefits and safety assessments (AATT). | TRL | 4 | 5 | 6 | | -- |
| | | $M | 2.7 | 2.9 | 4.9 | | -- |
| | Complete human factors and operations assessments (AATT). | TRL | 4 | 5 | 6 | | -- |
| | | $M | 12.8 | 10.1 | 13.6 | | -- |
| | Develop terminal airspace operations and surface operations decision support tools (for transfer to FAA Free Flight Program Office and/or community) (AATT). | TRL | 4 | 5 | 6 | | -- |
| | | $M | 16.8 | 12.4 | 13.7 | | -- |
| | Develop en route systems and operations decision support tools (for transfer to FAA Free Flight Program Office and/or community) (AATT). | TRL | 4 | 5 | 6 | | -- |
| | | $M | 12.37 | 12.6 | 21.6 | | -- |
| | Develop aircraft systems and operations decision support tools (for transfer to FAA Free Flight Program Office and/or community) (AATT). | TRL | 4 | 5 | 6 | | -- |
| | | $M | 8.2 | 13.0 | 14.7 | | -- |
| VAMS | Complete operational concept integration and analysis (VAMS). | TRL | 1 | 1 | 2 | 3 | -- |
| | | $M | 6.7 | 5.9 | 11.2 | | -- |
| | Complete a real-time virtual airspace simulation environment (VAMS). | TRL | 1 | 2 | 3 | 4 | -- |
| | | $M | 14.0 | 14.7 | 22.2 | | -- |
| | Complete the evaluation of an integrated system-wide operational concept that meets the objectives of the Enterprise's long-term capacity and mobility goals (VAMS). | TRL | 1 | 1 | 2 | 2 | -- |
| | | $M | 2.3 | 2.5 | 4.2 | | -- |
| SATS | Complete SATS Integrated Technology Demonstration . | TRL | 2 | 3 | 4 | 5 | -- |
| | | $M | 10.3 | 14.5 | 24.6 | | -- |
| | Secure technical, policy, and economic inputs for national investment decisions to develop the Small Aircraft Transportation System concept (SATS). | TRL | 2 | 3 | 4 | 5 | -- |
| | | $M | 5.2 | 4.8 | 8.2 | | -- |
| AOS | Develop cognitive and physiological computational models to enable designers of high fidelity displays & aviation systems to predict & assess human performance (PPSF). | TRL | 2 | 2 | 3 | 3 | -- |
| | | $M | 3.3 | 3.8 | 6.7 | | -- |
| | Develop preliminary cognitive architecture for analyzing & predicting human performance in complex aerospace systems (HEC). | TRL | 2 | 2 | 3 | 3 | -- |
| | | $M | 4.1 | 4.9 | 8.4 | | -- |
| | Develop training protocols, operational procedures, and technologies to improve the quality of pilot decision making and facilitate accurate pilot-controller communication (HAIR). | TRL | 2 | 2 | 3 | 3 | -- |
| | | $M | 4.1 | 4.9 | 8.4 | | -- |
| NExTNAS | Develop space-based communication and surveillance technology. | TRL | | -- | 2 | 2 | Acceleration of originally planned FY05 in-guide program (in formulation). |
| | | $M | | | 8.4 | | |
| | Develop distributed air/ground traffic management procedures. | TRL | | -- | 3 | 3 | |
| | | $M | | | 13.1 | | |
| | Develop system-wide information management system. | TRL | | -- | 2 | 2 | |
| | | $M | | | 3.6 | | |
| | Develop wake vortex avoidance procedures. | TRL | | -- | 2 | 2 | |
| | | $M | | | 4.8 | | |
| | Develop ATM automation technology from VAMS operational concepts. | TRL | | -- | 2 | 2 | |
| | | $M | | | 2.4 | | |
| | Current TRL status relative to FY03 plan (R/Y/G/B) | | | ⇧ | ⇧ | | Planned TRL status to FY03 |

| | Schedule **(Level 1 Milestones)** | FY04 President's Budget | Change from Baseline |
|---|---|---|---|
| AATT | Develop, demonstrate initial functionality, and evaluate human factors for a decision support tool for complex airspace. | Mar-03 | -- |
| | Develop, demonstrate initial functionality, and evaluate human factors for active terminal-area decision support tool. | Sep-03 | -- |
| | Initial feasibility evaluations of distributed air/ground traffic management concepts. | Apr-04 | |
| | Complete the development and formal technology transfer of decision support tools to FAA Free Flight Phase 2 Program. | Jun-04 | |
| | Complete validation and assessment of NASA-developed advanced air transportation technology products. | Sep-04 | -- |

***Chart Continued On Next Page***

**THEME:** Aeronautics Technology

## TECHNOLOGY AND ADVANCED CONCEPTS: Airspace Systems Program

| | Schedule **(Level 1 Milestones)** | FY04 President's Budget | Change from Baseline |
|---|---|---|---|
| | ***Chart Continued From Prior Page*** | | |
| VAMS | Complete virtual airspace systems technologies (VAST) real-time environments definitions and preliminary design. | Sep-02 | -- |
| VAMS | Identify candidate future Air Transportation System capacity- increasing operational concepts. | Sep-02 | -- |
| VAMS | Complete Build 1 VAST non real-time state-of-the-art airspace models toolbox with the ability to assess economic impact of new technology and NAS operational performance, and the ability to model the dynamic effects of interactive agents. | Dec-02 | -- |
| VAMS | Complete build 3 VAST non real-time toolbox enhanced with cognitive human performance attributes and CNS models. | Aug-04 | -- |
| SATS | Establish Governance of SATS Alliance partnership with States, industry, and academia. | Sep-02 | -- |
| SATS | Baseline Systems Engineering Documents | Sep-02 | -- |
| SATS | Complete Technology Downselect For Flight Experiments | Feb-03 | -- |
| SATS | Conduct Initial SATSLab Flight Experiments | Aug-04 | -- |
| AOS | Provide strategies for improving training and procedures to reduce misunderstandings between pilots and air traffic controllers. | Jun-03 | -- |
| AOS | Demonstrate theory-based predictive safety analysis for distributed systems. | Jun-04 | -- |
| AOS | Based on pilot simulation study, determine the extent of alertness/performance decrements associated with 18-hour flights. | Jun-04 | -- |
| NExTNAS | Previous research completed under AATT project and current work under VAMS project, provide preliminary analysis and assessment of distributed air/ground traffic management operational concept. | Sep-04 | Acceleration of originally planned FY05 in-guide program (in formulation). |
| NExTNAS | Develop preliminary DAG/TM architecture and procedures. | Sep-05 | |

### ACQUISITION STRATEGY & PERFORMING ORGANIZATIONS

Data current as of 1/6/2003

The Air Space Program's acquisition strategy is to leverage NASA's R&D investments through the use of Space Act Agreements, joint government-industry partnerships, and cost-shared contracts whenever possible. To maximize the impact of the deliverables, AS's "business" objective is to use NASA R&D as a catalyst for a national (public and private) investment in key technologies impacting the National Airspace System. Thus, the program business philosophy is to not pay for the entirety of any technology development.

AS will use standard competitive procurements when purchasing items where required specifications are known. AS will use the competitive NRA process to (1) stimulate cost-sharing from industry, (2) leverage public and private R&D Programs and resources, and (3) accelerate technology commercialization through broad technical teams capable of solving both the technical hurdles and the implementation and certification issues. In addition to government procured contract support, other resources may include: (1) FAA William J. Hughes Technical Center, (2) DOT's Volpe National Transportation System Center, (3) MIT Lincoln Laboratory, (4) MITRE CAASD, and (5) other FFRDCs. AS has selected a partner, National Consortium for Aviation Mobility (NCAM), Hampton, VA, for a joint venture to develop and demonstrate air mobility technologies for transportation using small aircraft and small airports.

| Current Acquisitions | Actual * | Selection Method | Actual * | Performer | Actual * |
|---|---|---|---|---|---|
| Cooperative Agreements | 2% | Full & Open Competition | 94% | Industry | 71% |
| Cost Reimbursable | 55% | Sole Source | 6% | Government | 4% |
| Fixed Price | 16% | | 100% | NASA Intramural | 2% |
| Grants | 11% | | | University | 14% |
| Other Space Act Agreements | 16% | Sci Peer Review | % | Non Profit | 9% |
| * as % of FY02 direct procurement | 100% | * as % of FY02 direct procurement | | * as % of FY02 direct procureme | 100% |

| Future Acquisitions - Major | Selection | Goals |
|---|---|---|
| 1. Real-time simulation (VAMS) | Fall '04 | |
| 2. Systems engineering & project management (VAMS) | Mar '03 | |
| 3. Non-real-time simulation (VAMS) | Oct '05 | |
| 4. SATS Space Act Agreement with NCAM | Mar '02 | Annual cost shared task order issued to the NCAM consortium, consisting of Large/Small companies, universities, and other non-profits. |

**THEME:** Aeronautics Technology

**TECHNOLOGY AND ADVANCED CONCEPTS:** Airspace Systems Program

## AGREEMENTS

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

**External:**

| # | Partner | Purpose | Dated |
|---|---|---|---|
| 1 | FAA - General | Umbrella agreement to Achieve Goals in Aviation and Future Space Transportation | Oct-98 |
| 2 | FAA #FNA/05 | FAA Program Support | Aug-90 |
| 3 | FAA #FNA/05-97-01 | Support of FAA R&D Field Offices Located at NASA Research Centers | Mar-97 |
| 4 | FAA #FNA/07 | Airspace System User Operational Flexibility and Productivity | Sep-95 |
| 5 | FAA #FNA/07-97-01 | Research on Airport Surface Operations in Reduced Visibility Weather Conditions | Apr-97 |
| 6 | FAA #FNA/07-98-02 | Air Traffic Management Research and Technology Development | Jul-98 |
| 7 | FAA #FNA/08 | Aviation Safety Research | Jul-99 |
| 8 | FAA #FNA/08-99-01 | Aviation Safety Reporting System | Jun-99 |
| 9 | FAA #FNA/08-00-01 | Weather Accident Prevention R&D Activities | Jun-00 |
| 10 | FAA #FNA/08-00-02 | National Airspace System Research and Technology Development | Nov-00 |
| 11 | FAA #FNA/IAI-536 | National Airspace Systems Research and Testing Development SATS Program Activities | Apr-01 |
| 12 | FAA #FNA/08-01-01 | Accident and Incident Mitigation Research | Jun-00 |
| 13 | DOT - Volpe | Research, Design, Development and Demonstration of Aviation Concepts and | Jun-01 |
| 14 | DOT - Volpe | Analysis of market, consumer, and community response issues related to SATS services | Sep-02 |
| 15 | NCAM - JSRA | Joint Sponsored Research & Development Agreement with National Consortium for Aviation Mobility (NCAM) on the Small Aircraft Transportation System (SATS) | Pending. |

## INDEPENDENT REVIEWS

| Types of Review | Performer | Last Review | Next Review | Purpose |
|---|---|---|---|---|
| Quality | ASEB/NRC | none | Feb-03 | Assess the scientific and technical quality of the ASP research and technology program against the current state of the art. |
| Performance | IPAO | Nov-01 | Jun-03 | Assess the programmatic performance of the ASP against the approved program plan. |
| Relevance | ATAC | Oct-02 | Feb-03 | Assess the relevance of the ASP research and technology program to the potential Government and Industry user communities. |

## BUDGET

| Budget Authority ($ in millions) | FY02 | FY03 | FY04 | |
|---|---|---|---|---|
| FY 2004 Budget Submit (Technology) | 133.9 | 125.1 | 217.2 | |
| Advanced Air Transportation Technology | 71.4 | 71.6 | 105.6 | |
| Small Aircraft Transportation System | 15.5 | 20.0 | 30.7 | |
| Virtual Airspace Modeling & Simulation | 23.0 | 23.0 | 33.3 | |
| Aviation Operations Systems | 11.5 | 10.5 | 20.6 | |
| Next Generations Air Transportation System | 0.0 | 0.0 | 27.0 | New Initiative. |
| Rotorcraft | 12.5 | 0.0 | 0.0 | |
| Changes since FY 03 Pres. Budget | +0.0 | +0.0 | +92.1 | |
| Advanced Air Transportation Technology | | | +34.0 | Full cost implications. |
| Small Aircraft Transportation System | | | +10.7 | Full cost implications. |
| Virtual Airspace Modeling & Simulation | | | +10.3 | Full cost implications. |
| Aviation Operations Systems | | | +10.1 | Full cost implications. |
| Next Generations Air Transportation System | | | +27.0 | New Initiative (See Page AS-10). |
| Rotorcraft | | | +0.0 | |

Indicates budget numbers in Full Cost.

Indicates changes since the FY 2003 Presidents Budget Submit.

*Note: For all formats, the FY02 column reflects the FY02 Congressional Operating Plan dated 9/30/02. The FY03 column reflects the FY03 President's Budget Submit (PBS) as Amended. The Change column includes both programmatic and full cost adjustments. The FY04 column is in full cost.*

**THEME:** Aeronautics Technology

## TECHNOLOGY AND ADVANCED CONCEPTS: Vehicle Systems Program

### PURPOSE

| Objectives | Reference FY 2003 Strategic Plan | Perf. Measures |
|---|---|---|
| 2.2 | Protect local and global environmental quality by reducing noise, emissions and others. | 4AT8, 4AT9 |
| 3.1 | Enhance the Nation's security by developing and demonstrating critical access-to-space technologies that benefit NASA, DOD, and other government agencies. | 4AT14 |
| 6.3 | Enhance science, technology, engineering and mathematics instruction with unique teaching tools and experiences that only NASA can provide, that are compelling to teachers and students. | 4AT15 |
| 7.3 | Increase public awareness and understanding of how research and innovations in aerospace technology affect and improve the quality of life. | 4AT16 & 4AT17 |
| 10.5 | Explore New Aeronautical Concepts: Pioneer novel aeronautical concepts to support earth and space science missions and new commercial markets. | 4AT18, 4AT19 |

The Vehicle Systems (VS) Program is focused on the development of breakthrough technologies for future aircraft and air vehicles. These technologies, if implemented, will reduce NOx emissions to reduce pollution near airports and in the lower atmospheric zone, reduce emissions of the greenhouse gas CO2 and reduce aircraft noise to simultaneously enable air traffic growth and reduce community noise impact. Vehicle Systems Technologies will be developed in collaboration with the Department of Defense to ensure National security through various air vehicle applications. Longer term research on technologies for next generation vehicles will focus on embryonic technologies to further increase the quality of life for our citizens.

### OVERVIEW

The Vehicle Systems Program is developing enabling technologies to meet the public's demand for increased air travel yet keep the environment unaffected. Research and technology will provide a broad spectrum of capabilities for vehicles in five classes: a) Subsonic Transports, b) Small Supersonic Aircraft, c) Unpiloted Air Vehicles, d) Runway Independent Air Vehicles and e) Personal Air Vehicles. The program develops technologies that are directly related to one or more of the vehicle classes. The Quiet Aircraft Technology (QAT) project is developing laboratory validated technologies through subscale testing and simulations to reduce community noise impact by 5 dB (re. to 2001 state-of-the art). The Ultra-Efficient Engine Technology (UEET) project is developing technologies to enable reduction of NOx emissions of future aircraft by 70% (re. to 1996 ICAO standard). UEET and the 21st Century Aircraft Technology (TCAT) project is developing technologies to enable reduction of CO2 emissions of future aircraft and propulsion systems by 25% (re. to 2000 state-of-the art). The Breakthrough Vehicle Technology (BVT), Propulsion & Power (P&P) and Flight Research (FR) projects are developing breakthrough technologies by investigating emerging technologies and basic sciences to enable reconfigurable systems, low weight and affordable systems, new energy concepts, knowledge of vehicle health, and autonomous systems.

### PROGRAM MANAGEMENT

The Vehicle Systems is a multi-project program within the Aeronautics Technology Theme. The Office of Aerospace Technology (OAT) Enterprise Program Management Council (EPMC) has VS governing responsibility. The NASA Enterprise official is Dr. Jeremiah F. Creedon, Associate Administrator, Office of Aerospace Technology. The Aeronautics Technology Theme is the responsibility of Mr. Terrence J. Hertz, Director, Aeronautics Technology Division, OAT. The Program Manager is Dr. Richard Wlezien at HQ. The program is compliant with NPG 7120.5A.

### TECHNICAL COMMITMENT

The baseline for this technical commitment is the FY2002 budget reflected in the FY2002 NASA Appropriation.

| Technical Specifications | | FY04 President's Budget | | | | Change from Base |
|---|---|---|---|---|---|---|
| | | FY02 | FY03 | FY04 | FY05 | |
| Validate in a laboratory and a relevant environment aircraft component technologies and advanced flight operations for reducing noise by 10 dB (re. to CY 1997 soa) to simultaneously enable air traffic growth and reduce community noise impact. (QAT) | TRL | 2 | 3 | 3 | 4 | None |
| | $M | 20.0 | 20.0 | 60.2 | | |

***Chart Continued on Next Page***

**THEME:** Aeronautics Technology

**TECHNOLOGY AND ADVANCED CONCEPTS:** Vehicle Systems Program

## TECHNICAL COMMITMENT (Continued)

| Technical Specifications | | FY04 President's Budget | | | | Change from Baseline |
|---|---|---|---|---|---|---|
| ***Chart Continued from Prior Page*** | | **FY02** | **FY03** | **FY04** | **FY05** | |
| Demonstrate combustor configurations for reducing NOx emission by 70% (re. to 1996) to reduce pollution and lower atmospheric ozone formation, with best configurations to be considered for further development to TRL 6. (UEET) | TRL | 3 | 3 | 4 | 4 | -- |
| | $M | 25.0 | 25.0 | 45.0 | | |
| Demonstrate airframe and engine component technologies for reducing emissions of the green-house gas CO2 by 25% (re. to 2000 soa) to protect the environment, with best configurations to be considered for further development to TRL 6.(TCAT & UEET) | TRL | 2 | 2 | 3 | 3 | -- |
| | $M | 54.0 | 54.0 | 87.1 | | |
| Provide proof of concept validation of micro flow control, self healing structures, self assembling materials, multifunctional ultra-lightweight structures, physics-based computational methods, robust controls, and advanced sensor and actuator systems which if implemented will contribute toward 50% $C0_2$ reduction. (BVT) | TRL | 1 | 1 | 1 | 1 | -- |
| | $M | 83.2 | 61.9 | 136.4 | | |
| Develop and demonstrate technologies to enable autonomous and intelligent flight for robust failure recovery of a flight control system, autonomous refueling of air vehicles, advanced flight instrumentation and test techniques, autonomous flight operations for unmanned combat vehicles, and flight experiments on testbed aircraft. (FR) | TRL | 2 | 2 | 3 | 3 | -- |
| | $M | 94.2 | 93.7 | 85.4 | | |
| Provide proof of concept validation of key component technologies to enable future intelligent gas turbine engines, non-conventional combustion based propulsion systems, and hybrid electric propulsions systems which if implemented will contribute toward 50% $C0_2$ reduction. (P&P) | TRL | 1 | 1 | 1 | 1 | -- |
| | $M | 92.4 | 141.1 | 124.3 | | |
| Develop and demonstrate technologies required for routine Unmanned Aerial Vehicle operations in the National Airspace System at and above the 18,000 ft. Level. (FR) | TRL | | -- | 3 | 4 | New project |
| | $M | | 0.0 | 8.0 | | |
| Complete flight validation of regenerative fuel cell technology to enable multi-week fight duration UAV's above 50,000 feet. (FR) | TRL | | -- | 4 | 5 | -- |
| | $M | | 0.0 | 11.9 | | |
| Current TRL status relative to FY03 plan (R/Y/G/B) | | | ⇧ | ⇧ | | Planned TRL to FY03 |

| Schedule | FY04 President's Budget | Change from Baseline |
|---|---|---|
| Validate in a laboratory and a relevant environment aircraft component technologies and advanced flight operations for reducing noise by 10 dB (re. to CY 1997 soa) to simultaneously enable air traffic growth and reduce community noise impact. | Jun-07 | -- |
| Demonstrate combustor configurations for reducing NOx emission by 70% (re. to 1996) to reduce pollution and lower atmospheric ozone formation, with best configurations to be considered for further development to TRL 6. | Jun-06 | -- |
| Demonstrate airframe and engine component technologies for reducing emissions of the green-house gas CO2 by 25% (re. to 2000 soa) to protect the environment, with best configurations to be considered for further development to TRL 6. | Jun-06 | -- |
| Complete proof of concept validation of micro flow control, self healing structures, self assembling materials, multifunctional ultra-lightweight structures, physics-based computational methods, robust controls, and advanced sensor and actuator systems which if implemented will contribute toward 50% C02 reduction. | Jul-06 | -- |
| Develop and demonstrate technologies to enable autonomous and intelligent flight for robust failure recovery of a flight control system, autonomous refueling of air vehicles, advanced flight instrumentation and test techniques, autonomous flight operations for unmanned combat vehicles, and flight experiments on testbed aircraft. | Aug-06 | -- |
| Complete proof of concept validation of key component technologies to enable future intelligent gas turbine engines, non-conventional combustion based propulsion systems, and hybrid electric propulsions systems which if implemented will contribute toward 50% C02 reduction. | May-06 | -- |

***Chart Continued on Next Page***

**THEME:** Aeronautics Technology

## TECHNOLOGY AND ADVANCED CONCEPTS Vehicle Systems Program

### TECHNICAL COMMITMENT (Continued)

| Schedule | FY04 President's Budget | Change from Baseline |
|---|---|---|
| ***Chart Continued on Next Page*** | | |
| Develop and demonstrate technologies required for routine Unmanned Aerial Vehicle operations in the National Airspace System at and above | Sep-08 | -- |
| Complete flight validation of regenerative fuel cell technology to enable extreme duration flight of UAV's. | Sep-06 | -- |

### ACQUISITION STRATEGY & PERFORMING ORGANIZATIONS

Data current as of 1/23/2003

Maximize R&D efforts in vehicle technologies through competitive sourcing, cooperative agreements, and cost-sharing with research partners, in addition to in-house projects. The Vehicle Systems Program is managed at NASA Headquarters, with Level II and III Projects and Sub-projects led at Glenn, Langley, and Dryden Flight Research Centers. The Vehicle Systems Program is composed of both low and mid TRL projects. For the low TRL projects, infusion of new ideas is encouraged through NRA's and grants. The mid TRL technologies are brought closer to technical maturation through partnerships with the end users -- industry and other government agencies. Capabilities and expertise for some projects within the Vehicle Systems program are obtained through competitive sourcing, resulting in performance based contracts for certain activities.

| Current Acquisitions | Actual * | Selection Method | Actual * | Performer | Actual * |
|---|---|---|---|---|---|
| Cooperative Agreements | 9% | Full & Open Competition | 90% | Industry | 76.0% |
| Cost Reimbursable | 43% | Sole Source | 10% | Government | 5.0% |
| Fixed Price | 5% | | 100% | NASA Intramural | 2.0% |
| Grants | 14% | | | University | 15.0% |
| Other | 30% | Sci Peer Review | 14% | Non Profit | 2.0% |
| * as % of FY02 direct procurement | 100% | * as % of FY02 direct procurement | | * as % of FY02 direct procurement | 100% |

| Future Acquisitions - Major | Selection | Goals |
|---|---|---|
| 1. NRA, multiple awards to universities and industry, 6M | FY 04 | 100% Full & Open Competition, 70% university/30% other |
| 2. JSRA for regenerative fuel cell research | FY 03 | 100% Full & Open Competition |

**Changes since FY03 Pres. Budget: None.**

### AGREEMENTS

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

**External:**

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/09 between the FAA and NASA concerning Aviation Environmental Compatibility; October 1990.
3. Memorandum of Agreement #FNA/09-01-01 between the FAA and NASA concerning the Impact of Aviation Air Emissions on Climate and Global Atmospheric Composition; April 2001.
4. Memorandum of Agreement #FNA/09-02-01 between the FAA and NASA concerning Aircraft Noise Reduction Technology; June 2002.
5. NASA will enter into additional external agreements to facilitate accomplishment of their objectives and the transfer of technology. A variety of mechanisms will be employed, including Memoranda of Understanding, Memoranda of Agreement, Interagency Agreements and Cooperative Agreements. Where applicable, the respective program plans will provide specifics of these agreements explaining involvement of external organizations, other agencies or international partners, and a brief overview of the external support necessary to meet program objectives. Some of the entities the program office has agreements with are: DoE, DoT, FAA, AFRL, Navy, AEDC, Sandia National Lab, DARPA, GE, PW, Honeywell, Allison/R&R, Boeing, The Cleveland Clinic, University of Nevada and others.

**THEME:** Aeronautics Technology

## TECHNOLOGY AND ADVANCED CONCEPTS: Vehicle Systems Program

### INDEPENDENT REVIEWS

| Types of Review | Performer | Last Review | Next Review | Purpose |
|---|---|---|---|---|
| Quality | ASEB/NRC | | Feb-03 | Assess the scientific and technical quality of the VSP research and technology program against the current state of the art. |
| Performance | IPAO | Apr-03 | Sep-03 | Assess the programmatic performance of the VSP against the approved program plan. |
| Relevance | ATAC | Oct-02 | Feb-03 | Assess the relevance of the VSP research and technology program to the potential Government and Industry user communities. |

### COST

| Budget Authority ($ in millions) | FY02 | FY03 | FY04 | Comments |
|---|---|---|---|---|
| **FY 2004 Budget Submit** | **368.8** | **274.3** | **573.6** | |
| Quiet Aircraft Technology (QAT) | 20.0 | 20.0 | 60.2 | |
| 21st Century Aircraft Technology (TCAT) | 29.0 | 29.0 | 42.1 | |
| Flight Research (FR) | 52.4 | 38.9 | 85.4 | Less ERAST (FY02/03) in Devl'mt. |
| Advanced Vehicle Concepts (AVC) | 42.3 | 7.8 | 41.0 | Less X-43A (FY02/03) in Devl'mt. |
| Breakthrough Vehicle Technologies (BVT) | 82.9 | 61.9 | 115.3 | |
| Ultra-Efficient Engine Technology (UEET) | 49.8 | 50.0 | 90.0 | |
| Propulsion & Power (P&P) | 92.4 | 66.7 | 139.6 | |
| Changes since FY03 Pres. Budget | **-47.6** | **-47.0** | **+299.3** | ***Reason for Change:*** |
| Quiet Aircraft Technology (QAT) | | | +40.2 | New Initiative (See Page AS-10). |
| 21st Century Aircraft Technology (TCAT) | | | +13.1 | Full cost implications. |
| Flight Research (FR) | -22.1 | -20.0 | +46.5 | Less ERAST (FY02/03) to Devl'mt. |
| Advanced Vehicle Concepts (AVC) | -25.0 | -27.0 | +33.2 | Less X-43A (FY02/03) to Devl'mt. |
| Breakthrough Vehicle Technologies (BVT) | -0.3 | | +53.4 | Full cost implications. |
| Ultra-Efficient Engine Technology (UEET) | -0.2 | | +40.0 | Full cost implications. |
| Propulsion & Power (P&P) | | | +72.9 | Full cost implications. |

Indicates budget numbers in Full Cost.

Indicates changes since the FY 2003 Presidents Budget Submit.

*Note: For all formats, the FY02 column reflects the FY02 Congressional Operating Plan dated 9/30/02. The FY03 column reflects the FY03 President's Budget Submit (PBS) as Amended. The Change column includes both programmatic and full cost adjustments. The FY04 column is in full cost.*