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Office of Aerospace Technology (Code R)
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The total Fiscal Year 2003 budget request for the Aerospace Technology Enterprise is $2,815.8 million; this is comprised of $1,842.5 million in direct program funding and $973.2 million for institutional support. This represents an increase of 11 percent from FY 2002. There are an estimated 4,618 direct Full Time Equivalent employees included within the Aerospace Technology Enterprise in Fiscal Year 2003.

The Aerospace Technology Enterprise mission is to advance U. S. pre-eminence in aerospace research and technology. The Enterprise aims to radically improve air travel, making it safer, faster and quieter as well as more affordable, accessible and environmentally sound. As part of this effort, the Enterprise has been working closely with the FAA to improve aviation safety and also to enable new aircraft capabilities and air traffic technology that will increase the capacity and mobility of the air transportation system without compromising safety. The Enterprise also is working closely with the DoD to develop more affordable, reliable and safe access to space; enhance aerospace system performance; improve the way in which air and space vehicles are designed and built; and ensure new aerospace technologies are available to benefit the public.

The Aerospace Technology Enterprise program structure has been reorganized to create a clear linkage between National policies, the Enterprise strategic goals and the program management structure. This restructuring creates an unambiguous linkage from the Agency strategic plan to this budget and provides a foundation for transparent, measurable performance-reporting through the Government Performance and Results Act. The four strategic goals of the Enterprise are:

- **Revolutionize Aviation:** Enable the safe, environmentally friendly expansion of aviation.
- **Advance Space Transportation:** Create a safe, affordable highway through the air and into space.
- **Pioneer Revolutionary Technology:** Enable a revolution in aerospace systems.
- **Commercialize Technology:** Extend the commercial application of NASA technology for economic benefit and improved quality of life**.**

Three exciting initiatives that will significantly improve the performance of future aerospace systems will be continued in fiscal year 2003.

Engineering for Complex Systems: The Engineering for Complex Systems (ECS) Program is a reformulated program previously called Design For Safety that supports the Pioneer Revolutionary Technology Goal. The recent problems in some NASA missions, along with similar or related problems in aerospace and general aviation, are symptomatic of the difficulty in synthesizing operational and design parameters. Safety is a system property, encompassing components, subsystems, software, organizations, human behavior and their interactions. Yet typically system design and analysis is de-coupled, addressing only components and subsystems; analysis of risk-factors is usually sporadic, and deferred until integration occurs.

ECS is a significant shift in the process of how systems engineering and operations are performed, and aims to place risk-estimation and risk-countermeasures for overall mission and human safety on a more rigorous, explicit and quantifiable basis. This would allow design trades to be evaluated based on a risk-factor, with the same fidelity and confidence used for other mission or system properties such as cost, schedule and performance.

The ECS program has a three-pronged approach to achieving its objective of enabling ultra-high levels of safety and mission success through the infusion of advanced information. First, the program intends to significantly advance the scientific and engineering understanding of system complexities and failures, including human and organizational risk characteristics. Second, processes, tools and organizational methods will be developed to quantify, track, visualize and trade off system designs and/or mission options with an emphasis on risk-management throughout the system lifecycle. Third, software-based resiliency tools and technologies will be developed to help mitigate risk in the operational and maintenance phases of the program lifecycles.

21st Century Aircraft Technology: 21st Century Aircraft Technology (TCAT), a project continued in fiscal 2003 within the Vehicle System Program, supports the Revolutionize Aviation Goal. TCAT is a next step in reaching the long-term Goal element of enabling development of an environmentally friendly global air-transportation system with greater safety that improves national mobility during the next century. The technologies developed in TCAT and the concepts enabled by these technologies will affect all objectives of the Goal. The TCAT Project will utilize systems analysis to quantify potential project benefits and to guide future project investment decisions.

The TCAT project will achieve in three steps its objective of enabling shifts in the design of future generations of aircraft, providing performance enhancements that can hardly be imagined today. First, vehicle and component-level aerodynamic, structures and material technologies will be developed and verified to enable ultra-efficient, ultra-quiet vehicles with optimal, on-demand performance available throughout mission-specific flight envelopes. Additionally, TCAT will develop vehicle control systems that integrate and optimize human, automation and ultra-distributed novel control capabilities -- much as the central nervous system of the human body integrates myriad complex biological

subsystems. Finally, TCAT will develop and validate "leapfrog" aircraft propulsion/power concepts leading to fully integrated propulsion/power concepts, in turn leading to fully integrated propulsion/airframe systems, which enable extremely efficient, whisper-quiet air vehicles with ultra-low emissions.

Virtual Airspace Modeling and Simulation: The Virtual Airspace Modeling and Simulation (VAMS) project in the Airspace Systems Program supports the Revolutionize Aviation Goal. The VAMS project will develop the analytical and simulation capability needed to analyze and validate the next generation of air-traffic management concepts and evaluate new air-traffic operational concepts and architectures. The models will include the ability to assess the economic impact of new technology and National Air Space (NAS) operational performance, including the effects of interactive agents and weather. These models will require a never-before-achieved level of fidelity.

The Aerospace Technology Enterprise budget request is divided among its four strategic goals as follows.

Revolutionize Aviation -- $541.4 million

Aviation Safety Program: The Aviation Safety program will continue to develop and demonstrate technologies and strategies to improve aviation safety by reducing both aircraft accident and fatality rates. Some of the items that will be accomplished in fiscal 2003 include: flight evaluation of synthetic vision-system products integrated with precision approach-and-landing and display system concepts, flight evaluation of the next-generation cockpit weather-information system, and a "smart" icing-management system for automatic management of ice-protection systems.

Vehicle Systems Program: The Vehicle Systems program will take advantage of the emergence of revolutionary advances in biotechnology, nanotechnology and information technology to enable significant advances in the functionality of the 21st century aircraft. Some of the items that will be accomplished during fiscal 2003 include: completion of sector-testing of engine combustors that reduce oxides of nitrogen emissions by 70 percent; development of physics-based models related to noise-generation and propagation-physics for airframe and engine-noise sources, as well as noise interaction between engine and airframe; and demonstration of a propulsion and power (P&P) system test-bed -- the first end-to-end demonstration of a P&P system, including fuel-cell power-generation and realistic loads configured for aircraft requirements.

Airspace Systems Program: The Aviation System Capacity Program will enable improvements in the mobility, capacity, efficiency and access of the airspace system. This will be accomplished by developing, validating and transferring technologies that improve collaboration, predictability and flexibility for airspace users, enable runway-independent aircraft and provide more access for general aviation operations. Some of the items that will be accomplished during fiscal 2003 include: completing models of the

airspace system that include the capability to model dynamic effects of interactive agents in the system; selection of candidate technologies for experimental flight-evaluation based on their impact on mobility through reduced system cost, improved doorstep-to-destination time, increased trip reliability and/or improved safety of small aircraft; and development of strategies to improve training and procedures to reduce misunderstandings between pilots and air traffic controllers.

Advanced Space Transportation -- $879.4 million

2nd Generation Reusable Launch Vehicle: The 2nd Generation Reusable Launch Vehicle Program, also known as the Space Launch Initiative (SLI) Program, last year implemented the first phase of technology developments, awarding contracts valued at more than $800 million to industry and academia. Another milestone, the Systems Requirements Review (SRR) Kickoff is planned for November 2002. This is the next step in the integration and synthesis of NASA, industry and DoD requirements for the 2nd Generation Reusable Launch Vehicle. This important review will result in more focused attention on fewer space transportation architectures and associated technology areas. Each industry partner will go forward with its most promising architecture, which will drive the technology-maturation investments for the program.

Following the SRR, the program will release a Request for Proposal (RFP) in February 2003, with contract awards planned for September 2003. This RFP is the next major milestone in the SLI process of focusing on architectures and technologies required to increase the safety and decrease the cost of space transportation systems. The solicitation will select the most promising architecture(s) to proceed toward a detailed preliminary design of the 2nd Generation Reusable Launch Vehicle.

Propulsion development for vehicle on-orbit maneuvering and control systems will be initiated in November 2002 with the Technology Readiness Review of a two new auxiliary propulsion-system designs: liquid oxygen/ethanol and liquid oxygen/liquid hydrogen. A prototype system will undergo a Critical Design Review in July 2003.

Space Transportation & Launch Technology: Also known as the 3rd Generation Reusable Launch Vehicle Program, the Space Transfer and Launch Technology (STLT) activity will pioneer the identification, development, verification, transfer and application of high-payoff space transportation technologies. STLT is responsible for implementing the 3rd generation element -- Hypersonics (of speeds equal to or exceeding five times the speed of sound) -- of NASA's Integrated Space Transportation Plan. As a result of NASA's participation in the National Hypersonics Plan development, the agency has focused its 3rd Generation Reusable Launch Vehicle (RLV) efforts on the unique, critical technologies required to meet these ambitious goals.

The refocused efforts are centered on integrated ground demonstrations of rocket-based combined-cycle systems, turbine-based combined-cycle systems and flight

demonstration of high-speed scramjet-propulsion/airframe integration. In fiscal 2003, STLT will complete the non-advocate review of three revolutionary hypersonic propulsion-technology systems demonstrations that include the rocket-based combined-cycle, turbine-based combined-cycle and scramjet engines. Other achievements will include the high-temperature composites demonstration where significant weight reduction for RLV engine systems can be quantified through actual test data.

Pioneer Revolutionary Technology -- $274.9 million

Computing, Information and Communications Technology Program: The Computing, Information and Communications Technology program is developing and demonstrating revolutionary computing, information and communications technologies in the specific areas of autonomy, human-centered systems, intelligent data-understanding, advanced computing and networking, information environments, and fundamental information and bio- and nano-technologies. Some of the items that will be accomplished during fiscal 2003 include: development of efficient algorithms for automated generation of software designs and code and development of ad-hoc space communications networks.

Engineering for Complex Systems: (as described previously in the new initiatives)

Enabling Concepts and Technologies Program: The Enabling Concepts and Technologies program provides revolutionary aerospace system concepts that can enable NASA's strategic vision and expand future mission possibilities. In fiscal 2003, the program will emphasize technologies to enable breakthrough capabilities in active science instruments, ultra-efficient and resilient space systems, and advanced system studies. Some of the areas in which investment will be made include: space-capable lidar instruments; efficient long-life lasers; advanced spacecraft-energy production and storage systems, including all-plastic batteries, long-life fuel cells and compact high-speed flywheels; new sensor concepts; formation-flying control methods; and components to enable distributed instrument networks.

Commercial Technology -- $146.9 million

NASA's Commercial Technology Program includes Commercial Programs, Tech Transfer Agents and Small Business Innovation Research/Small Business Tech Transfer programs. NASA's Commercial Technology Program responds to one of the principal NASA mission goals -- to develop and transfer advanced technology. The program objectives are to establish high-value technology-development partnerships with industry, to transfer advanced technology to industry for U.S. economic enhancement and contributions to public quality of life, and to provide outreach to the public on opportunities and success of NASA commercial and small business programs.

Technology partnerships are a key tool by which industry and NASA jointly pursue mutually advantageous research and development (R&D) projects that provide new technology both for industry use in new products and services and for NASA use in mission programs. One intended result of these high-value R&D partnerships is to accelerate the development of new technology by innovative leveraging of each partner’s unique capabilities and consequently to reduce development costs for both.

The basis for these technology partnerships is creation of strategic alliances with industry and close synchronization with the NASA enterprises' technology objectives. Some of the active technology areas for partnership with industry are advanced materials, sensors and instruments, medical devices and imaging, and information technology.

The Small Business Innovation Research/Small Business Tech Transfer (SBIR/STTR) programs were established to provide innovative technology in support of NASA missions and to promote the commercialization of their technology. The commercial programs and SBIR/STTR programs are closely coordinated and mutually supportive of the overall R&D mission.

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