

**National Aeronautics and
Space Administration**

**Glenn Research Center
2004 Implementation Plan**



Center Director's Message

The NASA Strategic Plan lays out our vision and strategies for forging our future and supporting America by infusing new technology and techniques that will improve the quality of life on Earth. As we move to implement these strategies we unite our voices and efforts in support of these endeavors as one team, One NASA.

In support of the NASA mission the Glenn Research Center joins the rest of the NASA team in aligning our objectives and resources in support of the implementation of the Agency strategies. This Center Implementation Plan summarizes the current and potential capabilities and activities at the Glenn Research Center, its key processes, and actions the Center will take to support NASA objectives. It provides an overall view of how the Center contributes to achieving the Agency mission and the capabilities we bring to support the team with expertise in areas uniquely suited to developing the next generation of technologies that will enable and facilitate future Agency endeavors.

Great challenges face NASA. Glenn, too, faces many challenges but we are committed to continuous improvement and learning, to managing our resources efficiently and effectively, and we are committed to making cultural changes to ensure we can fulfill our mission. We will pursue avenues to further strengthen our human resources technical competencies and expand collaborations to leverage capabilities across the Agency, industry, and academia. We will also be actively looking for those areas where we are best suited, by our expertise, to make the greatest impact and to construct a framework for Glenn's active contribution to our goals and objectives.

To successfully accomplish all these things, we at Glenn must not only commit ourselves to implementing this plan, but also to upholding NASA's key values relating to safety, people, excellence, and integrity. We also must commit ourselves to innovation and continuous improvement so that we will always be an effective and efficient provider of research, products, and services to NASA, our Nation, and the world.




Julian M. Earls, Director

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1

Introduction



1 Introduction

The Government Performance and Results Act (GPRA) of 1993 requires agencies to conduct long-term strategic planning, measure program outcomes, and be accountable for achieving program results. Accordingly, NASA has developed a Strategic Plan that articulates its activities, goals, customers, and methods for successfully accomplishing its mission.

The diagram below shows that the elements of the NASA Strategic Plan and Annual Performance Plan cascade to this NASA Glenn Center Implementation Plan and subsequently to program plans and individual employee performance plans.



Linkage to Strategic Management Process



1.1 Glenn Research Center in NASA's Vision and Mission

The NASA Vision and Mission communicate simply, but powerfully, our mandate in the 21st century:

NASA Vision

- To improve life here,
- To extend life to there,
- To find life beyond.

NASA Mission

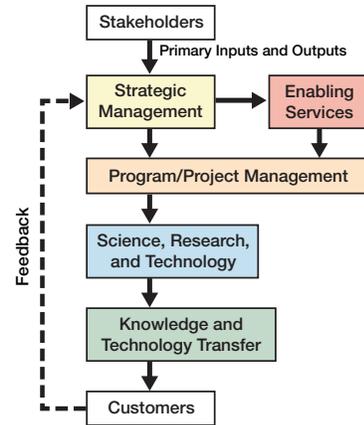
- To understand and protect our home planet
- To explore the Universe and search for life
- To inspire the next generation of explorers
- ... as only NASA can

Glenn Mission

As a diverse team working in partnership with government, industry, and academia to increase national wealth, safety, and security, protect the environment, and explore the universe, we develop and transfer critical technologies that address national priorities through research, technology development, and systems development for safe and reliable aeronautics, aerospace, and space applications.

1.2 Glenn Business Management System

All work at Glenn is managed, implemented, and evaluated in accordance with documented procedures in its Business Management System (BMS). Glenn's BMS is certified to the ISO 9001:2000 international quality management system standard. The BMS is organized around Glenn's five key processes: Strategic Management; Enabling Services; Program and Project Management; Science, Research, and Technology; and Knowledge and Technology Transfer. The effectiveness and efficiency of these five key processes are regularly assessed to ensure Glenn is continually improving and innovating so that it will have quality products, excellent services, and satisfied customers.



1.3 Glenn Milestones and Metrics

Glenn uses both milestones and metrics to assess and document the effectiveness and efficiency of its processes.

Milestones

Milestones are discrete events relating to the accomplishment of a Glenn mission, program, project, or process—such as delivery of a product, provision of a service, or development of a technology. Because milestones occur only once, they cannot be trended except in an aggregate sense.

All Glenn Level 1 and most Level 2 Program milestones are set forth in the Milestones and Metrics insert to this Plan. Other significant nonprogram milestones are also set forth in that insert.

Metrics

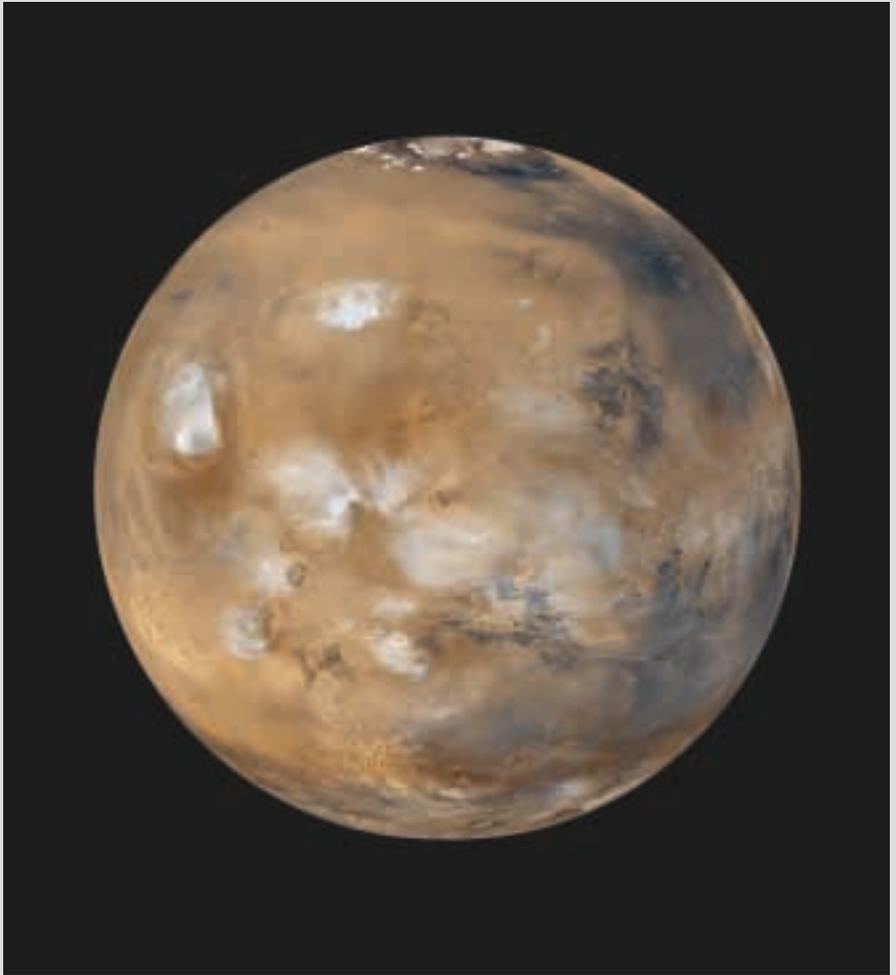
Metrics are measures or indicators of performance that are quantifiable, have specific goals or targets (ideally with “goodness” readily apparent), and can be trended. Metrics may measure or indicate effectiveness (such as customer satisfaction) or efficiency (such as how economically an activity was performed). Both effectiveness and efficiency metrics are important to understanding and improving the health of an organization. Glenn's key metrics are set forth in the Milestones and Metrics insert to this plan.





2

**Glenn Mission
Areas Supporting
NASA Themes**



2 Glenn Mission Areas Supporting NASA Themes

Under the One NASA philosophy, NASA centers work together as a team for common goals. NASA has developed a single set of objectives supporting Agency goals and core missions. This approach better integrates all Agency Enterprises into a single vision.

Each of NASA's six Enterprises is associated with one or more Themes:

Space Science

- Solar System Exploration
- Mars Exploration
- Astronomical Search for Origins
- Structure and Evolution of the Universe
- Sun-Earth Connection

Earth Science

- Earth System Science
- Earth Science Applications

Biological and Physical Research

- Biological Sciences Research
- Physical Sciences Research
- Research Partnerships and Flight Support

Aerospace Technology

- Aeronautics Technology
- Space Launch Initiative
- Mission and Science Measurement Technology
- Innovative Technology Transfer Partnerships

Education

- Education Programs

Space Flight

- International Space Station
- Space Shuttle Program
- Space and Flight Support

Glenn's role within this Agency organization is illustrated in the two charts on pages 12 and 13: Glenn Alignment with the NASA Strategic Plan, and NASA Goal and Glenn Fiscal Year 2004 Project and Mission Area Alignment.





Glenn Alignment With the NASA Strategic Plan		NASA ENTERPRISES																	
		Space Science			Earth Science		Biological and Physical Research		Aero-space Technology	Edu-cation	Space Flight		Aerospace Technology						
NASA MISSIONS	NASA GOALS	NASA THEMES																	
		Solar System Exploration	Mars Exploration Program	Astronomical Search for Origins	Structure and Evolution of the Universe	Sun-Earth Connection	Earth System Science	Earth Science Applications	Biological Sciences Research	Physical Sciences Research	Research Partnerships and Flight Support	Aeronautics Technology	Education Programs	International Space Station	Space Shuttle Program	Space and Flight Support	Space Launch Initiative	Mission and Science Measurement Technology	Innovative Technology Transfer Partnerships
Understand and protect our home planet	1	Understand Earth's system and apply Earth system science to improve the prediction of climate, weather, and natural hazards.	Gray	Gray	Gray	Gray	Gray	Gray	Gray	Gray	Gray	Gray	Gray	Gray	Gray	Gray	Gray	Gray	Gray
	2	Enable a safer, more secure, efficient, and environmentally friendly air transportation system.	Gray	Gray	Gray	Gray	Gray	Gray	Gray	Gray	Gray	Black	Gray	Gray	Gray	Gray	Gray	Gray	Gray
	3	Create a more secure world and improve the quality of life by investing in technologies and collaborating with other agencies, industry, and academia.	Gray	Gray	Gray	Gray	Gray	Gray	Gray	Gray	Gray	White	Gray	Gray	Gray	Gray	White	Gray	Gray
	4	Explore the fundamental principles of physics, chemistry, and biology through research in the unique natural laboratory of space.	Gray	Gray	Gray	Gray	Gray	Gray	Gray	Gray	Gray	Black	Gray	Gray	Gray	Gray	Gray	Gray	Gray
	5	Explore the solar system and the universe beyond, understand the origin and evolution of life, and search for evidence of life elsewhere.	Black	Gray	Gray	Gray	Gray	Gray	Gray	Gray	Gray	Gray	Gray	Gray	Gray	Gray	Gray	Gray	Gray
Inspire the next generation of explorers	6	Inspire and motivate students to pursue careers in science, technology, engineering, and mathematics.	Gray	Gray	Gray	Gray	Gray	Gray	Gray	Gray	Gray	Black	Gray	Gray	Gray	Gray	Gray	Gray	Gray
	7	Engage the public in shaping and sharing the experience of exploration and discovery.	Gray	Gray	Gray	Gray	Gray	Gray	Gray	Gray	Gray	White	Gray	Gray	Gray	Gray	White	Gray	Gray
	8	Ensure the provision of space access, and improve it by increasing safety, reliability, and affordability.	Gray	Gray	Gray	Gray	Gray	Gray	Gray	Gray	Gray	Gray	Gray	Gray	Gray	White	Black	Gray	Gray
	9	Extend the duration and boundaries of human space flight to create new opportunities for exploration and discovery.	Gray	Gray	Gray	Gray	Gray	Gray	Gray	Gray	Gray	Gray	Gray	Gray	Gray	Gray	Gray	Gray	Gray
	10	Enable revolutionary capabilities through new technology.	Gray	Gray	Gray	Gray	Gray	Gray	Gray	Gray	Gray	Gray	Gray	Gray	Gray	Gray	Gray	Gray	White

NASA primary contribution

NASA supporting contribution

Glenn primary contribution

Glenn supporting contribution

Gray goal shades relate to the Glenn Mission Areas and Projects on the following chart.

NASA Goal and Glenn Fiscal Year 2004 Project and Mission Area Alignment							
Goal Number	NASA Goal	NASA Enterprise	Theme	Objective Number	NASA Objective	Glenn Projects and Tasks	Glenn Mission Area
2	Enable a safer, more secure, efficient, and environmentally friendly air transportation system.	Aerospace Technology	AT	2.1	Decrease the fatal accident rate, reduce the vulnerability of the air transportation system to hostile threats, and mitigate the consequences of accidents and hostile acts.	<ul style="list-style-type: none"> Aviation safety and security technology Weather safety technology 	Aeropropulsion
				2.2	Protect local and global environmental quality by reducing aircraft noise and emissions.	<ul style="list-style-type: none"> Low Emissions Alternative Power Ultra-Efficient Engine Technology Quiet Aircraft Technology 	
				2.3	Enable more people and goods to travel faster and farther, with fewer delays.	<ul style="list-style-type: none"> Digital airspace infrastructure technologies and architecture 	
3	Create a more secure world and improve the quality of life by investing in technologies and collaborating with other agencies.	Biological and Physical Research	PSR	3.3	Resolve scientific issues in the low-gravity environment of space that enrich life on Earth by leading to better design tools in energy, materials, medical, and communication technologies.	(Fundamental microgravity research)	Microgravity
4	Explore the fundamental principles of physics, chemistry, and biology through research in the unique natural laboratory of space.	Biological and Physical Research	PSR	4.2	Expand understanding of fundamental physical processes and insight into the laws of nature through space-based investigation.	<ul style="list-style-type: none"> Fluids and Combustion Facility ISS research projects 	Microgravity
5	Explore the solar system and the universe beyond, understand the origin and evolution of life, and search for evidence of life elsewhere.	Space Science	SSE	5.1	Learn how the solar system originated and evolved to its current diverse state.	<ul style="list-style-type: none"> Project Prometheus 	Aerospace Power
						<ul style="list-style-type: none"> In-Space Propulsion 	Space Propulsion
8	Ensure the provision of space access and improve it by increasing safety, reliability, and affordability.	Aerospace Technology	SLI	8.2	Improve the safety, affordability, and reliability of future space transportation systems.	<ul style="list-style-type: none"> Propulsion Research and Technology Turbine-based combined-cycle propulsion Revolutionary Turbine Accelerator Rocket-based combined-cycle Integrated System Test Space transportation 	Aeropropulsion
						<ul style="list-style-type: none"> International Space Station 	Aerospace Power
				Space Flight	ISS		<ul style="list-style-type: none"> Energetics Engineering for Complex Systems Computing, networking, and information systems
10	Enable revolutionary capabilities through new technology.	Aerospace Technology	MSM	10.2	Create system concepts and demonstrate technologies that will enable new science measurements and scientific missions.	<ul style="list-style-type: none"> Space communications Spectrum Management 	Aerospace Communications



2.1 Aeropropulsion

NASA Themes and Goals: Aeronautics Technology, Goal 2; Space Launch Initiative, Goal 8; and Mission and Science Measurement Technology, Goal 10

Aeropropulsion Vision

Glenn continues to be the world leader in aeropropulsion research and technology. This leadership will foster a series of technological revolutions early in the 21st century to produce propulsion systems that are intelligent, whisper quiet, clean and lean with near-zero emissions, and structurally integral to the vehicle. These revolutionary propulsion systems will be based upon innovative cycle concepts and breakthroughs in new technologies such as high-temperature nanomaterials, nanodevices, and computational intelligence. They will enable 21st-century vehicle systems to blend into the environment, inspiring new pioneers for air and air-to-space travel.

Aeropropulsion Mission

Develop, verify, and transfer air-breathing propulsion technology for subsonic, supersonic, hypersonic, general aviation, and high-performance aircraft and rotorcraft. Relative to this mission, Glenn conducts fundamental research in propulsion-related

materials, structures, internal fluid mechanics, instrumentation, controls, and systems. Aeropropulsion encompasses turbine engines, all varieties of intermittent combustion engines, electric engines, hybrid engines, and all other types of engines applicable to future generations of air and space vehicle systems.

2.1.1 Ultra-Efficient Engine Technology

Aeronautics Technology, Goal 2

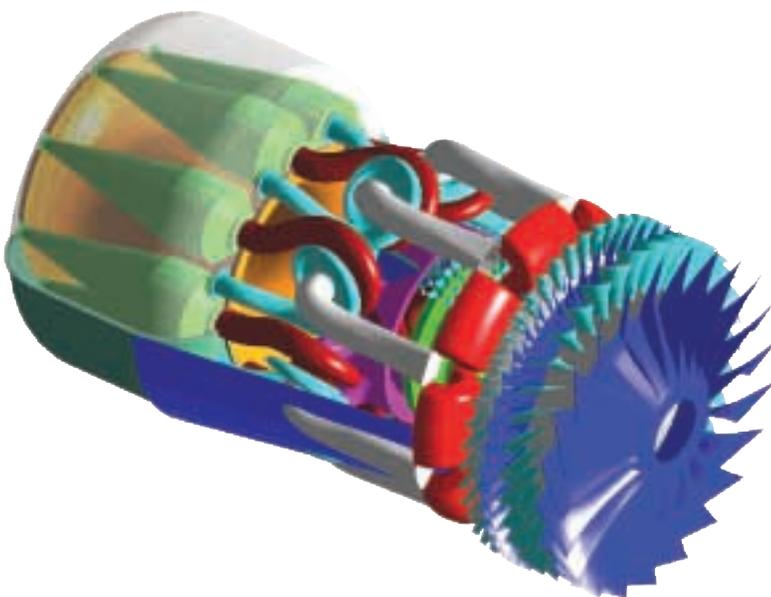
Glenn has responsibility for the Ultra-Efficient Engine Technology (UEET) Project, which is a key project within the Vehicle Systems Program. UEET will develop, validate, and transfer revolutionary propulsion technologies that will enable future generations of aerospace vehicles. These technologies will be applicable across the speed range from subsonic to hypersonic, with the emphasis on turbine-based systems.

The UEET Project will address local air quality concerns, long-term aviation growth, and aviation's impact on world climate by providing technology to dramatically increase fuel efficiency while reducing CO₂ and NO_x emissions. UEET will also develop technology to avoid impacting the ozone layer during aircraft cruise operations. This research will lead to future projects, including engine system test demonstrators accomplished in partnership with other Government agencies and industry. Technologies developed by the UEET Project will likely be transferred to other programs and projects, such as Advanced Space Transportation and Quiet Aircraft Technology.

2.1.2 Low Emissions Alternative Power

Aeronautics Technology, Goal 2

Low Emissions Alternative Power (LEAP) is a new advanced technology project under the Vehicle Systems Program of the Aeronautics Technology Theme. It is the cornerstone effort in the aeronautics business line of New Aircraft Energy Sources and Management. This project is founded on solid high-potential technology efforts explored in the Propulsion and Power (P&P) Program. It focuses on (1) discovering new energy sources and developing



Low Emissions Alternative Power



unconventional engines and power systems that are directed towards greatly reduced emissions, and (2) enabling new vehicle concepts for public mobility, new science missions, and national security. The LEAP Project produces demonstrations, through integrated ground tests, of a constant-volume combustor in an engine system and an uninhabited aerial vehicle (UAV) and small transport aircraft all-electric power system. LEAP consists of technology development and demonstration efforts that mature technology through a Technology Readiness Level of 6 (TRL 6) corresponding to "system/subsystem model or prototype demonstrated/validated in a relevant environment." Beyond the LEAP Project, the long-term vision for project planning includes a follow-on LEAP Flight Systems Demonstration Project and a follow-on advanced technology development project (Alternative Energy Systems), both of which are anticipated to start in fiscal year 2009 (FY09).

2.1.3 Quiet Aircraft Technology

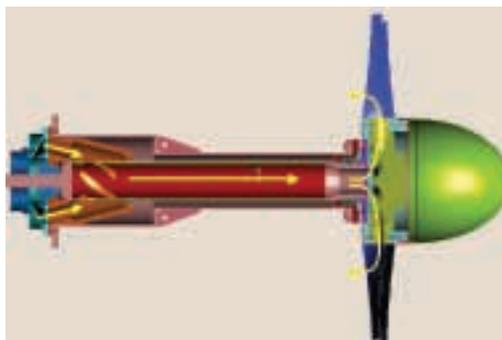
Aeronautics Technology, Goal 2

The Quiet Aircraft Technology (QAT) Program will develop technology to directly improve the quality of life for U.S. citizens by reducing the public's exposure to aircraft noise. Glenn is responsible for the QAT Engine System Noise Reduction Project, which will provide the analytical tools to predict engine noise and the technologies to reduce it.

The goals of the Engine System Noise Reduction Project are based on NASA's Aerospace Technology Enterprise goals. This would require reductions of 4 dB in engine fan and jet noise relative to current state-of-the-art engine noise reduction technologies. The primary goal of the Engine System Noise Reduction Project is therefore to develop the technologies to reduce both fan and jet noise by 4 dB, and to demonstrate these technologies through engine tests (TRL 6) by 2007.

For jet noise reduction, Glenn is investigating technologies such as chevrons in nozzles and pulsed injection concepts. For fan noise

reduction, Glenn will perform rig demonstration of trailing-edge ejection from the fan blade to eliminate rotor wakes and reduce fan noise. Glenn is also performing rig testing of advanced active control concepts for fan noise reduction.



Quiet Aircraft Technology

2.1.4 Aviation Safety and Security Technology

Aeronautics Technology, Goal 2

The objective of Glenn activities in Aviation Safety and Security is to develop and advance technologies that will reduce the aircraft fatal accident rate, mitigate the impact of accidents, and mitigate consequences to the aircraft from an intentional attack. NASA is researching technologies with a long-term development horizon to address all aspects of the aviation industry, including commercial, business, and general aviation. These products are intended for the next-generation system; however, issues such as retrofitting, certification, system implementation, and cost benefits will be considered during the technology development process. Glenn research includes hardened and security-enhanced aircraft networks and data links; remote monitoring of the aircraft environment and systems; propulsion safety research, including propulsion systems health management, adaptive propulsion control systems, and ultrasafe engine technologies that will enable us to predict, detect, prevent, and compensate for significant propulsion malfunctions or damage; and fire prevention, including fuels and sensor research and commercial aircraft fuel tank inerting.



2.1.5 Weather Safety Technology

Aeronautics Technology, Goal 2

The Weather Safety Technology Project is under the Aviation Safety and Security Program. The overall project objective is to improve safety operations and reduce the incidence of aircraft accidents relating to icing, turbulence, and other adverse weather-related conditions. These adverse conditions can be mitigated by the availability of timely, intuitive weather information in the cockpit, mitigation technologies and analysis tools, and innovative education and training aids. The technologies arising from this project will reduce the role of atmospheric conditions in aviation fatal accidents, incidents, and injuries. This project will develop aviation weather information and digital communications systems; turbulence detection systems; tools for design, certification, and qualification of aircraft systems; icing detection and protection systems; icing educational and training aids; and atmospheric hazard avoidance and mitigation methods.



Icing research

2.1.6 Propulsion Research and Technology

Space Launch Initiative, Goals 3 and 8

Propulsion Research and Technology (PR&T) develops rotating components and seals, flow path components, and engineering capabilities to enable the operational characteristics required for future space launch propulsion systems that utilize air breathing for part of their mission duty cycle. The propulsion systems using these technologies include turbine-based systems, rocket-based systems,

and scramjets. The project also performs basic academic research on the problems of air-breathing hypersonic propulsion for access to space. The project is implemented with participation from industry, academia, the Department of Defense (DOD), and several NASA centers. The academic research is implemented through two Hypersonics University Research and Engineering Technology Institutes (URETIs), for which PR&T is the host project. These URETIs cover topics from propulsion, design, and airframe structure and materials to aerosciences and education. An interagency agreement provides for DOD collaboration within the URETIs. Component technologies addressed by PR&T include seals, instrumentation, high-temperature bearings, inlets, cooled structural panels, rotating structures such as high-temperature compressor disks, and large static structures such as propulsion flow path panels. Engineering capabilities development includes ram combustion physics, integrated thermal balance, materials capabilities in ceramics and metallics, and environments prediction. The key challenges include the extreme environments generated by hypersonic flight, the wide operating ranges needed in components, access-to-space component performance and life requirements (greater than 100 missions, which is unprecedented for access-to-space propulsion), and orders-of-magnitude improvements in reliability and safety. PR&T will use many methods of technology maturation, including developing test articles to be integrated in the ground-based propulsion test beds (for example, the turbine-based combined-cycle Revolutionary Turbine Accelerator, and the rocket-based combined-cycle Integrated System Test of an Air-Breathing Rocket) and test flights.

2.1.7 Turbine-Based Combined-Cycle Revolutionary Turbine Accelerator

Space Launch Initiative, Goals 3 and 8

The turbine-based combined-cycle Revolutionary Turbine Accelerator (TBCC RTA) project will develop and demonstrate the necessary technologies for a turbine-based propulsion system for access to space. It is being implemented with participation from



industry, academia, DOD, and several NASA centers. The TBCC RTA project consists of three major elements: development and testing of a ground-based turbine accelerator demonstrator engine; concept definition of a subscale TBCC propulsion system (turbine accelerator with dual-mode scramjet for a reusable, combined-cycle flight demonstrator (RCCFD) flight test); and concept definition and analysis of visionary turbine-based propulsion systems.

The midscale (approximate diameter of 100 cm) effort will be aimed at identifying and mitigating the issues surrounding development of a large turbine accelerator and will incorporate advanced technologies as they mature. The subscale effort will be primarily aimed at addressing issues with integrating RTA propulsion systems into high-mach flight vehicles. The concept studies are aimed at identifying the performance specifications for both demonstrator and visionary vehicles and investments in enabling technologies specific to RTA and TBCC propulsion systems. The Next Generation Launch Technology (NGLT) Program is pursuing candidate vehicle and propulsion systems in support of NASA's endeavor to reduce the cost and improve the safety of space flight, and incorporate airline-like operations. The combined-cycle propulsion system allows for the maximum propulsive efficiency over a wide mach operating range. The RTA takes advantage of the high propulsive efficiency of a turbine propulsion system at lower mach numbers, combining it with the higher efficiency of a dual-mode scramjet (DMSJ) at mach 4 and above.

2.1.8 Rocket-Based Combined-Cycle Tests

Space Launch Initiative, Goals 3 and 8

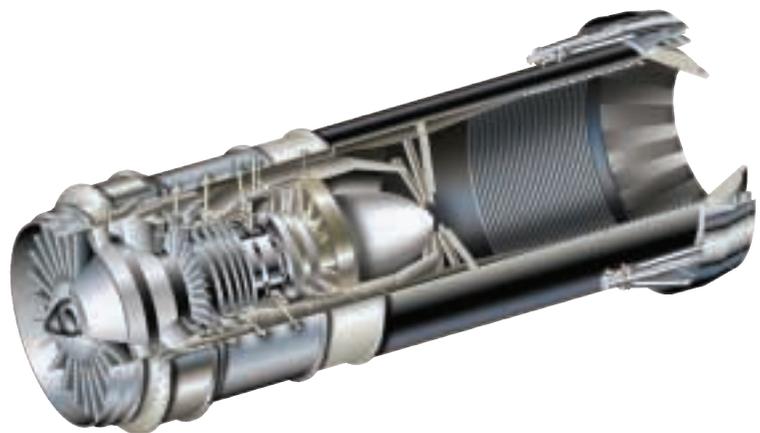
Glenn Research Center supports the rocket-based combined-cycle (RBCC) Integrated System Test of an Air-breathing Rocket (ISTAR) project by conducting most of the major testing within the project. Glenn performs three key testing activities. The first involves the Direct Connect Combustion Rig (DCCR). Glenn will design and build the DCCR test article and conduct testing at the

Hypersonics Test Facility (HTF) at Glenn's Plum Brook Station in Sandusky. This testing will provide development and characterization of the combustor for the ground testbed RBCC flow path. The second activity is to test a scale-model heat-sink flow path in free-jet mode at the HTF. This testing will verify and validate the RBCC performance. The third activity is to test a scale-model partially actively cooled engine at the HTF. This test will validate critical characteristics for flightlike components. The three sets of test activities will be conducted at multiple operating points representing the range of conditions over which the ISTAR is designed to operate (subsonic to mach 7).

2.1.9 Engineering for Complex Systems

Mission and Science Measurement, Goal 10

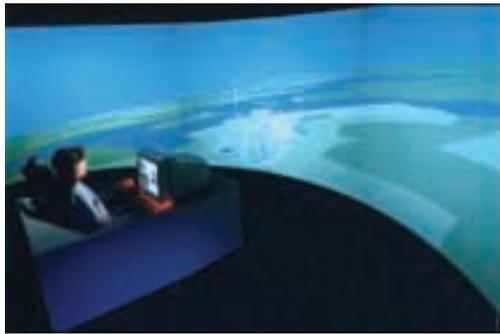
The Engineering for Complex Systems (ECS) vision is to achieve ultrahigh levels of safety and mission success by fundamentally advancing NASA's system life cycle approach through the infusion of advanced technologies. Within the resilient systems and operations (RSO) area, Glenn's work will develop and mature integrated engine systems for performance optimization throughout the engine's life. Specifically, this work includes adaptive propulsion control algorithms, diagnostics, and prognostics technologies that will enable autonomous operation of the propulsion systems based on commands generated from an autonomous flight control or vehicle



Revolutionary Turbine Accelerator



management system. Glenn's support of the system reasoning for risk management (SRRM) area builds on established Glenn probabilistic physics-based risk tools (PRTs) developed for structural analysis. These tools will be extended to systems engineering analyses that are required from the earliest conceptual design stages through the operational decisionmaking phases of projects. The application of PRTs enables higher performance conceptual designs with lower cost, and more informed operational decisions.



Piloted evaluation station used to evaluate turbofan engine control and diagnostics algorithms

2.1.10 Computing, Networking, and Information Systems

Mission and Science Measurement, Goal 10

Within the Computing, Information, and Communication Technologies Program, the Computing, Networking, and Information Systems (CNIS) Project pioneers the development and integrated access of computing platforms and information systems. Supporting this goal, the objective of Glenn CNIS work is to build a plug-n-play infrastructure that provides Grand Challenge applications with a suite of tools for coupling codes together, numerical zooming between fidelity of codes, and deployment of these simulations onto heterogeneous computing resources available within the information power grid. Within the Information Technology Strategic Research (ITSR) Project of CICT, Glenn focuses on integrated controls and diagnostics to develop and validate advanced control systems, health monitoring, and

instrumentation technologies that are critical to enhancing the safety, reliability, and operability of aircraft propulsion systems.

2.2 Aerospace Power

NASA Themes and Goals: Solar System Exploration, Goal 5; Aeronautics Technology, Goals 2 and 10; International Space Station, Goal 8; Space and Flight Support, Goal 8; and Space Launch Initiative, Goal 8

Aerospace Power Vision

NASA Glenn develops power system technology breakthroughs that expand NASA's horizon of discovery and revolutionize the aerospace industry.

Aerospace Power Mission

Develop aerospace power technologies that enable future NASA missions and transfer these technologies to industry. This mission is accomplished by a well-balanced combination of in-house research, design, testing, and evaluation, as well as through key partnerships and cooperation with other NASA centers, other Government agencies, universities, and industry. In addition, Glenn provides expert technologist expertise to NASA activities in aerospace power.

2.2.1 Energetics

Solar System Exploration, Goal 5

Glenn's Energetics Project develops advanced power and propulsion technologies to enable lower cost missions with increased capabilities and extend mission reach beyond current horizons. Under the Advanced Energy Systems portion of the project, technology developments include solar power generation, energy storage and conversion, and power management and distribution. In addition, under the Advanced Propulsion portion of the Energetics Project, Glenn is developing advanced electrical and chemical spacecraft propulsion technologies.

2.2.2 Project Prometheus (formerly the Nuclear Systems Initiative)

Solar System Exploration, Goal 5



Glenn supports Project Prometheus' three primary elements (radioisotope power systems development, nuclear propulsion research, and the Jupiter Icy Moon Orbiter (JIMO) mission). Under the Space Propulsion mission area, Glenn provides technical support for overall project management, systems, and mission analysis to guide technology and research investments, and leading-edge research in electric propulsion technologies to enable the utilization of nuclear power for expanded and comprehensive scientific exploration of the solar system.

2.2.3 International Space Station

International Space Station, Goal 8

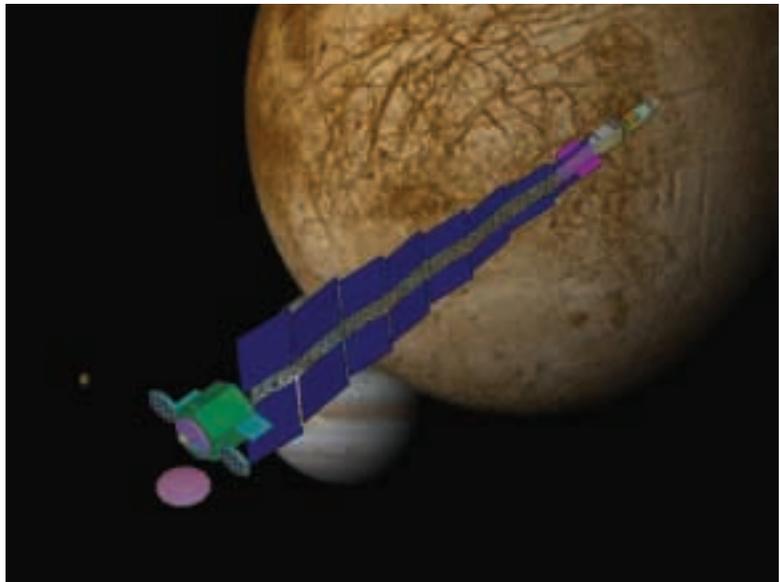
The Glenn International Space Station (ISS) program area comprises tasks performed in support of station design, construction, and operation. The ISS program area utilizes Glenn core skills and competencies in power, propulsion, and related technologies. The Glenn ISS tasks range from hardware and software development and on-call support of assembly missions to critical analysis (before and after space shuttle-ISS assembly flights) of the ISS electrical power system.

2.2.4 Space Transportation

Space Launch Initiative, Goals 3 and 8

Vehicle Subsystems

Glenn manages the Vehicle Subsystems Project for the Agency's Next Generation Launch Technology (NGLT) Program. The project includes technology development of advanced power systems, electric actuators, health management technology, and avionics. The power element addresses a variety of components, including the Glenn-led proton exchange membrane (PEM) fuel cells for launch vehicle application and contracted activities for advanced batteries, ultracapacitors, and turbine power units. The overall project goal is to enable highly safe and reliable, lower cost, operationally responsive launch vehicles through technology such as "all-electric" actuation, eliminating the cost, maintenance, and tendency to failure of hydraulic actuation systems.



Prometheus spacecraft concept

Orbital Space Plane

Glenn provides technical expertise supporting the spacecraft element of the Agency's Orbital Space Plane (OSP) Program. This includes expertise in thermal protection, seals, propulsion, communication, tracking, mechanisms; electrical power systems, and integrated health management. Glenn also supports the OSP Program Office through the acquisition process, evaluating proposals in our areas of expertise and providing insight to the Program Integration Office. The overall goal of the Glenn effort is to provide support and expertise to ensure a successful OSP.

2.2.5 Low Emissions Alternative Power

Aeronautics Technology, Goal 2

See the Aeropropulsion mission area for information on power systems development in support of the Low Emission Alternative Power Project.

2.3 Microgravity

NASA Themes and Goals: Physical Sciences Research, Goals 3, 4, and 9

Microgravity Vision

Glenn microgravity research is recognized



worldwide for inspiring and enabling a growing array of high-value scientific and technological advancements through Glenn's unique capabilities in reduced-gravity and interdisciplinary research. Glenn microgravity-enabled research will be critical to the achievements of a broad-based spectrum of international scientists, technologists, and educators from academia, industry, and government; Glenn-supported microgravity research will be pivotal to the development of advanced technology to enable future space missions; and research supported or conducted by Glenn will be sought by industry to provide new products and services that benefit the American public and others worldwide.

Microgravity Mission

Promote and enable the use of the microgravity environment for the advancement of scientific and technological knowledge, and expand the application of that knowledge to the widest possible benefits, both in future space missions and increased national wealth, health, safety, and security. Engage the national research community by fostering synergistic and creative microgravity research proposals by academic, governmental, and industrial researchers and technologists. Develop ground-based and flight facilities and diagnostic capabilities to support peer-reviewed and selected investigations.

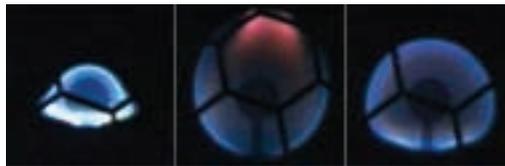


Image of ethylene flames burning in 1 atm pressure in microgravity subject to different dc voltages between the two electrodes (voltage of the outer electrode with respect to the inner electrode).

2.3.1 Fluids and Combustion Facility

Physical Sciences Research, Goal 4

The Fluids and Combustion Facility (FCF) is a key project enabling NASA's Biological and Physical Research Enterprise to conduct scientific investigations on the International Space Station (ISS). It will be deployed on the ISS in 2005 and will mark a new era in the

quality and quantity of research capabilities in combustion science, fluid physics, and other disciplines. The FCF is a system of on-orbit and ground hardware and software, including two powered racks for combustion and fluid physics research. It will provide advanced telescience capabilities to allow researchers to operate their experiments interactively, as though working in their own laboratory. Each investigation can be customized with a small amount of equipment that can be easily installed by the ISS crew. The FCF is adaptable and modular so that it can be upgraded as needed. The facility will accommodate 10 to 30 combustion and fluid physics experiments each year of its 10-year lifetime.

2.4 Space Propulsion

NASA Themes and Goals: Solar System Exploration, Goal 5; Aeronautics Technology, Goal 10

Space Propulsion Vision

NASA Glenn develops space propulsion system technology breakthroughs that expand NASA's horizon of discovery and revolutionize the aerospace industry.

Space Propulsion Mission

Develop propulsion technologies to enable future NASA missions and transfer these technologies to industry. The mission is accomplished by a well-balanced combination of in-house research, design, testing, and evaluation, as well as through key partnerships. In addition, Glenn provides expert technologist expertise to NASA to complete activities in space propulsion.

2.4.1 In-Space Propulsion

Solar System Exploration, Goal 5

The In-Space Propulsion Program researches and develops transportation technologies for orbital transfer missions and solar system exploration. It is managed by the Office of Space Science and implemented by the Marshall Space Flight Center. Glenn performs research on technology to improve travel in and beyond low Earth orbit, including electric propulsion systems, cryogenic fluid



management systems, lightweight components, and system and mission analysis. Technologies being developed by Glenn will enable future NASA missions, decrease trip times, and reduce the weight of the propulsion systems required for travel throughout our solar system. The NASA Evolutionary Xenon Thruster (NEXT) being developed at Glenn is a major component of the Space Propulsion mission area support to the In-Space Propulsion Program. This new electric thruster will significantly improve on the state-of-the-art ion thruster previously flown on the Deep Space 1 mission.

2.4.2 Energetics

Aeronautics Technology, Goal 10

See the Aerospace Power mission area for information on advanced propulsion technology development in support of the Energetics Project.

2.4.3 Project Prometheus (formerly the Nuclear Systems Initiative)

Solar System Exploration, Goal 5

See the Aerospace Power mission area for information on the advanced propulsion technology developments in support of the Project Prometheus Program.

2.5 Aerospace Communications

NASA Themes and Goals: Mission and Science Measurement, Goal 10; and Aeronautics Technology, Goal 2

Aerospace Communications Vision

Glenn's vision for aerospace communications in the 21st century is to enable the interconnection of aircraft and spacecraft with the seamless ease that is observed today on the terrestrial Internet. This vision will enable NASA mission managers and researchers to interact with multiple spacecraft to collect knowledge on complex physical phenomena that affect our planet. It will transform the Nation's current 1960's voice-dominated, legacy-based air transportation system into a 21st-century global system that will integrate



NEXT project 40-cm ion thruster

communications, navigation, and surveillance systems to provide a revolutionary ground-air-space network for full interconnectivity between all users.

Aerospace Communications Mission

Develop, verify, and transfer systems and technologies to transform the National Airspace System and enable future space visions. Glenn provides communication and network architectures, systems modeling, and enabling technologies for global communications network connectivity, and integrated communications, navigation, surveillance, and weather information. Glenn develops and infuses technologies for the next generation of NASA space missions to enable broad, continuous presence and coverage through increased data capability and



enhanced connectivity between ground, air, and space-based assets.

2.5.1 Space Communications

Mission and Science Measurement, Goal 10

Glenn manages the Level 2 Space Communications Project in the Computer Information Communication Technology (CICT) Program for the Aerospace Technology Enterprise. The Space Communications Project meets the CICT and Mission Science and Measurement Theme objectives by providing new communication and information technology breakthroughs that will enable broad coverage, increased presence, and high-rate data delivery, thereby establishing a virtual presence throughout the solar system.

The goals of Glenn space communications research are to develop innovative technology products for space data delivery that enable high data rates and broad coverage; Internet-like data access that will vastly expand the reach of Earth and space science in observable phenomena, physical space and time, and information richness; and distributed communication architectures, networks, and communications technologies to provide broad coverage and intelligent-based real-time data delivery from air, Earth, and space, to obtain and distribute information directly to the user.

2.5.2 Spectrum Management

Mission and Science Measurement, Goal 10

Glenn oversees NASA's Spectrum Management Program. The primary role of the program, in addition to supporting housekeeping functions, is to secure the radiofrequency and orbital resources that are required for execution of all flight missions. NASA's Office of Space Flight, through its agent, the Glenn Research Center, is responsible for coordinating Agency spectrum requirements and maintaining an interference-free operating environment through official dealings with other Federal agencies, industry, and regulatory bodies (domestic and foreign), obtaining all requisite

authority to operate pertinent telecommunications systems and spectrum-dependent devices associated with programmatic activities.

NASA's spectrum management mandate lies in two complementary arenas to ensure the continued availability of sufficient spectrum and orbital resources to facilitate Agency flight and administrative programs. The two arenas are involvement in International Telecommunications Union treaty-based activities such as the World Radio Conferences, which deal with spectrum allocations, radio regulations, and technical operating standards; and the official proceedings of the Interdepartmental Radio Advisory Committee, which is charged with setting National Federal Spectrum Policy.

2.5.3 Digital Airspace Infrastructure Technologies and Architecture

Aeronautics Technology, Goal 2

Under the Airspace Systems Program within the Office of Aerospace Technology, Glenn manages the Digital Airspace Infrastructure Technologies and Architecture (DAITA) Project. The goal of the DAITA Project is to initiate the transition of today's communications, navigation, and surveillance (CNS) systems into a high-performance network-enabled digital infrastructure to support the transformation of the National Airspace System.

The DAITA Project objectives are to create a blueprint for a high-performance integrated CNS system; define the global network architecture for the digital airspace; develop an approach for aviation spectrum utilization and global support spectrum allocations; enable efficient oceanic and remote operations through improved communications and surveillance capability; increase air-ground data link performance and capacity for terminal and en route operations; and improve airport surface operations via an integrated wireless CNS network. The project tasks include definition of requirements, candidate architectures assessment, system and subsystem technology development and evaluation, and high-fidelity CNS evaluation.





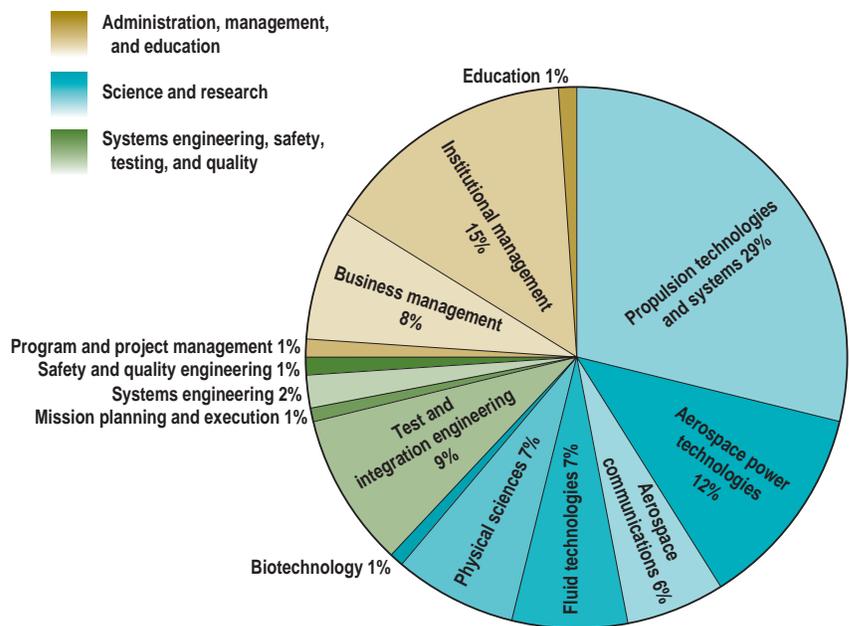
3

**Glenn Core
Competencies**



3 Glenn Core Competencies

The Glenn Research Center implements Agency goals and strategies by building and maintaining critical skills, capabilities, and business functions to support technology development, resulting in four technology core competencies. Glenn also builds and maintains critical skills, capabilities, and business functions to support scientific research, resulting in three science core competencies. Finally, the Center's continuing significant role in improving scientific and mathematical education in our Nation draws upon an ancillary competency in education. Glenn supports the ongoing development of NASA's Competency Management System (CMS). The Center has mapped its workforce to the competency groupings in the CMS at the organizational level as well as the workforce level. This information serves as a tool for workforce planning and development. The chart below shows the percentages of Glenn employees working in each competency.



Listed below are the Center's core competencies and their corresponding strategic thrusts:

3.1 Technology Competencies

Aeropropulsion Systems

Applied research to

- Improve turbomachinery components and propulsion systems
- Develop improved aero-thermo-structural and mission analysis modeling and simulation tools
- Develop improved materials and structural concepts
- Reduce propulsion system noise and emissions
- Increase propulsion system efficiency
- Advance harsh environment instrumentation and sensors
- Develop propulsion control and health management system
- Apply high-temperature materials expertise to airframe applications

Aerospace Power and Electric Propulsion

Applied research to

- Enhance ability to propel spacecraft on science and exploration missions
- Provide transit and surface power to NASA missions
- Create technology in power and electric propulsion to enhance and enable NASA missions
- Provide system analysis, modeling and simulation, and mission analysis to guide technology in end-to-end power and electric propulsion developments

Aerospace Communications

Applied research to

- Provide end-to-end system analyses, modeling, simulation, and demonstrations
- Advance frequency spectrum utilization and signal propagation analyses
- Promote multigigabit processing communication payloads, Internet protocols, (IP)-compliant aircraft and spacecraft, data distribution networks, and satellite constellation networks
- Promote space Internet protocols and technologies for space-terrestrial interoperability

- Advance communications, navigation, and surveillance (CNS); aviation security technologies; and sensors, local area networks (LAN), wide-area networks (WAN), and data distribution
- Advance communication device and component specialties, including high-power electronic and monolithic microwave integrated circuit (MMIC) devices, phased-array antennas, and processing electronics

Fluids and Combustion

Basic and applied research to

- Understand and improve combustion processes
- Improve fire safety and fire prevention, detection, and suppression
- Develop computational fluid dynamics tools for turbulent reacting flows
- Determine fluid and thermal physics of ice growth processes
- Determine effects of ice accretion on vehicle performance
- Develop icing tolerant designs and ice avoidance systems
- Develop fluid management and cryogenic fluids technologies

3.2 Science Competencies

Fluid Physics

Basic and applied research to

- Enhance basic understanding of fluid phase processes, from molecular to large-scale phenomena with emphasis on gravitational effects on these processes
- Improve control and utilization of fluids in space-based systems (e.g., propellant management, life support, and thermal control systems)
- Exploit the knowledge-transfer potential for Earth-based environmental and industrial processes

Combustion Science

Basic and applied research to

- Enhance basic understanding of combustion and other chemically reacting processes involving a wide combination of fuel, oxidizer, and ignition conditions with emphasis on gravitational effects on these processes



- Improve fire safety practices and technologies for space-based systems (e.g., spacecraft fire safety flammability standards, detection systems, and suppression systems)
- Exploit the knowledge-transfer potential for Earth-based processes to improve fuel efficiency, reduce pollution, and control fires and explosions

Bioscience and Engineering

Basic and applied research to

- Stimulate increased productive, cross-disciplinary, collaborative research involving the physical science, engineering, and biological science communities
- Adapt and apply research, knowledge, and technology of fluids, sensors, instrumentation, and imaging to provide improvements in biotechnology and biomedical research

3.3 Education Competencies

Glenn educational programs will utilize NASA's unique mission, resources, and people to inspire and motivate students to pursue careers in science, technology, engineering, and mathematics (STEM) in the following manner:

- Increase the number of elementary and secondary students and teachers who are involved in NASA-related education opportunities
- Support higher education research capabilities and opportunities that attract and prepare increasing numbers of students and faculty for NASA-related careers
- Increase the number and diversity of students, teachers, faculty, and researchers from underrepresented and underserved communities in NASA-related STEM fields
- Increase student, teacher, and public access to NASA education resources through the establishment of e-Education as a principal learning support system
- Improve public understanding and appreciation of science and technology, including NASA aerospace technology, research, and exploration missions

3.4 Glenn Core Facilities

- 10- by 10-Foot Supersonic Wind Tunnel

- Engine Components Research Laboratory
- 8- by 6-Foot Supersonic Wind Tunnel
- Engine Research Building
- 9- by 15-Foot Low-Speed Wind Tunnel
- Electric Propulsion Laboratory
- Icing Research Tunnel
- Electric Propulsion Research Building
- Aeroacoustic Propulsion Laboratory
- Space Power Facility (Plum Brook)
- Propulsion Systems Laboratory
- Spacecraft Propulsion Research Facility (Plum Brook)
- Research Combustion Laboratory
- Hypersonic Tunnel Facility (Plum Brook)
- Cryogenic Propellant Tank Facility (Plum Brook)

Real property at the Glenn Research Center is grouped into the following classifications: Institutional Mechanical; Institutional Electrical; Institutional Civil/Structural; and Central Process Systems (CPS).

From 1997 to 2001, both institutional and CPS condition assessments were performed on 128 Glenn buildings and structures and over 2000 CPS equipment items. These assessments have been used to establish the Glenn Maintenance and Construction of Facilities (CoF) Program.

Glenn's Institutional Mechanical and Electrical systems, which include domestic water; steam and natural gas distribution; storm and sanitary sewer systems; heating, ventilating, and air-conditioning systems; and low- (<600 volts) and high-voltage power distribution, are in "good" to "very good" condition. Many of these systems have been recently upgraded by discrete and phased minor CoF projects. Ongoing CoF projects and small component replacement projects under the Maintenance Program are planned in an attempt to attain a "very good" condition rating for these Institutional systems.

Glenn's Institutional Civil/Structural systems, which include buildings, pavements, culverts, and bridges, are in "good" condition, with the exception of roofing systems and pavements, which range from "poor" to "fair." Several CoF projects are planned through FY07 to upgrade these systems to "good" or "very good" condition.



Glenn CPS such as combustion air, altitude exhaust, and variable frequency systems, are in “good” condition. Several CoF projects in the 1990s addressed major repairs to the large rotating equipment, electric motor rewinds, replacement of interstage coolers, and miscellaneous valve and piping replacement. In addition, Glenn plans future CoF and maintenance projects to continue CPS renovation.

Glenn current real property plans include continuing the reliability-centered maintenance philosophy with priority on mission-critical and mission-support facilities and systems. This includes continued use and expansion of the computerized maintenance management system, predictive testing and inspection processes, and time-based maintenance processes. Real property management is further supported through the use of an integrated facility planning team process. This process involves primary stakeholders in the identification of annual recurring needs, small and short-term project needs, and long-term capital project needs in a matrix with appropriate funding mechanisms.

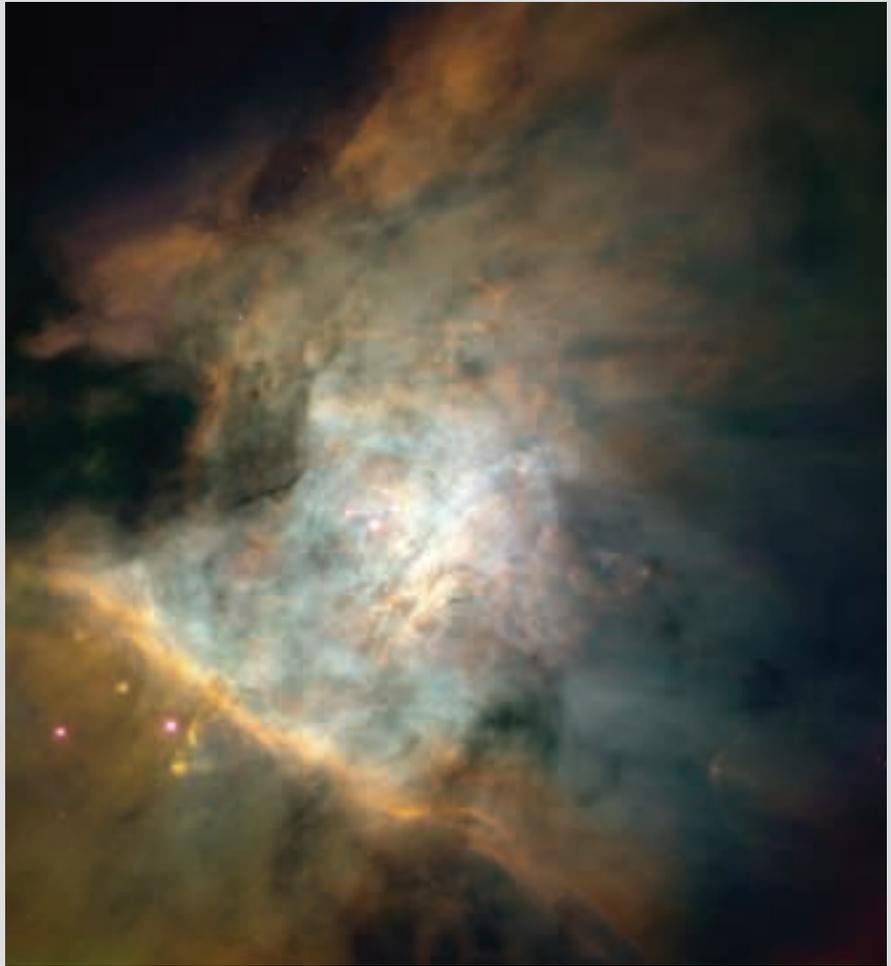
Long-term real property management will be addressed in a Center Master Plan (CMP). Glenn’s last CMP was generated in 1986, and there are current efforts to develop a new plan in the next few years. The CMP will address facility and land use in accordance with projected trends towards lower civil service personnel levels, lower maintenance budgets, anticipated future research growth areas, and increased security requirements. The CMP will include plans for the demolition of under-utilized facilities, the construction of new, lower maintenance program-critical facilities, and potential government and private enhanced-use leasing opportunities.





4

**Glenn Strategic
Capabilities and
Plans for the
Future**



4 Glenn Strategic Capabilities and Plans for the Future

4.1 Glenn Support of the Aerospace Technology Enterprise

Aeronautics Technology Theme

Glenn will continue to transfer high-risk research and technology to industry-compatible propulsion configurations. Revolutionary propulsion ideas and technology research at the Center will support a long-term vision with the national research community. In 10 years, NASA Glenn will

- Continue to infuse advanced technology into gas turbine engines. Technology will include pulsed-detonation engines, alternative fuels, quiet tiltrotor aircraft
- Develop ultraquiet, zero-emission, intelligent propulsion systems
- Support an engine architecture revolution through distributed and vectored turbine-based propulsion concepts
- Develop intelligent component-level and system-level technologies for supersonic propulsion systems
- Research and develop technologies for an all-electric primary and secondary propulsion system (Technologies will include solid oxide fuel cells.)
- Support transformation from component-level to system-level safety improvements

Space Launch Initiative Theme

Glenn will continue to conduct research in vehicle systems and propulsion technology applications for access to space. The portfolio of activities will include both high-visibility efforts such as testbeds and broad fundamental technology development. Glenn will

- Develop and test a ground-based turbine accelerator demonstrator engine
- Define the concept for a subscale turbine-based combined-cycle propulsion system flight test engine (turbine accelerator with



dual-mode scramjet for a reusable, combined-cycle flight demonstrator (RCCFD) flight test

- Continue concept definition and analysis of visionary turbine-based propulsion systems
- Provide cross-cutting vehicle subsystems and airframe technology products, including actuators, PEM fuel cells, batteries, health management sensors, and airframe high-temperature structures and materials
- Conduct research on cryofluid management to enable nontoxic auxiliary propulsion
- Continue characterizing rocket propellant 1 (RP-1) fuel properties and performing heated tube tests on relevant materials using RP fuel
- Develop machining and coating techniques for new materials (GRCop-84) to fully utilize the benefits of the material in full-scale engine components
- Develop rotating components and seals for future space launch propulsion systems
- Develop flow path components for future space launch propulsion systems
- Continue supporting academic research for propulsion technology through University Research and Engineering Technology Institutes (URETIs)
- Provide technical expertise supporting the spacecraft element of the Orbital Space Plane (OSP) Program

Mission and Science Measurement Theme

Glenn will be responsible for the development of computational systems, and intelligent control and sensor technologies applicable to advanced propulsion systems. Future technological areas will include

- Self-healing, self-diagnostic, full-fidelity simulation of propulsion systems
- Miniaturization of infrastructure for the simulation of propulsion systems on the chip level
- Low-cost, reduced-footprint 64-bit personal computer cluster computing
- Intelligent data coupling and zooming techniques that include cognizance of related data, information, location, and knowledge of how to generate information

4.2 Glenn Support of Other NASA Enterprises

In support of the Space Science, Space Flight, Biological and Physical Research, Space Science, and Earth Science Enterprises, Glenn will continue the development of transformational technologies. These include breakthroughs in space propulsion techniques that will enable spacecraft to travel faster and farther, carry larger scientific payloads, and make new types of measurements. New power systems will transform the way we conduct research in space, and revolutionary communications technologies will dramatically increase our ability to transmit information across the solar system. Glenn will help to enable the use of the microgravity environment to advance scientific and technological knowledge, and expand the application of that knowledge to the widest possible benefits, both in future space missions and increased national wealth, health, safety, and security.

Aerospace Power Mission Area

Glenn shall develop advanced power and onboard propulsion technology to enable future space exploration initiatives. Glenn will

- Develop power system technologies to support the use of a radioisotope power system on the Mars Lander mission
- Develop advanced electric propulsion and power conversion systems in support of the Jupiter Icy Moons Orbiter (JIMO) mission
- Continue to support the launch and operations of the power system for the International Space Station
- Continue to develop advanced propulsion technologies for the exploration of the solar system

Space Shuttle Program

Glenn has been involved in space shuttle Return to Flight activities, which includes support of the Columbia Accident Investigation Board and the NASA Accident Investigation Team. These activities have addressed wing leading edge (WLE) aging effects testing, WLE reinforced carbon-carbon panel slag deposit chemical analysis, thermal protection system (TPS) impact testing, Protuberance air-loads (PAL) ramp wind tunnel tests, TPS verification



analysis, and testing data review. Glenn will continue to provide technical expertise to the Space Flight Enterprise as the Agency completes Return to Flight activities and implements service life extension activities.

Microgravity Research Mission Area

Glenn shall provide high-value scientific and technological advancements through use of reduced gravity capabilities and interdisciplinary research to advance knowledge for the benefit of future space missions and the lives of people here on Earth.

- Glenn will be operating the Combustion Integrated Rack (CIR) and the Fluids Integrated Rack (FIR) onboard the International Space Station as a science platform for basic and applied fluid physics, combustion science, and other research that enables NASA's Biological and Physical Research Enterprise.

Aerospace Communications Mission Area

Glenn shall develop seamless aerospace communications to revolutionize the National Aerospace System (NAS) and enable future space vision. Glenn will

- Provide integrated CNS architectures and technologies to revolutionize NAS capabilities to meet the demands of all users in the year 2020
- Use world leadership role in these areas to expand human knowledge, support education and the development of the next generation of scientists, and foster technology infusion for commercial applications
- Provide for a steady stream of unique research returns from the International Space Station and realize the successful application of those research results through enabling new spacecraft technologies and systems, and improvements in terrestrial products and processes

4.3 Glenn Support of NASA's Human Capital Strategies

To align Glenn's Human Capital with its organizational objectives, Glenn Research

Center has developed a workforce consisting of a diverse mix of permanent and nonpermanent civil servants, including temporary and term-appointment employees. Glenn will continue to place special emphasis on cooperative education and intern programs and structure its recruitment efforts to fill at least 30 percent of its full-time permanent positions with fresh-outs. The Intergovernmental Personnel Act (IPA) will be used to meet critical short-term needs. Glenn will also use other alternatives, such as contractors, grantees, onsite employees of other agencies, detailees from other Federal agencies, shared services, and partnerships. This will ensure that the appropriate workforce mix will be available when needed to make optimum use of Center resources and eliminate duplication of effort.

Human resources tools such as the Competency Management System will be used to establish baseline staffing requirements, both in terms of numbers and skills. These requirements will drive workforce transition plans, identify immediate core competency requirements and skills imbalances, and allow flexibility in acquiring competencies needed for future project success. Glenn will make decisions and take actions consistent with procedures outlined in the Agency Policy for Program/Project Workforce Transition when addressing full-time equivalents (FTEs) affected by termination, rescoping, and descoping of programs and projects. Glenn will also follow processes outlined in the Agency Strategic Workforce Management Policy. This includes targeted buyouts, early retirement, hiring restrictions, retraining, career transition assistance, contracts structured with incentives to hire civil servants, and, as a last resort, reduction in force.

The Center will build needed leadership capabilities consistent with the new Senior Executive Service (SES) evaluation factors, which focus performance and personnel decisions on issues that are central to ensuring a healthy and effective organization. Specifically, Glenn will use the Senior Executive Service Career Development Program (SESCDP) to include developmental opportunities based on themes of the seven factors.



Developmental work assignments and training will focus on the ability to create a more efficient organization and use of human capital and improved financial data collection and reporting in support of the President's Management Agenda. Assignments will also include the importance of mission and workforce safety as it relates to improvements in management systems and procedures.

Meeting NASA diversity objectives will be emphasized. Candidates will be strongly encouraged to support staff development and the implementation of a fair and equitable performance-based evaluation system. The One-NASA perspective will also be integrated into development assignments emphasizing the importance of enabling other NASA organizations to achieve their mission and goals. In addition, the importance of meeting budget and schedule requirements as related to specific program objectives to meet or advance the objectives of the NASA Strategic Plan and the Government Performance and Results Act (GPRA) Performance Plan will be included in the program.

Glenn has a strong commitment to a culture of learning, training, and development programs that contribute to the performance and effectiveness of its workforce. It will continue to ensure that training plans, priorities, and decisions are aligned to meet both the immediate mission needs of the workforce and the strategic competency needs of the Center. Plans and programs will be based on organizational, individual, and occupational requirements assessed through information from the competency management system, management officials, technical experts, and other sources.

To further its commitment to learning, Glenn will invest in tools and opportunities to foster a climate of learning and improvement. Glenn will renew policies and improve practices related to the use of Individual Development Plans for all employees, and particularly managers and supervisors. Knowledge sharing and knowledge transfer will be facilitated through the conduct of

focused events and the formation of networks in areas of project management, focused change efforts, leadership, and at-risk competencies. A formal mentoring program will also be piloted and implemented for Glenn employees, with a focus on all new hires. Organizational learning will be supported through facilitated retreats, meetings, and other organizational development interventions.

4.4 Glenn Support of NASA's Real Property Strategies

Glenn is committed to support NASA Headquarter's real property initiatives as described in the Agency Facilities Engineering Division Functional Leadership Plan. By developing an effective Center Master Plan (CMP) with a 20-year vision, Glenn will strategically plan and manage our real property to meet the Goals/Objectives portion of this plan. The CMP will address infrastructure reduction, alignment of facilities with programmatic needs, pursuit of creative government and private leasing options, and maintenance and upkeep of remaining real property.

The Glenn Master Planning process will engage key stakeholders of all Enterprise programs at the Center in a dialogue to identify current and future needs. In addition, the CMP will incorporate Graphic Information System (GIS) technology to manage facility data including current building floor plan information, building occupancy information, service pool data, real property information, and environmental, safety, and security data. Using this technology, Glenn property utilization will be continually assessed and decisions will be made regarding the need for rehabilitation, demolition, or enhanced-use leasing opportunities.

Glenn's near-term plan is to utilize the Headquarters demolition program from FY04 to FY07 to reduce existing underutilized infrastructure. The current plan involves the demolition of three structures in FY04 (\$2.1 million demolition cost), four structures in FY05 (\$2.75 million demolition cost), and



two structures in FY06 (\$5 million demolition cost). It is anticipated that as the CMP process matures, additional underutilized or outdated structures will be demolished to reduce Center maintenance costs.

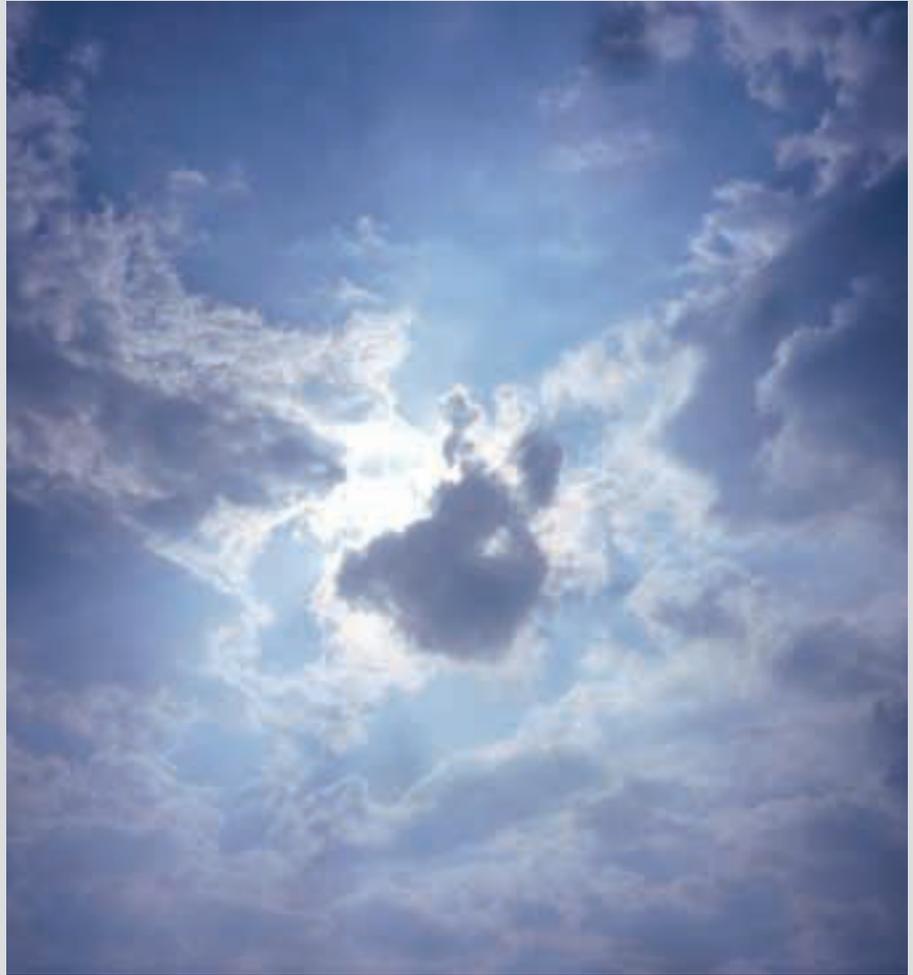
Glenn also intends to use the Staubach report as a tool to aid in the development of the CMP. Of particular interest are suggested opportunities for leasing Glenn buildings 500 and 501 and the shared use of building 14. In addition, revenue-generating opportunities such as the government and private sector shared use of the Plum Brook Rye Beach Pumping Station need to be factored into the Center's long-range plans.





5

**Glenn Key Process
Alignment to NASA
Implementing
Strategies**



5 Glenn Key Process Alignment to NASA Implementing Strategies

Several factors determine what NASA does, for whom, and why. The National Aeronautics and Space Act of 1958 and its Amendments define the Agency's charter and mission. To accomplish this mission, the Administration and Congress provide specific guidance through statutes, policies, and directives. NASA establishes goals, objectives, and implementing strategies to accommodate these policies and directives and meet the needs of external customers.

Goals, Objectives, and Implementing Strategies need not be in a quantitative or measurable form, but they must be expressed in a manner that allows an assessment of whether they are being achieved.

NASA Implementing Strategies and Objectives

IS-1: Achieve management and institutional excellence comparable to NASA's technical excellence

IS-2: Demonstrate NASA leadership in the use of information technologies

IS-3: Enhance NASA's core engineering, management, and scientific capabilities and processes to ensure safety and mission success, increase performance, and reduce cost

IS-4: Ensure that all NASA work environments, on Earth and in space, are safe, healthy, and environmentally sound and secure

IS-5: Manage risk and cost to ensure success and provide the greatest value for the American public

The alignment of NASA Implementing Strategies and Objectives and Glenn's Key Processes is shown on the chart on page 40. Glenn milestones supporting NASA Implementing Strategies and Objectives can be found in the Metrics and Milestones insert in this plan.





<p>NASA Implementing Strategies and Objectives</p>	<p>Glenn Key Processes</p>
<p>Implementing Strategy 1 (IS-1): Achieve management and institutional excellence comparable to NASA's technical excellence</p>	<p>Strategic Management Enabling Services (Equal Employment Opportunity)</p>
<p>1.1 Attract and maintain a workforce that is representative of the Nation's diversity and includes the competencies that NASA needs to deliver the sustained levels of high performance that the Agency's challenging Mission requires</p>	<p>Enabling Services (Acquisition)</p>
<p>1.2 Define and adopt procedures to improve the competitive acquisition of programs, services, and assets to benefit the NASA Mission and the American taxpayer</p>	<p>Enabling Services (Financial Management)</p>
<p>1.3 Improve and streamline the NASA financial management system to enhance accuracy, timeliness, and accountability</p>	<p>Strategic Management (Resource Analysis and Management)</p>
<p>1.4 Unify the processes for strategic and budget planning, budget reporting, and performance planning and reporting</p>	<p>Enabling Services (Information Technology)</p>
<p>1.5 Provide an integrated and user-friendly NASA-wide internet portal that will provide improved public access to NASA Mission results and other products, improved visibility into NASA plans and programs, and enhanced communication among NASA employees and contractors</p>	<p>Enabling Services (Logistics and Technical Information)</p>
<p>1.6 Improve the institutional management of capital assets to ensure that NASA's real property, personal property, processes, and systems are sustained and optimized to support NASA's missions and the capabilities required for today and tomorrow.</p>	<p>Enabling Services Enabling Services (Information Technology) Enabling Services (Information Technology) Enabling Services (Information Technology)</p>
<p>IS-2: Demonstrate NASA leadership in the use of information technologies</p>	<p>Science, Research, and Technology Knowledge and Technology Transfer</p>
<p>2.1 Provide all NASA operations with secure, highly reliable, interoperable information systems</p>	<p>Science, Research and Technology</p>
<p>2.2 Enable NASA people to communicate across an integrated, low-cost information technology infrastructure</p>	<p>Science, Research, and Technology Program and Project Management</p>
<p>2.3 Design and operate a One NASA network to improve organizational interactions and foster improved collaboration and sharing of accumulated NASA knowledge assets</p>	<p>Science, Research, and Technology Program and Project Management</p>
<p>2.4 Establish systems to deliver superior information services to consumers, educators, students, researchers, and the general public, as well as to Government agencies, NASA contractors and suppliers, and other businesses</p>	<p>Science, Research, and Technology Program and Project Management</p>
<p>IS-3: Enhance NASA's core engineering, management, and scientific capabilities and processes to ensure safety and mission success, increase performance, and reduce cost</p>	<p>Science, Research, and Technology Program and Project Management</p>
<p>3.1 Implement collaborative engineering capabilities and integrated design solutions to reduce the life-cycle cost and technical, cost, and schedule risk of major programs</p>	<p>Science, Research, and Technology Program and Project Management</p>
<p>3.2 Apply methods and technologies to ensure that designs are safe and have a high likelihood for success</p>	<p>Science, Research, and Technology Program and Project Management</p>
<p>3.3 Improve our systems engineering capability and ensure that all NASA programs follow systems engineering best practices throughout their life cycles</p>	<p>Science, Research, and Technology Program and Project Management</p>
<p>3.4 Establish a process management approach that can be tailored to the needs of all projects and programs based on safety, scope, complexity, cost, and acceptable risk</p>	<p>Science, Research, and Technology Program and Project Management</p>
<p>3.5 Use peer review to ensure that NASA's scientific research is of the highest quality</p>	<p>Science, Research, and Technology Program and Project Management</p>
<p>IS-4: Ensure that all NASA work environments, on Earth and in space, are safe, healthy, and environmentally sound and secure</p>	<p>Enabling Services Enabling Services (Safety) Enabling Services (Security)</p>
<p>4.1 Prevent injuries from occurring during the course of NASA activities on NASA facilities or in the use of NASA equipment</p>	<p>Enabling Services (Security)</p>
<p>4.2 Work closely with other Government agencies and local authorities to identify and try to remove all security threats to NASA people, facilities, and information</p>	<p>Enabling Services (Security) Enabling Services (Safety)</p>
<p>4.3 Protect NASA's physical assets from damage or theft</p>	<p>Enabling Services (Environmental Management)</p>
<p>4.4 Eliminate the incidence of occupational health problems for the NASA workforce</p>	<p>Enabling Services Enabling Services (Safety and Assurance Directorate)</p>
<p>4.5 Eliminate environmental incidents, toxic chemical use, hazardous waste, and environmental liability at all NASA sites</p>	<p>Program and Project Management</p>
<p>IS-5: Manage risk and cost to ensure success and provide the greatest value for the American public</p>	<p>Program and Project Management</p>
<p>5.1 Provide tools, techniques, and expertise that will enable all elements of the Agency to make well-informed decisions on matters of critical Mission importance</p>	<p>Program and Project Management</p>
<p>5.2 Improve processes for cost estimation and the management of major NASA projects and programs</p>	<p>Program and Project Management</p>



The NASA Vision

To improve life here,
To extend life to there,
To find life beyond.

The NASA Mission

To understand and protect our home planet,
To explore the universe and search for life,
To inspire the next generation of explorers
...as only NASA can.



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NASA Glenn Key Process Metrics*

(As of November 26, 2003)

Strategic Management (SM)

Director's Action Item Responsiveness

Tracks how promptly Glenn responds to action requests from or through the Center Director. Goal is to complete at least 80% of all such action items on time.

Revenues

Tracks the amounts and sources of Glenn funding. Goal is to increase total revenues every year.

Major Milestone Performance

Tracks performance of all milestones in the annual Center Implementation Plan. Goal is successful completion of at least 85% of all milestones.

External Customer Satisfaction

Tracks the satisfaction of key center-level customers, obtained from a bi-annual, executive survey. Goal is to continually increase customer satisfaction.

Employee Satisfaction

Tracks the satisfaction of Glenn employees, obtained from center-wide surveys. Goal is to increase employee satisfaction every year.

Center Obligations and Costing

Tracks how quickly Glenn obligates and costs its appropriated funds. Goal is to be within 5% of plan.

New Business

Tracks the value and cost of new business pursuits and captures. Goals to be set in FY2004.

Enabling Services (ES)

Enabling Services Center-Level Milestones Met

Tracks performance of Glenn's Enabling Services milestones. Goal is successful completion of at least 85% of all ES milestones.

Enabling Services Customer Satisfaction

Tracks the satisfaction of Glenn's Enabling Services customers, obtained from point-of-service surveys. Initial goal is to achieve an average response score of at least 4 (on a 1-5 scale).

Enabling Services Timeliness

Tracks the timeliness of Glenn's Enabling Services, obtained using various methods. Initial goal is to achieve an average response score of at least 4 (on a 1-5 scale).

Enabling Services Performance/Quality

Tracks the performance/quality of Glenn's Enabling Services, obtained using various methods. Initial goal is to achieve an average response score of at least 4 (on a 1-5 scale).

Safety and Health

Tracks all of Glenn's safety and health metrics. Initial goal is a score of at least 4 (on a 1-5 scale).

*Notes:

1. Glenn Key Processes may have other metrics; these are the most significant metrics at this time.
2. New GRC key process metrics are continually being developed and tested. When they become operational and have specific goals, they may be added to this list or replace existing metrics on this list.

NASA Glenn Key Process Metrics*

(As of November 26, 2003)

Program/Project Management (PPM)

PPM Milestone Technical Performance

Tracks Glenn program/project milestone technical performance. Goal is for 100% of Glenn's PPM milestones to achieve at least minimum technical success.

PPM Milestone Schedule Performance

Tracks Glenn program/project milestone schedule performance. Goal is for at least 85% of Glenn's PPM milestones to be completed on schedule.

Program/Project Cost Performance

Tracks how quickly Glenn costs its programs and projects. Goal is for at least 85% of the programs and projects reporting to the Glenn PMC to stay within 5% of their plan.

Science, Research and Technology (SRT)

Journal Articles and Conference Proceedings

Tracks the number of these Glenn publications in the ISI Web of Science. Goal is 350 per year; Lower Control Limit is 300; Upper Control Limit is 400.

New Technology Disclosures

Tracks the number of innovations reported by Glenn employees, contractors and grantees. Goal is 180 per year; Lower Control Limit is 160; Upper Control Limit is 200.

Science, Research and Technology Milestone Performance

Tracks performance of Glenn's Science, Research and Technology milestones. Goal is successful completion of at least 85% of all SRT milestones.

Science, Research and Technology Customer Satisfaction

Tracks the satisfaction of Glenn's Science, Research and Technology customers, obtained from an annual survey for both internal and external customers. Goal is to achieve an average response score of at least 4 (on a 1-5 scale).

Knowledge and Technology Transfer (KTT)

Glenn Success Stories

Tracks the number of successful applications of GRC technology. Goal is at least 50 per year.

Glenn Student Program Representation

Tracks the number of African American, Hispanic, Native American, females, and students with disabilities participating in Glenn Student Programs (including SEMAA, SHARP, NASA Plus, LERCIP College, Shadowing, and Explorers). Goal is to increase their representation by 5% using FY03 baseline data from the Educational Programs Office program participant database and the NASA Education Evaluation Information System (NEEIS).

Glenn Teacher Program Representation

Tracks the number of elementary and secondary teachers participating in Glenn teacher programs and utilizing NASA content-based Science, Technology, Engineering and Mathematics (STEM) materials. Goals will be set in FY2004.

*Notes:

1. Glenn Key Processes may have other metrics; these are the most significant metrics at this time.
2. New GRC key process metrics are continually being developed and tested. When they become operational and have specific goals, they may be added to this list or replace existing metrics on this list.

NASA Goals, Implementing Strategies, and Objectives

GRC FY2004 Milestones As of November 20, 2003

GRC Strategic Management Key Process

Implementing Strategy IS-1: Achieve management and institutional excellence comparable to NASA's technical excellence.

Objective IS-1.4.: Unify the processes for strategic and budget planning, budget reporting, and performance planning and reporting.

Objective IS-1.5: Provide an integrated and user-friendly NASA-wide internet portal that will provide improved public access to NASA Mission results and other products, improved visibility into NASA plans and programs, and enhanced communication among NASA employees and contractors.

4SM11.4.1 IFMP Budget Formulation: Implement the budget formulation module at GRC in conjunction with the Project Office at GSFC. This includes support to the project office in the areas of requirement development, configuration testing, training development and administration at the center to applicable users.

4SM11.5.1 External Customer Feedback System: Develop a web-based system for collecting external customer compliments, complaints and suggestions, and link it to GRC's Corrective and Preventive Action Reporting System, and implement it Center-wide.

GRC Enabling Services Key Process

Implementing Strategy IS-1: Achieve management and institutional excellence comparable to NASA's technical excellence.

Objective IS-1.1: Attract and maintain a workforce that is representative of the Nation's diversity and includes the competencies that NASA needs to deliver the sustained levels of high performance that the Agency's challenging mission requires.

Implementing Strategy IS-2: Demonstrate NASA leadership in the use of information technologies.

Objective IS-2.2: Enable NASA people to communicate across an integrated, low-cost information technology infrastructure.

4ES11.1.1 Affirmative Employment Program (AEP) Annual Reports: Complete the Center FY03 AEP Accomplishment Report and FY04 AEP Plan Updates as follows: AEP Accomplishment Report and Plan for Individuals with Disabilities; AEP Accomplishment Report and Plan for Disabled Veterans; Language Assistance Program (LAP) Assessment; Hispanic Initiative Program (HIP) Accomplishment Report; and the AEP Accomplishment Report and Plan Update for Minorities and Women.

4ES11.1.2 Annual Discrimination Reports: Complete the Center's Annual Discrimination Complaints Report.

4ES12.2.1 Implement ODIN Delivery Order 2: Implement the second delivery order of the Outsourcing Desktop Initiative for NASA contract. GRC is part of the Code R delivery order.

4ES12.2.2 Agency Mac Browser Standard: Develop recommendations for a new Agency browser standard for Macintosh operating systems as part of the NASA Competency Center for Architecture, Testing and Standards (NCCATS).

4ES12.2.3 Agency Desktop Standards: Complete the next revisions of the Agency 2804 and 2805 Hardware and Software Desktop Standards.

NASA Goals, Implementing Strategies, and Objectives

GRC FY2004 Milestones As of November 20, 2003

Implementing Strategy IS-4: Ensure that all NASA work environments, on Earth and in space, are safe, healthy, environmentally sound, and secure.

Objective IS-4.1: Prevent injuries from occurring during the course of NASA activities on NASA facilities or in the use of NASA equipment.

Objective IS-4.2: Work closely with other Government agencies and local authorities to identify and try to remove all security threats to NASA people, facilities, and information.

Objective IS-4.5: Eliminate environmental incidents, toxic chemical use, hazardous waste, and environmental liability at all NASA sites.

Implementing Strategy IS-5: Manage risk and cost to ensure success and provide the greatest value for the American public.

Objective IS-5.1: Provide tools, techniques, and expertise that will enable all elements of the Agency to make well-informed decisions on

4ES14.1.1 Voluntary Protection Program (VPP): Submit application for GRC VPP registration.

4ES14.2.1 Facility Security Enhancement: Implement Facility Security Enhancement modifications for specific GRC buildings.

4ES14.5.1 ISO 14001 Registration: Successfully complete two outside audits demonstrating compliance of the GRC ISO-14000 registered Environmental Management System.

4ES14.5.2 Plumbrook Reactor Decommissioning: Complete segmentation of the Reactor Tank. Remove the Reactor Tank, Reactor Internals, and other Fixed Equipment from the facility and ready the material for disposal.

4ES15.5.1 Continuous Risk Management Implementation: Facilitate the GRC Continuous Risk Management Implementation process for an additional 12 GRC projects.

4ES15.5.2 Process Based Mission Assurance: Ensure Secure Socket Layer Workgroup and PBMA Knowledge Registry capabilities.

GRC Program and Project Management & Science, Research and Technology Key Processes

Goal 2: Enable a safer, more secure, efficient, and environmentally friendly air transportation system.

Objective 2.1: Decrease the fatal accident rate, reduce the vulnerability of the air transportation system to hostile threats, and mitigate the consequences of accidents and hostile acts.

4A2.1.1 LEWICE Version 3 2D Ice Accretion Code: Release validated 2D ice prediction code with improved physical modeling of ice growth, expanded validation of thermal algorithms, additional subroutines for multi-element airfoil protection analysis, and expanded operational capability from the current LEWICE version.

4A2.1.2 Fire Explosion/Detection Technologies: Develop and test Low-False-Alarm Fire Detection System Technology and Elevated Flashpoint Fuel Concepts. Write reports of technology attributes and implementation issues in relation to AvSP Accident Mitigation project goals.

4A2.1.3 Interim Assessment of Next-Generation Cockpit Weather Communications Technologies: Complete interim assessment of development progress of next-generation cockpit weather communications technologies.

NASA Goals, Implementing Strategies, and Objectives

GRC FY2004 Milestones As of November 20, 2003

Objective 2.2: Protect local and global environmental quality by reducing aircraft noise and emissions.

Objective 2.3: Enable more people and goods to travel faster and farther, with fewer delays.

Goal 3: Create a more secure world and improve the quality of life by investing in technologies and collaborating with other agencies, industry and academia.

Objective 3.3: Resolve scientific issues in the low gravity environment of space that enrich life on Earth by leading to better design tools in energy, materials, medical, and communication technologies.

4A2.1.5 High-Strength Turbine Disks and Engine Containment Materials [NASA APG 4AT5]: Develop prototype disks and engine containment materials with inherent failure-resistant characteristics that will be ready for full-scale testing to be conducted in FY 2005.

4A2.2.1 Noise Mitigation Roadmap for Constant Volume Combustion Cycle Engine: Noise mitigation roadmap for constant volume combustion cycle engine developed.

4A2.2.2 Wind Tunnel Test Quiet High Speed Fan 2: In collaboration with Honeywell, conduct a four-month long wind tunnel evaluation of the aerodynamic and acoustic characteristics of a low-noise, forward-swept fan concept in the GRC 9x15 wind tunnel.

4A2.2.3 Advanced Flow Diagnostics for Jet Noise Prediction: Complete implementation and validation testing of Particle Image Velocimetry and Rayleigh Scattering measurement capabilities on Small Hot Jet Acoustic Rig in Aeroacoustic Propulsion Lab.

4A2.2.4 Airframe and Engine Source Noise Reduction Concepts [NASA APG 4AT8]: Validate initial concepts for engine and airframe source noise reduction by 5dB (compared to CY2001 state-of-the-art).

4A2.2.6 Experimentally Demonstrate Two-Stage Highly-Loaded Compressor [NASA APG 4AT9]: Experimentally demonstrate a two-stage highly loaded compressor for increasing pressure rise per stage.

4A2.2.7 Determine Technologies and Platforms for TRL6 Demos Partnership with U.S. Industry: Complete decisions on TRL 6 Demonstrations in Partnership with U.S. Industry.

4A2.2.8 Intelligent Propulsion Systems Foundation Technologies Selection: Select through competitive process the foundation technologies for Intelligent Propulsion Systems.

4A2.2.9 Initial High Fidelity Engine System Simulation: Predict steady state aerodynamic performance of selected engine system at take-off and cruise conditions using high-fidelity system simulation tools.

4A2.2.11 Preliminary System Requirement for aircraft all-electric secondary power system: Preliminary system requirements for all-electric secondary power system for aircraft defined.

4A2.3.2 Ku-Band Satellite Communications Technology Demonstration: Demonstrate satellite technology with other wireless links and network connections as applicable for aviation.

4B3.3.2 Multiuser Droplet Combustion Facility Flight Hardware: Complete Multiuser Droplet Combustion Facility Pre-Ship Review.

NASA Goals, Implementing Strategies, and Objectives

GRC FY2004 Milestones As of November 20, 2003

Goal 4: Explore the fundamental principles of physics, chemistry, and biology through research in the unique natural laboratory of space.

Objective 4.2: Expand understanding of physical processes and insight into the laws of nature through space-based investigation.

4B4.2.1 Boiling Experiment Facility Flight Hardware: Complete preship review for the Boiling Experiment facility including the first two facility payloads -- Microheater Array Boiling Experiment and Nucleate Pool Boiling Experiment.

4B4.2.2 Boiling Experiment Facility CDR: Complete Critical Design Review for the Boiling Experiment facility including the first two facility payloads -- Microheater Array Boiling Experiment and Nucleate Pool Boiling Experiment.

4B4.2.3 Light Microscopy Module CDR: Complete the Light Microscopy Module Critical Design Review. The LMM is the first multiuser module for the Fluids Integrated Rack.

4B4.2.4 CIR Flight Hardware: Complete the preship review for the Combustion Integrated Rack (CIR) . The CIR is the first rack of the Fluids and Combustion Facility.

4B4.2.6 MIDAS PDR: Complete the Miscible Interface Dynamics and Simulation experiment Preliminary Design Review.

4B4.2.7 Bouyancy-Driven Instabilities in Single-Bubble Sonoluminescence CDR: Complete the Bouyancy-Driven Instabilities in Single-Bubble Sonoluminescence Critical Design Review.

4B4.2.9 Flow Enclosure Accomodating Novel Investigations in Combustion of Solids PDR: Complete Flow Enclosure Accommodating Novel Investigations in Combustion of Solids project Preliminary Design Review process.

4B4.2.11 Triaxial Sensor Head- Ethernet Standalone: Deliver flight TSH-ES to CIR for integrated testing.

Goal 5: Explore the solar system and the universe beyond, understand the origin and evolution of life, and search for evidence of life elsewhere.

Objective 5.1: Learn how the solar system originated and evolved to its current diverse state.

4S5.1.1 Stirling Thermal-Vacuum Test: Complete thermal-vacuum performance test of Stirling converter.

4S5.1.2 NEXT Generation Ion Thruster Life Test: Initiate long duration ion thruster life test.

4S5.1.3 Stirling Extended Test: Accumulate 3,000 hours of extended testing on a matched pair of Stirling Technology Development Convertors 13 and 14.

4S5.1.4 Hall Thruster High Power Testing: Complete high power, high voltage test of Hall 400M Thruster at over 50kW and 4500 sec Isp.

4S5.1.5 Stirling Launch Environment Vibration Test: Complete launch environment vibration test of advanced lightweight Stirling converter.

4S5.1.6 RPS Contracts: Initiate all Advanced Radioisotope Power System NRA contracts.

NASA Goals, Implementing Strategies, and Objectives

GRC FY2004 Milestones As of November 20, 2003

4S5.1.7 NPR Phase I Reports: NRA Power contractors to document results of Phase I activities (trade studies, conceptual designs, and Phase II technology plans).

4S5.1.8 JIMO Brayton ATU: Complete 100KW Brayton ATU (Alternator Test Unit) design.

4S5.1.9 JIMO EP Demo: Jupiter Icy Moon Orbiter (JIMO) EP concept thruster demonstration.

Goal 8: Ensure the provision of space access, and improve it by increasing safety, reliability and affordability.

Objective 8.2: Improve the safety, affordability and reliability of future space transportation systems.

4A8.2.1 C/SiC Life Demonstration: Demonstrate the effects of commingling SiC and heat treated carbon fibers on C/SiC life in an oxidizing environment.

4A8.2.2 Miniaturized Sensor Array: Complete fabrication and integration of hardware and sensor array for miniaturized hardware prototype demonstration.

4A8.2.3 Electro-Mechanical Actuator: Deliver prototype Electro-Mechanical Actuator (EMA).

4A8.2.4 Electro-Hydrostatic Actuator: Deliver prototype Electro-Hydrostatic Actuator (EHA).

4A8.2.5 RTA-1 SSR: Complete Systems Requirements Review for Revolutionary Turbine Accelerator-1.

4A8.2.6 RTA-1 PDR: Complete the Preliminary Design Review for Revolutionary Turbine Accelerator-1.

4A8.2.7 High Speed Fan for Mach 4 Turbine Testbed: Complete the design for a high speed fan for the Mach 4 turbine.

4A8.2.9 DCCR Test: Perform Mach 3.5 Direct Connect Combustor Rig test.

4A8.2.10 OSP 8x6 SWT Testing: Complete 8x6 Supersonic Wind Tunnel Testing of Lockheed-Martin Subscale Model of the Orbital Space Plane (OSP).

4A8.2.11 GRCop-84 Calorimeter Liner: Deliver metal spun GRCop-84 calorimeter liner preform suitable for machining into finished liner.

4A8.2.12 PR&T NRA and GLS Awards: Complete competitive sourcing for Propulsion Research and Technology via NRA and GLS solicitations, including selection and contract awards.

4A8.2.13 Turbine Power Unit: Deliver brassboard of Turbine Power Unit (TPU).

4A8.2.14 Advanced Control Surface Seals: Complete critical function performance tests on advanced control surface seals.

4F8.2.1 Shuttle RTF Ballistic Impact Testing: Complete ballistic impact testing for Shuttle Return to Flight.

NASA Goals, Implementing Strategies, and Objectives

GRC FY2004 Milestones As of November 20, 2003

Goal 10: Enable revolutionary new capabilities through new technology.

Objective 10.2: Create system concepts and demonstrate technologies that will enable new science measurements and scientific missions.

4A10.2.1 Solid-State High-Efficiency Space Communication Devices: Deliver packaged, prototype solid state microwave devices for near earth and deep space communications applications which operate at high overall efficiency (>50%) compared to current state-of-the-art devices.

4A10.2.2 Highly-Efficient, Miniature Traveling Wave Tube (TWT): Deliver a prototype TWT for near earth and deep space communications applications that, using a novel internal design, which exhibits both increased efficiency (>55%) and reduced mass and volume (>20%) compared to current state-of-the-art devices.

4A10.2.3 Spacecraft Networking Technologies [NASA APG 4MSM11]: Develop critical spacecraft networking technologies. Demonstrate spacecraft communications technologies achieving 1Gbps or greater for near Earth, and 1Mbps or greater for deep space applications. Develop related protocols and software for Internet-like space computing and communications.

4A10.2.4 Lithium Battery Polymer Electrolyte: Select polymer electrolyte candidates with suitable characteristics for lithium polymer batteries.

4A10.2.5 Lightweight Propellant Feed System: Demonstrate feed system for ion thrusters that is 1/10 the weight of current systems.

4A10.2.6 Pathfinder Sub-Kilowatt Ion Thruster [NASA APG 4MSM4]: Investigate performance and stability of a sub-kilowatt ion thruster concept to lay foundation for potential REP mission application.

4A10.2.7 Intelligent DC/DC Converters: Develop distributed control in modular DC-DC converters and demonstrate active current sharing, efficiency optimization, and phase-stagger switching between multiple DC-DC converters.

4A10.2.8 Information Environments for Grid Applications: Develop and demonstrate distributed coupling of two computational fluid dynamics analyses executing on the Information Power Grid, including the usage of a web-enabled visual assembly and Developer's Kit capabilities. Comparing against a 2000 baseline, these capabilities reduce by a factor of five the time required for coupling the codes.

4A10.2.9 Outer Loop Control: Simulation demonstration of outer loop control to optimize performance and/or operability based on mode of operation.

4F10.2.1 Federal Spectrum Policy: Support HQ in providing NASA's contribution to the development of recommendations for improving spectrum management policies and procedures to stimulate more effective, efficient and beneficial use of spectrum by the Federal Government.

4F10.2.2 Ultra Wideband Noise Floor Study: Determine the noise floor environment in critical spectrum bands to enable an assessment of the adverse effect on the noise floor that would be caused by widespread commercial use of ultra wideband devices in these bands. In particular, study the effect on aviation navigation systems.

NASA Goals, Implementing Strategies, and Objectives

GRC FY2004 Milestones As of November 20, 2003

GRC Knowledge and Technology Transfer Key Process

Goal 3: Create a more secure world and improve the quality of life by investing in technologies and collaborating with other agencies.

Objective 3.2: Improve the Nation's economic strength and quality of life by facilitating innovative use of NASA technology.

4KTT3.2.1 Technology Transfer and Partnership Performance and Impact Report: Publish a TT&PO Performance and Impact Report.

4KTT3.2.2 National SBIR/STTR Conference: Co-host the National SBIR/STTR Conference with the Ohio Department of Development and US Air Force Wright Labs.

4KTT3.2.3 Annual Research and Technology Report: Highlight GRC's research and technology accomplishments and identify practical and beneficial applications.

Goal 6: Inspire and motivate students to pursue careers in science, technology, engineering and mathematics.

Objective 6.1: Increase the number of elementary and secondary students and teachers who are involved in NASA-related education.

4ED6.1.1 Video/Webcast Event: Conduct at least one video conference or webcast to reach the NASA Explorer Schools within the GRC region utilizing NASA content-based Science, Technology, Engineering and Mathematics (STEM) materials and programs.

4ED6.1.2 SEMAA Family Component: Provide training on Science, Engineering, Mathematics and Aerospace Academy (SEMAA) family involvement activities to NASA Explorer Schools Family Coordinators.

Objective 6.2: Support higher education research capability and opportunities that attract and prepare increasing numbers of students and faculty for NASA-related careers.

4ED6.2.1 College and Career Event: Provide a faculty and student event during the Lewis Educational Research Collaborative Internship Program (LERCIP) summer internship program that relates academic programs to NASA STEM career fields.

4ED6.2.2 University Linkages to Human Capital Initiative: Establish linkages between universities participating in the GRC Scholar's Program and the NASA Corporate Recruitment Strategy in support of the Agency's Human Capital Initiative.

4ED6.2.3 NASA Scholars Symposium: Conduct a research symposium for NASA Scholars involved in the internship program to present the results of their research.

Objective 6.3: Increase the number and diversity of students, teachers, faculty and researchers from underrepresented and underserved communities in NASA-related STEM fields.

4ED6.3.2 Integrate SEMAA Curriculum at Four Sites: Integrate four new Science, Engineering, Mathematics and Aerospace Academy (SEMAA) sites into the National SEMAA program in order to increase the number and diversity of participants from underrepresented and underserved communities in NASA-related STEM fields.

4ED6.3.3 STEM Protocol: Develop a protocol to establish a baseline of elementary and secondary teachers participating in NASA programs and utilizing NASA content-based STEM materials.

NASA Goals, Implementing Strategies, and Objectives

GRC FY2004 Milestones As of November 20, 2003

Objective 6.4: Increase student, teacher, and public access to NASA education resources via the establishment of e-Education as a principle learning support system.

Goal 7: Engage the public in shaping and sharing the experience of exploration and discovery.

Objective 7.1: Improve public understanding and appreciation of science and technology, including NASA aerospace technology, research, and exploration missions.

04ED6.3.4 GRC Student Recruiting Strategy: Develop and implement a strategy to recruit more students for underrepresented and underserved communities participating in GRC Student Programs (including SHARP, NASA plus, LERCIP College, Shadowing, and Explorers). This will increase the number and diversity of participants.

4ED6.4.1 Centennial of Flight Software: Develop on-line educational software to support the centennial anniversary of powered flight.

4ED6.4.2 EDD Learning Network: Develop the infrastructure for an Educational Digital Distance Learning Network that will have the capability to deliver NASA unique content to Education and Outreach audiences contingent upon Code N funding. This will increase access to resources via e-Education.

4KTT7.1.1 Mars Simulation Scenario: Design and document a scenario for a Mars Simulation.

4KTT7.1.2 Aerospace Education Family Conference: Conduct an Aerospace Education Family Conference that will introduce families from the Great Lakes Region to NASA educational resources through workshops, demonstrations and related Education Programs Office resources.

4KTT7.1.6 Media Relations Annual Report: Publish first annual report showcasing the amount of media coverage generated for the Center.