Marshall Space Flight Center

FY 2002 Implementation Plan

Marshall Space Flight Center

Mission

Bringing people to space; bringing space to people.
We are world leaders in access to space and the use of space for research and development to benefit humanity.

Goals

- Establish MSFC as number one in safety within NASA
- Develop and maintain NASA's preeminence in space propulsion, enabling the exploration and development of space while dramatically increasing program and mission safety and reliability and reducing overall cost
- Lead the research and development of space transportation technologies and systems that support our customers' needs—strengthening the U.S. launch industry, dramatically increasing safety and reliability, and reducing overall cost
- Lead NASA's Microgravity Research and Space Product Development Programs, and develop and maintain capabilities required to meet national research objectives
- Lead the Agency in the development of lightweight, large-aperture space optics manufacturing technology for use in achieving the mission goals of NASA's strategic enterprises
- Enhance and sustain a highly skilled, ethical, diverse, and motivated workforce committed to safety while working in a creative and productive environment in support of cutting-edge systems and technology development
- Support Agency and other Center scientific and technical initiatives and various Agency infrastructure activities in assigned roles delegated to the Center.

Center of Excellence

- Space Propulsion

Mission Areas

- Space transportation systems development
- Microgravity
- Space optics manufacturing technology

Director's Message

The Marshall Space Flight Center 2002 Implementation Plan is the blueprint that defines our important work. The Implementation Plan summarizes the primary responsibilities of this historic field Center and identifies the course we will take to successfully uphold the goals and objectives of the Agency and its Enterprises. The plan emphasizes Marshall's place within the Agency as the Center of Excellence for Space Propulsion and our commission in Space Transportation Development, Microgravity, and Space Optics Manufacturing. Our work on the Space Launch Initiative (SLI) will continue. The support given to Marshall Space Flight Center by the Administration and Congress echoes the important role SLI will play in the United State's space transportation future.

Our course is set with safety as its guide. Safety is our first commitment and the workforce has been trained to meet our commitments without compromise. Marshall will continue the work entrusted us by all five of the Agency's Enterprises: Human Exploration and Development of Space, Aerospace Technology, Space Science, Earth Science, and Biological and Physical Research.

Marshall is a values-based culture and the very foundation of what we do is based in the Marshall Space Flight Center Quality Policy. The Quality Policy states that we will "provide quality products and services to our customers through the Marshall Values: People, Customers, Excellence, Teamwork, and Innovation." We are dedicated to using the Marshall Center's Core Values as a guide for our decisions and behavior. Following these values will allow us to succeed in our efforts to make a significant difference in "Bringing People to Space and Bringing Space to People."

I am confident the Marshall Team of civil servants and contractors will continue to perform in the same excellent and committed manner for which Marshall is renowned.

Art Stephenson
Center Director

MSFC FY 2002 Implementation Plan

Table of Contents

Commitment to Safety and Mission Success

Our Goal: Establish MSFC as number one in safety within NASA.

As world leaders in access to space and the use of space technologies to benefit humanity, MSFC is committed to the success of every mission, making space flight safer, more reliable, and more affordable for future generations.

MSFC employees and contractors perform the day-to-day work that enables the continued exploration and development of space. Mission success results from creating and maintaining a safety-minded culture, one in which safety permeates every aspect of our work and influences every decision we make. Mission success tomorrow begins with safety today.

MSFC Safety Policy

MSFC will strive to prevent human injury and occupational illnesses and to ensure the safety of all operations and products.

MSFC Principles of Safety

- Unsafe conditions are correctable.
- All mishaps can be prevented.
- Management is responsible and accountable for prevention of on-the-job mishaps, incidents, and close calls.
- All mishaps must be reported, investigated, and the causes rectified.
- Management is responsible for training employees to work safely.
- Each employee is responsible for safety.
- Off-duty safety is an important part of our safety success.
- A comprehensive safety and risk management program increases the probability of mission success.

Management Programs and Techniques

MSFC has developed innovative management programs and techniques to improve the safety of the public, the astronauts and pilots, the NASA workforce, and high-value equipment and property.

Current Safety Processes and Activities

The Safety and Mission Assurance (S&MA) Office is organized to effectively support MSFC organizations and to maintain co-located mission assurance specialists at major project offices and contractor plants throughout the U.S.

An occupational Safety, Health, and Environmental Committee structure steers the MSFC safety program. It includes participation from top management down through line supervisors, an employee safety action team, and a contractor safety forum.

An integrated MSFC Safety, Health, and Environmental Web site provides single-point Web access to safety, mission success, environmental and health information, and makes MSFC safety data and reporting systems more user-friendly.

MSFC continues to improve the Safety Concerns and Reporting System, allowing employees to easily and anonymously report safety and mission success concerns. Use of the system is consistently increasing, indicating that MSFC is taking an increasingly proactive approach to employee safety concerns.

Risk management planning support, technical assistance, and training are available to provide MSFC projects with the tools they need to implement effective risk management.

MSFC plans to apply for OSHA Voluntary Protection Program (VPP) Star Certification.

Managers and supervisors conduct monthly safety meetings, perform monthly workplace occupational safety and health walk-through inspections with employees, and ensure their employees have appropriate safety training. A new Web-based supervisor's safety Web page assists supervisors in performing these duties, records potential hazards, and assigns and tracks corrective actions.

MSFC has also established consistent and comprehensive safety performance standards for MSFC contractors.

Marshall Safety First Class

FY 2002 Safety Initiatives

MSFC will maintain its current ISO 9001 registration, striving to meet or exceed ISO 9000:2000 standards and will aggressively pursue OSHA VPP Star Certification by continuing to develop and deploy safety and health management practices that are consistent with a world-class safety program. We will achieve our goal through four core processes.

- **Management commitment and employee involvement**
  Continue to implement improvements to the MSFC Safety Program that meet or exceed OSHA standards.
- **System and worksite hazard analysis**
  Continue to train supervisors to perform hazards analysis and deploy/maintain a current online database of all hazardous operations at MSFC. Deploy a dedicated Safety Operations Center to provide single-point telephone and Internet access to all MSFC safety and mission success related information.
- **Hazard prevention and control**
  Continue to build hazards awareness and encourage employees and supervisors to report and correct potential hazards before they cause problems.
- **Safety and health training**
  Maintain current awareness by providing refresher training, new employee training, and continue to develop innovative, awareness building activities.

Safety and Mission Success Metrics

- Achieve a world-class lost-time injury rate of 0.1 or less, with an ultimate goal of 0.
- Zero type A or B mishaps in FY 2002.
- Maintain a mission success rate of 100 percent.
- All MSFC projects will complete safety reviews on time.

Marshall Space Flight Center's Commitment to Quality

Our vision: Maximize the effectiveness of the Marshall Management System that fully supports the MSFC core values in every aspect of what we do.

MSFC's Quality Policy

To provide quality products and services through the Marshall values—people, customers, excellence, teamwork, and innovation.

Marshall Management System Objectives

- Satisfy our customers with our products and services.
- Continually improve our processes.
- Detect nonconformances and take corrective action.
- Improve corrective action response time.
- Provide a continuously learning workforce.

Key Quality Processes and Activities

- The Marshall Quality Council (MQC) assesses opportunities for improvement, the need for changes to the Marshall Management System (MMS), and resource needs. Action items are assigned as necessary and tracked to completion. The MQC includes participation from senior management and the MMS Implementation Team, which is composed of senior management, line supervisors, and employees.
- External audits, conducted by NASA's registrar, and internal audits, coordinated by Safety and Mission Assurance with participation by Center organizations, provide a review of the MMS processes and procedures for compliance to ISO 9001 standards and other applicable documents. These audits identify areas for improvement.
- The Marshall Integrated Document Library (MIDL) is an electronic database that provides easy and immediate access to MSFC and NASA directives, multi-program/project documentation, industry standards, organizational issuances, and other documentation.
- MSFC determines the necessary competence for personnel. Competency is based on appropriate education, training, skills, experience, and demonstrated performance. Supervisors work these issues with employees and the Customer and Employee Relations (CaER) Directorate.
- The MSFC corrective action system is structured to review hardware nonconformances, customer complaints, procedure problems, and concerns input by Center employees for remedial action and recurrence control. Timeliness and effectiveness are important aspects of corrective actions.
- Processes and products are continually improved through employee innovation and standard processes for improvement. Employees are encouraged and rewarded for their contributions.
- Senior management provides a customer focus, and each directorate solicits customer feedback with the aim of enhancing customer satisfaction.

Quality Success Metrics

- Obtain full scope, ISO 9001:2000 registration.

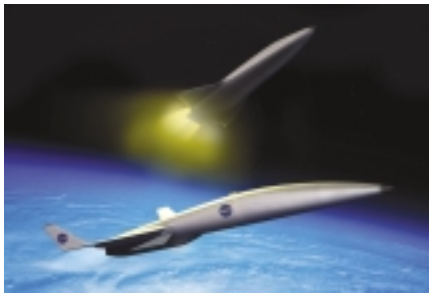
Center of Excellence
Space Propulsion

Our goal: Develop and maintain NASA's preeminence in space propulsion, enabling the exploration and development of space while dramatically increasing program and mission safety and reliability and reducing overall cost.

We Support

- **Human Exploration and Development of Space Enterprise**
- **Aerospace Technology Enterprise**
- **Space Science Enterprise**
- **Industry and Commercial Needs**
- **Other Federal Agencies.**

Pulse detonation concept.



Propulsion elements are being advanced to enable safer, more reliable, and less expensive access to space for 21st century civil, defense, and commercial missions.

The Marshall Space Flight Center in Huntsville, AL, is NASA's Lead Center for space transportation systems development and the Center of Excellence for space propulsion. While striving to achieve the full potential of all human endeavors through affordable space transportation, the Marshall Center initiates the development and implementation of advanced Earth-to-orbit and in-space propulsion systems and technologies.

The Marshall Center continues to invest in personnel, processes, facilities, and other support elements to remain the designated Center of Excellence. NASA Marshall not only recognizes the need to advance technologies but also considers the transfer of these technological advancements into commercial applications as critical thereby enhancing U.S. industrial growth and improving the quality of life on Earth.

Marshall's Inter-Center Systems Analysis Team (ISAT) provides engineering design and systems assessments in support of NASA's Space Launch Initiative (SLI). This multidiscipline and multi-Center systems analysis team develops reference reusable launch vehicle (RLV) concepts that are used to perform assessments on emerging, advanced technologies. ISAT also conducts system architecture evaluations in an integrated engineering environment. The effort of the ISAT team will provide a framework to ensure that the next generation launch vehicle will be safer, more reliable, and more affordable.

The Integrated Space Transportation Plan (ISTP), is the framework for our nation's major investment in the future of space exploration and commercialization is managed by Marshall's Transportation Directorate (TD) and Second Generation RLV Program Office. The ISTP investment plan addresses—

- Space Shuttle safety upgrades—innovative propulsion techniques are being developed at Marshall;
- Design and development of a second generation RLV over the coming decade—the Marshall managed SLI is a comprehensive plan to dramatically increase the safety, reliability, and affordability of space transportation systems
- Long-term investment in third generation and in-space technologies—Marshall's Advanced Space Transportation Program (ASTP) is responsible for implementing the third generation technologies and long-term research elements of ISTP.

Second Generation Reusable Launch Vehicle Propulsion Office

The Second Generation RLV Propulsion Office manages the development of all propulsion elements in support of the program's overall goals to improve space transportation safety and reliability while reducing costs. Marshall's Propulsion Office coordinates with other NASA programs to ensure that the propulsion activities it manages are applicable and synergistic with current NASA programs and projects, Department of Defense (DOD), and commercial RLV activities.

A major objective is to reduce the risk level associated with the main propulsion system, Orbital Maneuvering System/Reaction Control System (OMS/RCS), upper stages, main engine, and propellant management required for the most promising second generation RLV architectures, while enabling full-scale development competition between architecture designs.

The approach being taken maximizes lessons learned from the Space Shuttle Program and includes—

- Demonstrating significantly improved propulsion systems safety, operability, and reliability.
- Reducing the technical and programmatic risks for propulsion flight hardware development.
- Providing a high-fidelity basis for estimates of flight systems development costs.
- Designing, developing, and testing prototype propulsion systems and subsystems.

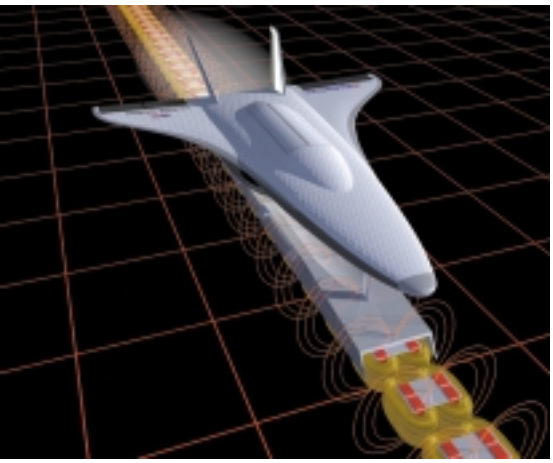
The projects managed by the Second Generation RLV Propulsion Office reflect the overall scope, including boost propulsion (i.e., engines, propellant delivery systems), reentry, crew-escape propulsion, flyback propulsion, on-orbit propulsion, and propellant management. The initial contracts awarded under NASA Research Announcement (NRA) 8–30 include the following activities/projects:

- Foster a competitive business environment for developing a detailed design for a fuel-rich, staged-combustion, high-performance liquid oxygen/liquid hydrogen (LOX/LH_2) prototype engine—
  - The RS–83 Main Engine–1 Project
  - The COBRA Main Engine–2 Project.
- Develop and demonstrate a main propulsion propellant cross-feed system and nontoxic reaction control system thrusters, while also facilitating requirements flow between architecture definition and other propulsion activities through the Main Propulsion System/Auxiliary Propulsion System (MPS/APS) project
- Develop and demonstrate peroxide coolant utilization detonation, main combustion chamber material compatibility, hypergolic injectors, integrated fluid/gas controller, catalyst sensitivity to contaminants and stabilizers, and advanced turbopump technology through the Upper Stages Project.
- Develop and demonstrate cooled nozzle/panel technology, combustion chamber and nozzle materials, large composite valves, and technologies for staged combustion injectors, turbomachinery, injector test-bed, LH_2 densification, miniaturized leak detection, and electromechanical actuators through the NASA-led and Special Studies Project.

These and other activities are underway to find solutions to the challenges that must be overcome to realize dramatic propulsion improvements. Advancing state-of-the-art propulsion will enable the Agency and its stakeholders to make an informed decision about the best course of action to move from the research phase into full-scale development of the nation's next generation RLV.

Second Generation RLV Propulsion Office Metrics

- Complete Critical Design Review for the Crossfeed Checkvalve Test Article.
- Perform the work-horse engine tests for the Auxiliary Propulsion System Reaction Control Engine.
- Complete final testing of the monopropellant gas generator for powering turbine drives.
- Design and build a hypergolic injector for orbital propulsion.
- Complete the RS–83 System Definition Review.
- Complete the COBRA Powerhead Critical Design Review.
- Complete the COBRA prototype engine Preliminary Design Review.



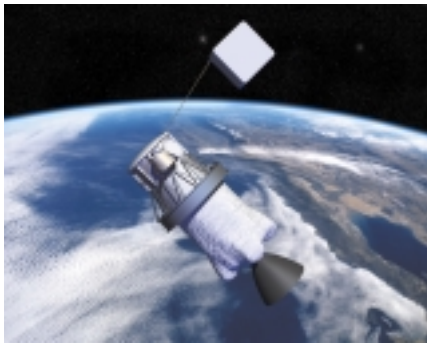
Magnetic levitation propulsion concept.

Earth-To-Orbit Propulsion

A critical element needed to increase safety and lower the cost of space access is increasing the performance margin of Earth-to-orbit propulsion systems while lowering the operations, development, and manufacturing costs. The Marshall Space Flight Center's near-term activities are focused on enabling technology for a long life, high thrust-to-weight rocket-based RLV near the end of the decade. Building on near-term developments, mid-term technology activities are centered around enabling air-breathing combined cycle rocket engines. By incorporating synergy between space and aeronautics activities, Marshall has initiated flowpath demonstrations of these bold, new concepts. Midterm efforts also include evaluation of new engine cycles like pulse detonation concepts and use of high-energy density fields. Efforts will continue to further increase life and thrust-to-weight of rocket engines. Long-term technologies include revolutionary offboard energy sources, such as magnetic levitated track launch assist, ground-based laser propelled systems, and nonchemical rocket/air-breathing combined cycle engines.

In-Space Propulsion

Central to Marshall's Center of Excellence role in propulsion is a strong propulsion research capability for providing a fundamental understanding of propulsion issues, and for developing new propulsion capabilities. Ambitious missions to destinations within the solar system will require significant improvements in propulsive capability. This is especially true for human exploration which require dramatic reductions in trip time with the assurance of safe and reliable mission operations. Marshall is pursuing technologies to enable Earth-orbital and planetary transportation that include advanced chemical engines, solar thermal and solar electric propulsion systems, and electrodynamic tethers. Future missions to near-interstellar space and eventually the stars will require performance well beyond our current capabilities.



Propulsive small expendable deployer system (ProSEDS).

The first demonstration of a propellant-free space propulsion system is planned in August 2002. Developed by Marshall, this experiment will use an electrodynamic tether to lower the orbit of a spent rocket stage. Tether propulsion is inexpensive, environmentally clean, completely reusable, and perhaps, best of all, requires no fuel. Its energy comes from the near-Earth space environment. The Propulsive Small Expendable Deployer System Experiment (ProSEDS) will demonstrate the use of tethers for deorbiting spacecraft. Future experiments are planned to demonstrate the use of tethers for raising the orbit of spacecraft. Tether propulsion applications range from cleaning up space debris that has accumulated over 40 years of space exploration to helping the *International Space Station* (*ISS*) maintain its operating orbit. Tether propulsion is one of many innovative technologies being developed by Marshall's ASTP to reduce space transportation costs from $10,000 per pound to merely hundreds of dollars per pound.

Propulsion Research Laboratory

New technologies start with new ideas, and new ideas come from research. NASA Marshall's Propulsion Research Center is a major hub for space propulsion research. Fundamental research being conducted today is aimed at improving access to orbit—opening the space frontier for ambitious exploration, and strengthening commercial development and human settlement of space. The Propulsion Research Center supports Marshall's designation as the Agency's Lead Center for space propulsion by conducting propulsion science leading to advanced propulsion concepts and improvements to existing space propulsion systems.

Space Propulsion Metrics

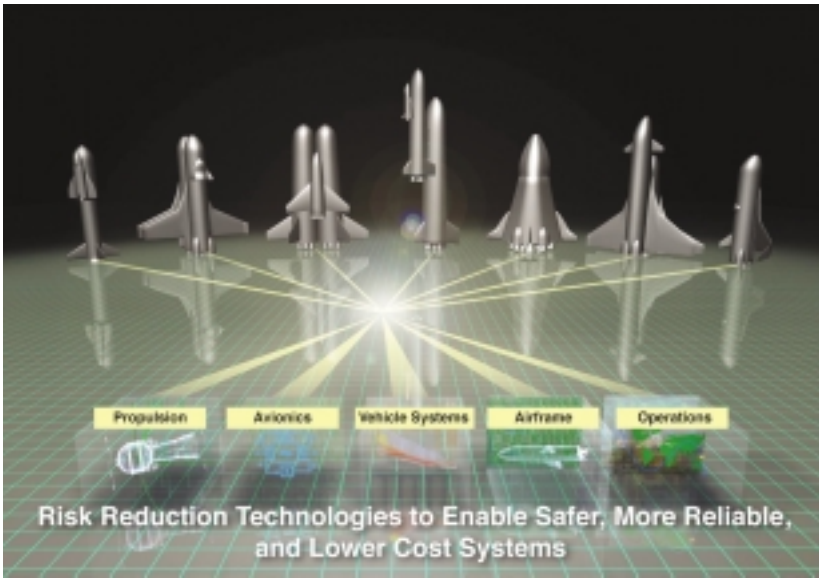
- Fly ProSEDS tether propulsion flight experiment.
- Complete design of the Propulsion Research Laboratory (PRL).
- Provide system analysis for technology and architecture to support NASA's Space Launch Initiative.

Lead Center for the Second Generation Reusable Launch Vehicle Program

NASA's Top New Development Program Managed by MSFC

The Space Launch Initiative (SLI) is the near-term business plan for NASA and its partners, including the DOD and the U.S. aerospace industry, to join forces to design versatile new space transportation architectures, while advancing the technologies and management systems required to build them.

SLI met a major milestone in FY 2001, when Marshall was named Lead Center and, subsequently, established the Second Generation RLV Program Office to coordinate this NASA-wide and, indeed, nationwide initiative.



NASA's Second Generation RLV Program is developing key technologies while designing new space transportation systems for improved access to space.

The way to safe, reliable, and affordable access to space has been blocked by technical and business risk. NASA contributes extensive systems engineering expertise, combined with investments in space transportation architecture design and targeted technology development, to help remove risk barriers for second generation RLVs.

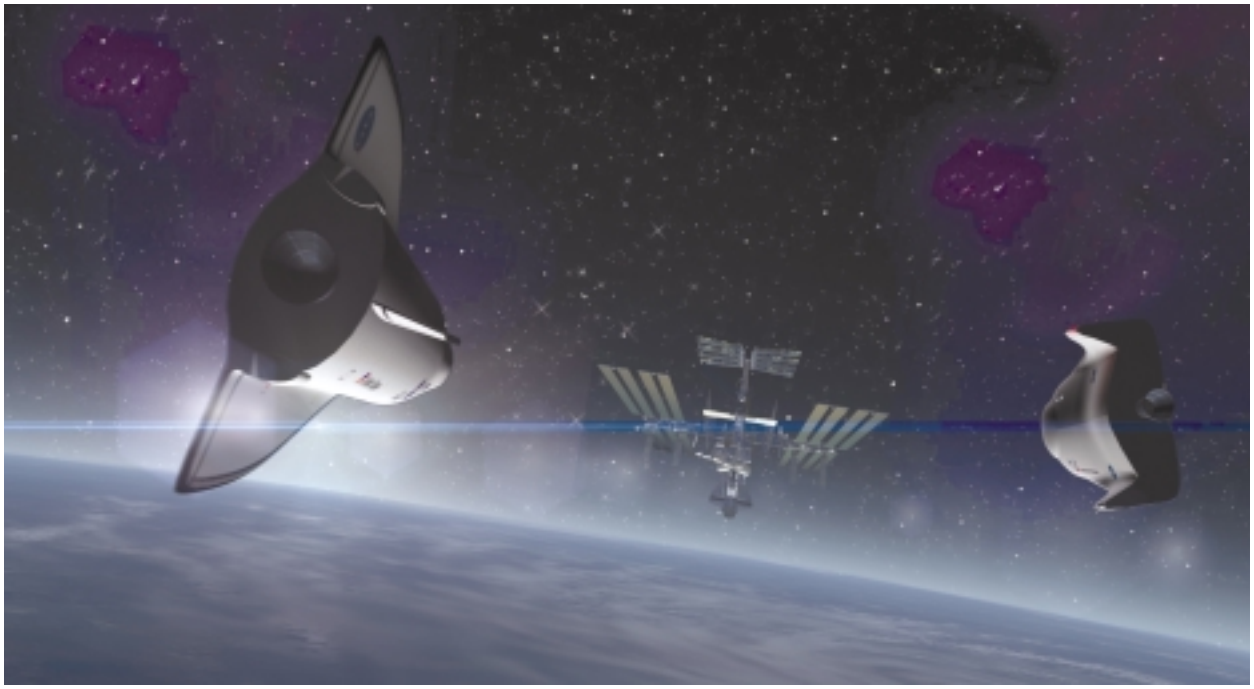
The overall goal of the Second Generation RLV Program is to enable the full-scale development of a new class of RLVs configured for 21st century missions. NASA's specific goals are to dramatically improve safety and reliability, while significantly reducing costs.

Also significant in FY 2001, was the awarding of contracts under NASA Research Announcement 8–30, which officially began the first cycle of the extensive work necessary to lay a firm foundation for the nation's next generation RLV. Architecture definition studies are being conducted in parallel with the maturation of key technologies specifically identified to improve safety and reliability while reducing operational costs.

An architecture broadly includes an Earth-to-orbit RLV, on-orbit transfer vehicles and upper stages, mission planning, ground and flight operations, and support infrastructure both on the ground and in orbit. The systems engineering approach ensures that the technologies developed—such as lightweight structures, long-life rocket engines, and robust thermal protection systems—will synergistically integrate into the optimum vehicle architecture in the full-scale development phase.

Through this process, NASA is refining its specialized needs and identifying where defense and commercial requirements overlap those of civil missions. These mission requirements and the program's progress are subject to external independent validation and review.

To best direct technology development decisions, analytical models are employed to accurately predict the benefits of each technology toward potential space transportation architectures. Vehicle designs that meet primary requirements, such as transporting crew and cargo to the *ISS*, will be investigated. Designs that can evolve to meet potential future missions, such as satellite servicing and space exploration, also are being sought.



Transporting crew and cargo to and from the *ISS* is one of the primary missions addressed by the Second Generation RLV Program.

A low-cost, highly reliable next generation system will help ensure America's preeminence in space. Dramatically lower costs will enable the further development and utilization of the new frontier, including astronomy and Earth science, biomedical research, telecommunications, and will help DOD with security issues related to protecting vital national interests. The activities managed by Marshall's Second Generation RLV Program represent the work of a nation, yielding immediate economic benefits from coast to coast, while posturing the U.S. for strong leadership on Earth and in space.

Second Generation Reusable Launch Vehicle Program Metrics

- Develop comprehensive stakeholder relationship management system that defines what is important to individuals and groups, measures satisfaction, implements corrective action, and provides mutual development of future requirements.
- Establish an advanced engineering environment to provide a state-of-the-art computer-aided-design/computer-aided engineering capability that enables concurrent systems analysis and design among geographically disperse Government, industry, and university teams.
- Conduct the interim architecture and technology review to ensure that processes and plans are in place to successfully achieve a subsequent systems requirements review (SRR), and to ensure that work is proceeding to complete necessary products and analyses for the SRR.

Space Transportation Systems Development

Our goal: Lead the research and development of space transportation technologies and systems that support our customers' needs—strengthening the U.S. launch industry, dramatically increasing safety and reliability, and reducing overall cost.

We Support

- **Human Exploration and Development of Space Enterprise**
- **Aerospace Technology Enterprise**
- **Space Science Enterprise**
- **Earth Science Enterprise**
- **Biological and Physical Research Enterprise**
- **Industry and Commercial Needs**
- **Other Federal Agencies**

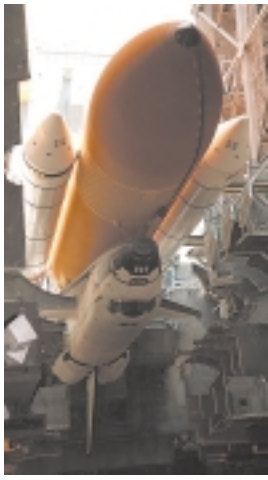
Space Shuttle Main Engine (SSME)

MSFC has responsibility for research, technology maturation, design, development, and integration of space transportation and propulsion systems. This includes both reusable space transportation systems for Earth-to-orbit applications, as well as vehicles for orbital transfer and deep-space transportation.

Space Shuttle Main Engine

The Space Shuttle Projects Office (SSPO) Space Shuttle Main Engine (SSME) Project Office is responsible for the design, development, manufacturing, testing, upgrade, launch processing support, flight performance, anomaly resolution, inspection, overhaul, and delivery of the SSMEs. Major tasks include managing technical and programmatic requirements, budgets and schedules, and managing resident offices, facilities, personnel, and other resources required to meet hardware development and production delivery requirements. Project office personnel also assist in the administration of prime contracts and resolving associated contractor requirements, performance, and technical issues. The SSME project manager participates as a member of the Space Shuttle Program Requirements Control Board and Mission Management Team, and serves as Chairperson of the Project Configuration Control Board.

External Tank



External Tank and Solid Rocket Boosters.

The SSPO External Tank (ET) Project Office is responsible for the design, development, manufacturing, testing, upgrade, launch processing support, flight performance, inspection, anomaly resolution, and delivery of the Space Shuttle ET. Major tasks include managing technical and programmatic requirements, budgets and schedules, and managing resident offices, facilities, personnel, and other resources required to meet hardware development and production delivery requirements. Specific improvement initiatives for FY 2002 include activation of friction stir weld tooling at MAF, implementation of digital x ray in the dome weld area, and the development of a new sidewall foam for tank insulation. Project office personnel also assist in the administration of prime contracts and resolving associated contractor requirements, performance, and technical issues. The ET project manager participates as a member of the Space Shuttle Program Requirements Control Board and Mission Management Team, and serves as Chairperson for the Project Configuration Control Board.

Lift-off of Space Shuttle Atlantis.

Solid Rocket Booster

The SSPO Solid Rocket Booster (SRB) Project Office is responsible for the design, development, manufacturing, testing, upgrade, launch processing support, flight performance, inspection, anomaly resolution, refurbishment, and delivery of Space Shuttle SRB assemblies.

The SRB prime contractor is United Space Alliance (USA), an element of the Space Flight Operations Contract (SFOC). USA is also the prime contractor for other major Shuttle efforts. The SRB provides many critical functions for the Space Shuttle vehicle, including the structural interface for the Shuttle vehicle with the launch pad, pyrotechnic separation from the launch pad at T–0, steering capability during the first 2 minutes of flight, pyrotechnic separation from the ET approximately 2 minutes after launch and the parachute recovery system allowing the SRBs to be recovered from the ocean for reuse. The SRB contractor, teamed with the SRB Project Office, is responsible for the SRB ocean retrieval operations, disassembly, refurbishment, assembly, and delivery of certified safe hardware to Kennedy Space Center ground operations.

Reusable Solid Rocket Motor Project

The Reusable Solid Rocket Motor (RSRM) Project Office has overall management responsibility for the design, development, test, manufacturing, delivery, launch, and refurbishment of the Space Shuttle RSRMs. At liftoff, the two RSRMs provide 71.4 percent of the total vehicle thrust, accelerating the Shuttle to nearly 3,100 mph before separation at an altitude of 150,000 feet, 123 seconsa into flight. Management of the RSRM contract monitors both performance management (flight support, budget and contract management) and safety and mission assurance (quality of hardware, problem reporting/resolution, and flight hardware production safety). In addition, specific areas are identified for further emphasis based on project priorities to promote safety/reliability advancements in the manufacture of RSRM hardware. Consistent with this process, in 2002 the RSRM will be upgrading several production activities including the automation of the gritblast process of the metal cases, high-pressure (40 ksi) water pumps that eliminate numerous operator hazards, and improvement in the process flow of nozzle phenolic tapewrap operations. These, as well as several ergonomic studies are being pursued through funding provided by the Space Shuttle Program's Industrial Engineering for Safety (IES) Initiative.

Shuttle Integration Office

The MSFC SSPO Shuttle Integration Office (SIO) serves as the integrated systems engineering, launch support, business management, and administrative organization for SSPO. The SIO engineering integration group manages, for example the Huntsville Operations Support Center (HOSC) activities related to Shuttle launch simulations, prelaunch testing, launch, and related data management; main propulsion system requirements review and issue resolution; the Shuttle Environmental Assurance (SEA) Initiative; and, the Space Shuttle Electromagnetic Effects (EME) task. Business management responsibilities include integration of SSPO budget and SIO Propulsion System Integration (PSI) Program Operating Plan (POP) requirements and submissions. Administrative functions cover a wide variety of responsibilities, including export control, SSPO Web site development, ISO 9001 requirements and compliance, and personnel actions. In addition, the SIO ensures that definition, development, and maintenance of office computer configurations and applications are accomplished according to SSPO requirements and priorities.

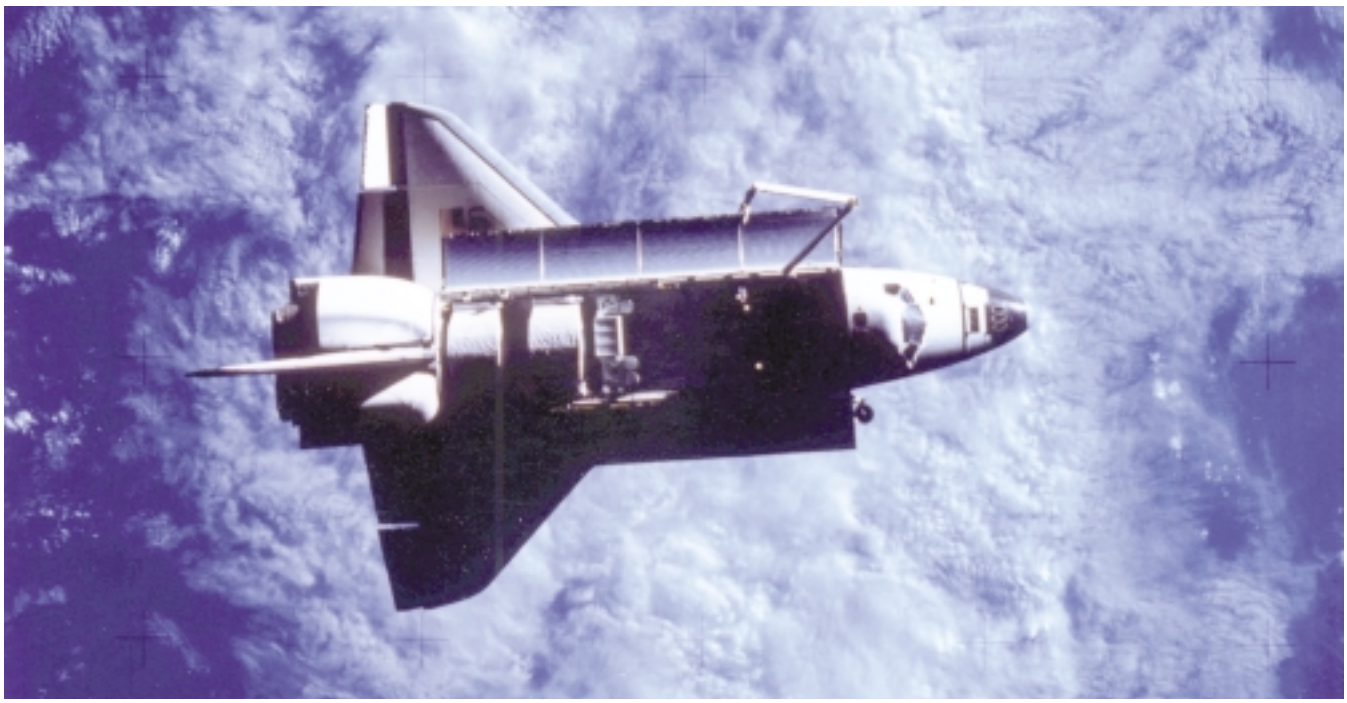
Space Shuttle Metrics

Project Activities

- Maintain less than one in-flight anomaly (IFA) per mission.
- SSME block II flights will be fully implemented during FY 2002.
- ET will implement friction stir welding for production of longitudinal welds.
- SRB will successfully continue the design, development, and qualification for the upgrade of the altitude switch assembly (ASA), within schedule and budget commitments. ASA's function is to initiate the parachute recovery system for the SRB which allows the SRBs to be recovered from the ocean and reused.
- The SRB Project will satisfactorily complete the formulation phase for the Integrated Electronic Aassembly (IEA) and Automated Booster Assembly and Checkout System (ABACS) supportability upgrades by mid-FY 2002.
- The RSRM project will identify and reduce risks to flight hardware and personnel caused by human/process error by optimizing human-system interfaces. Industrial Engineering for Safety (IES) upgrades to be pursued include—RSRM robotic glass bead, nozzle handling improvements, and high-pressure reciprocating pumps.
- The Space Shuttle Program will meet the manifest and improve mission supportability through—
  - Robust processes
  - Process control
  - Production process efficiency
  - On-time launches with no delays attributable to the MSFC propulsion elements.
- SIO will publish and distribute the Shuttle Environmental Assurance (SEA) Initiative Annual Report which defines the programmatic and technical accomplishments and activities for FY 2001.
- SIO will implement the Space Shuttle Program EME Action Plan in response to the Office of Special Council letter concerning potential EMI issues.
- SSPO will maintain a 90-percent customer satisfaction (rate) and document continuous improvement using input and feedback from the SSPO Web page.

Work Force Safety

- Conduct the following Safety Initiatives to ensure a safe workplace environment:
  - Monthly area walkthroughs and documentation
  - Monthly project safety meetings
  - Maintain safety performance records at our contractor facilities which exceed industry standards.



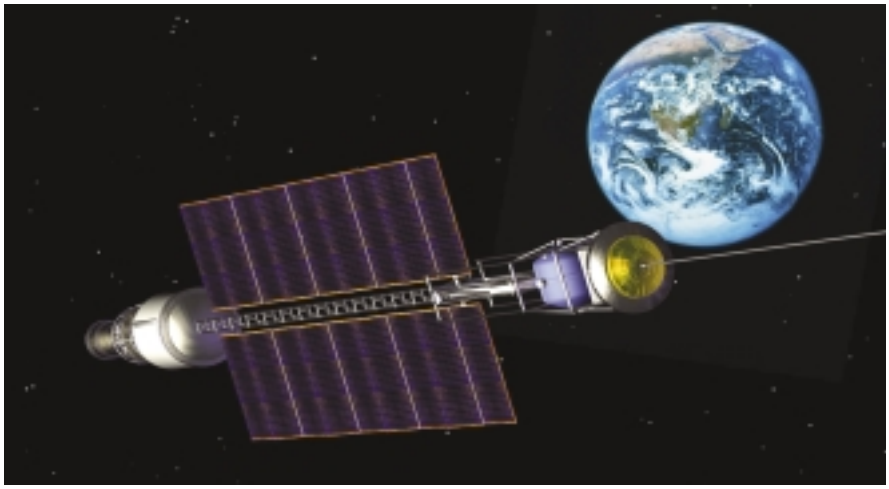
Advanced Space Transportation Technology

The Marshall Space Flight Center's Advanced Space Transportation Program (ASTP) is NASA's "technology central" for future space transportation systems. ASTP leads a team of NASA Centers, U.S. Government agencies, industry, and academia focused on products and developing a variety of propulsion and vehicle technologies. Technology development is concentrated in the areas of hypersonic transportation, travel beyond low-Earth orbit, and advanced concepts research. ASTP is developing innovative technologies needed for ultralow-cost space transportation systems as safe and reliable as today's airliners. Intense research efforts and technology development are aimed toward accelerating breakthroughs that will make it possible for ordinary people to live, work, and play on the space frontier.

The program's primary emphasis is on technologies for third generation RLV's that could be operational in a 2025 timeframe. The goal is to develop space transportation systems that would be 100 times cheaper and 10,000 times safer than today's launch vehicles. These true spaceliners of the future could take off from aerospace ports that will accommodate both air and space vehicles. Air-breathing propulsion, magnetic levitation, highly integrated airframe structures that morph in flight, and intelligent vehicle health management systems are some of the technologies being considered for a third generation RLV. ASTP is also investigating technologies for a fourth generation RLV that could be operational in the 2040 timeframe. The goal is to make space travel 20,000 times safer and 1,000 times cheaper than today's systems. Then, passenger space travel would become routine.

Dramatic improvements in our access to space will enable exciting new space markets, including—

- Space adventure tourism and travel
- Space business parks
- Clean, solar-electric power beamed from space to Earth's population
- Space hospitals for treatment of chronic pain and disabilities
- Asteroid mining of high-value minerals
- Worldwide, 2-hour express package delivery.



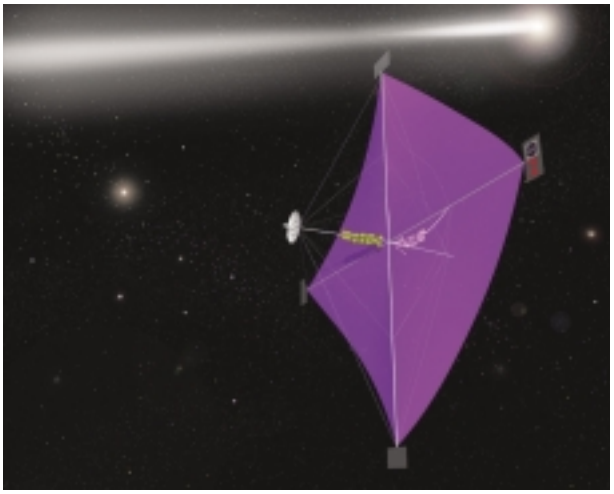
Momentum-exchange tethered propulsion (MXER).

Beyond Earth's orbit

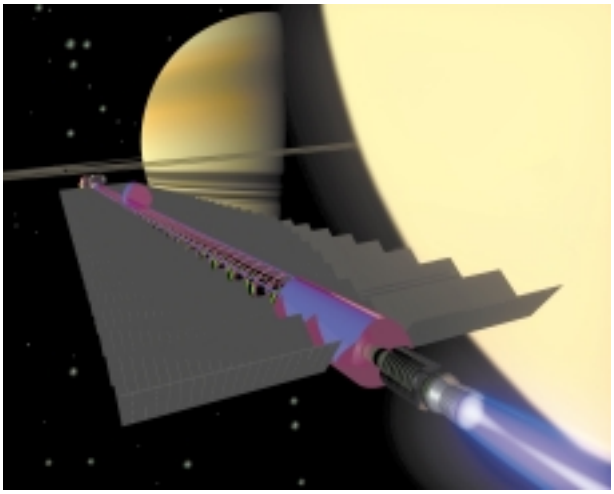
ASTP is developing technologies to decrease the trip times and reduce the weight of the propulsion systems required for planetary missions and even bolder missions to the edge of our solar system and beyond. Electrodynamic tethers, space sails, aeroassist and high-power electric propulsion are just a few of the technologies being developed to achieve the goals.

ASTP is also conducting fundamental research on the cutting edge of modern science and engineering including fission, fusion, antimatter propulsion, and breakthrough physics theories that might enable thrusting against space-time itself and faster-than-light travel.

The primary NASA internal customers and advocates of ASTP are the Office of Aerospace Science and Technology and the Office of Space Science. ASTP is a crosscutting technology program that also serves transportation users in NASA's Earth Science and Human Exploration and Development of Space Enterprises. The program also serves broad national interests by factoring DOD and commercial industry requirements into the process for selecting investments. System concepts and supporting technologies that meet customer needs will continually be assessed for potential payoff. Those concepts and technologies that have the highest payoff for the most critical or largest number of customer requirements will become higher priorities and will ultimately be included in the portfolio of ASTP technology investments.



Space sail propulsion.



Fusion propulsion.

Hypersonics

In addition to the goals of safer and cheaper RLVs, ASTP is promoting innovative research in the area of hypersonics. Hypersonic air-breathing propulsion offers the greatest potential for meeting NASA's safety, reliability, and cost goals for a third generation RLVs. Hypersonic technologies could open new space markets and expand U.S. defense capabilities.

Goals in the hypersonics investment area are to define, develop, and deliver the technologies—including verified advanced concepts, engineering capabilities, processes, and cultural changes—that will enable design, fabrication, verification, and airlinelike operations of revolutionary launch systems needed for a safe, affordable highway through the air and into space.

In-Space

More than 40 percent of payloads go beyond Earth orbit. NASA Marshall's ASTP is researching and developing in-space transportation technologies that run the gamut from orbital transfer to interstellar missions.

ASTP has many research and technology efforts underway to improve travel beyond low-Earth orbit. Presently, great strides are being made in the areas of propellantless propulsion systems such as space sails, tethers, and aeroassist to avoid carrying heavy fuel onboard and fission propulsion to enable rapid, affordable access to any point in the solar system, just to name a few. Technologies being developed by NASA and its partners will decrease trip times and reduce the weight of propulsion systems required for travel throughout our solar system and beyond.

Quality Objective

- The Space Transportation Directorate will initiate and maintain a customer feedback database that will be used to document, evaluate, and improve performance in the areas of—
  - Products and services
  - Customer relationships
  - Financial management.

ASTP Metrics

- Complete Systems Requirements Review (SRR) on Rocket-Based Combined Cycle (RBCC) demonstrator engine.
- Release NRA for next generation ion propulsion.
- Release NRA for in-space propulsion transfer technology.

Microgravity Research in Space

Our goal: Lead NASA's Microgravity Research and Space Product Development Programs, and develop and maintain capabilities required to meet national research objectives.

We Support

- **Biological and Physical Research Enterprise**
- **Human Exploration and Development of Space Enterprise**
- **NASA-Approved Principal Investigators**
- **National Scientific Community**
  - Academia
  - Industry
  - Government
- **Commercial Space Centers and Industry Partners**
- **American Companies/ Industries**

Astronaut Susan J. Helms (left) and astronaut James S. Voss, both Expedition Two flight engineers, aboard the Zvezda/Service Module of the *International Space Station* (*ISS*).

MSFC is responsible for implementing NASA's physical science research programs that utilize the low-gravity environment of space as a laboratory to conduct research. MSFC's efforts provide scientific and commercial researchers the unique opportunity to study phenomena normally obscured by Earth's gravity for the purpose of generating new knowledge, improving processes, and developing products and services that enhance the quality of life on Earth and support the human exploration of space.

MSFC implements this assignment through partnerships with other NASA and commercial space centers. In addition to working closely with the U.S. academic, industrial, and Government communities, strong relationships have been forged with international partners who have common research and hardware goals and objectives.

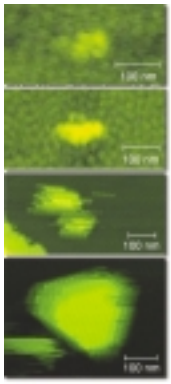
MSFC, in conjunction with our partners, administers research grants and contracts; manages the development of specialized instrumentation; flight hardware and research facilities; secures flight opportunities on parabolic aircraft, the Space Shuttle, and the *ISS*; and provides education and outreach opportunities to the research community, industry, and the public. Additional information on microgravity research in space can be found at www.microgravity.nasa.gov.

Students from middle schools and high schools across America have prepared biological samples for a microgravity biotechnology experiment that astronauts placed aboard the *ISS*.

Microgravity Research Program

The mission of the Microgravity Research Program is to use the environment of space to obtain new knowledge and increase the understanding of natural phenomena in biological, chemical, and physical systems especially with regard to the effects that may be obscured on Earth. The Microgravity Research Program also facilitates the application of such knowledge to commercially viable products, processes, and services.

Microgravity researchers are provided the unique opportunity to study natural processes and phenomena in the near absence of gravity. Comparison between ground- and space-based research data allows scientists to accurately understand the role gravity plays in everyday life. Low-gravity research also allows

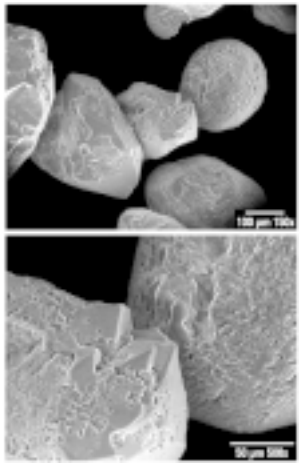


Microgravity biotechnology investigator Peter Vekilov, of the University of Alabama in Huntsville, and his team of researchers have perfected techniques to catch individual molecules at the moment they begin to organize. Vekilov and his team use an atomic force microscope to create subatomic image sequences of molecules as they attach and detach from a crystal nucleus. Using this tool, they have been able to observe individual molecules of the substance, apoferritin (a protein that stores iron in the body), as they join into a nucleus 20–50 molecules in size. Prior to this discovery, scientists could only gauge the rate of nucleation in any given crystal mass by counting the crystals once they had grown to macroscopic size. This discovery will allow scientists to directly measure nucleation rates in the very smallest of aggregates. Molecules of the iron-storing protein apoferritin come together to form a nucleus in this series of images. A cluster of four molecules in a diamond shape marks the beginning of nucleation (top). As more molecules attach to the cluster, they arrange themselves into rods (second from top), and a raft-like configuration of molecules forms the critical nucleus (third from top). In the final image, a crystallite consisting of three layers containing approximately 60–70 molecules each is formed.

scientists the opportunity to explore phenomena normally masked by the effects of gravity. Scientists selected into the program perform peer-reviewed fundamental and applied investigations in the research areas of cellular and molecular biotechnology, combustion science, fluid physics, fundamental physics, and materials science. MSFC manages the implementation of the program including the development of major facilities to be permanently housed on the *ISS* and available to the science community for unique low-gravity research opportunities.

Microgravity Research Metrics

- Publish abstracts and reports of progress for over 90 percent of FY 2000 research investigations.
- Support publication of approximately 1,500 journal articles in referenced journals.
- Support emergent microgravity research programs in biophysics and tissue engineering by selecting up to 10 new investigations.
- Through the use of national teacher conferences and workshops, provide approximately 300 elementary and high school classrooms nationwide with electronic (multimedia/computer technologies) and printed materials that focus on activities in science, math, and technology relating to microgravity research and specifically written for students in grades K–12.
- Conduct biotechnology, fluid physics, and small multidiscipline investigations on the *International Space Station* according to the U.S. Partner Utilizing Plan.
- Launch and operate 12 *International Space Station* research investigations.
- Launch and operate six Space Shuttle microgravity research investigations.
- Establish at least one process to monitor and evaluate customer satisfaction.



What appears to be boulders fresh from a tumble down a mountain are really grains of Ottawa sand, a standard material used in civil engineering tests and also used in the Mechanics of Granular Materials (MGM) Experiment. The craggy surface shows how sand grains have faces that can cause friction as they roll and slide against each other, or even causing sticking and form small voids between grains. This complex behavior can cause soil to behave like a liquid under certain conditions such as earthquakes or when powders are handled in industrial processes. MGM uses the microgravity environment of space to simulate this behavior under conditions that cannot be achieved in laboratory tests on Earth. MGM is shedding light on the behavior of fine-grain materials under low effective stresses. Applications include earthquake engineering, granular flow technologies (such as powder feed systems for pharmaceuticals and fertilizers), and terrestrial and planetary geology. Nine MGM specimens have flown on two Space Shuttle flights. Another three are scheduled to fly on STS–107.

Space Product Development

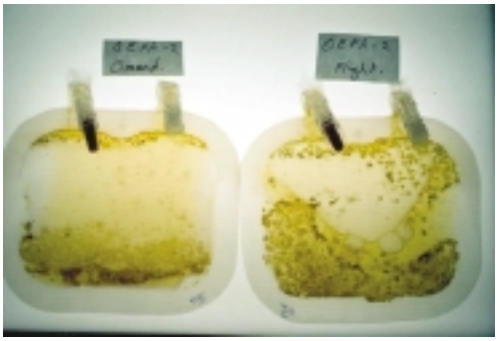
The mission of the Space Product Development (SPD) Program is to encourage and facilitate the use of space for the development of commercial products and services. In fulfilling this responsibility to encourage the fullest commercial use of space, the SPD Program is managing an organization of Commercial Space Centers (CSCs) that have successfully employed methods for encouraging private industry to exploit the benefits of microgravity research in the areas of advanced materials, biotechnology, and agribusiness. The unique opportunities of this environment are being made available to private industry in an effort to develop new competitive products, create jobs, and enhance the quality of life. Success of the CSC's research is evidenced by the increasing amount of participation in commercial microgravity research and the potential products nearing marketability.

Astronaut James Voss takes air samples from the advanced astroculture installed in EXPRESS rack in the Destiny lab module of *ISS*.

Space Product Development Metrics

- Maintain a ratio of non-NASA funding to NASA funding not less than 3:1 in FY 2002.
- Ensure that one of 39 product lines currently under investigation is brought to market in FY 2002.
- Enable at least 10 new active industrial partnerships to be established with Space Product Development Commercial Space Centers.
- Launch and operate seven Space Shuttle Space Product Development research investigations.

Commercial space and microgravity research with a rose resulted in a new scent that is now a part of Zen perfume.



Commercial space and microgravity research in microbial fermentation may help improve pharmaceutical production on Earth.

Microgravity Science and Applications

Glovebox

The Microgravity Program maintains two glovebox facilities for use in performing experiments whose hardware can be implemented as a small, self-contained device that can benefit from crew interaction. These facilities provide containment for the experiments plus power, data acquisition, computer control, video recording, and photo imaging. The smaller unit is designed for the Shuttle middeck and the SpaceHab facility, while the larger Microgravity Science Glovebox (MSG) will be installed in the *ISS* in 2002. Also under development for MSG is a microgravity vibration isolation system that is designed to mount to the experiments on a levitated base to shield them from externally induced disturbances. Both glovebox facilities are modeled after a laboratory workbench and then fly essentially the same design in space where the flight crew can operate it in microgravity. The investigator can participate closely in the flight operation through video and real-time data links. In addition to providing flight facilities, the program also advises the investigator during the building of experiment hardware and provides guidance through the required documentation and safety measures required of all NASA space flight activities.

Glovebox Metrics

- Deliver the Microgravity Science Glovebox Facility to *ISS* for flight.
- Deliver the vibration isolation system glovebox integrated microgravity technology (g-Limit) to *ISS* for flight.
- Integrate four experiments into MSG for flight.
- Hold a postflight workshop for potential MSG investigators after the facility becomes operational.

Materials Science Research

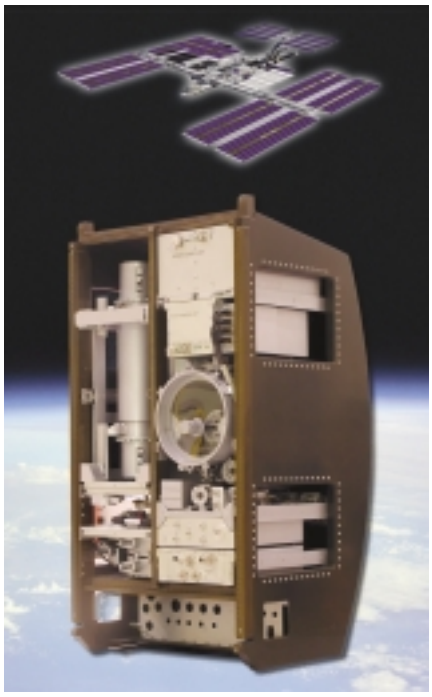
The Materials Science Program deals with relationships among processing, structures, and properties of materials. The goal is to control processing to yield materials with exceptional properties and thus enhance performance. Materials scientists seek to understand the mechanisms by which structures are formed and how they influence material properties on various scales ranging from atomic through microscopic to very large macroscopic levels. Understanding these relationships between material structures and their corresponding physical properties is key to the manipulation of various processing parameters to obtain optimal material performance.

Basic materials science programs study the fundamental and direct relationship between gravity and certain biological, chemical, and physical processes; in which case, gravity is a considerable experimental variable. The *ISS* will give scientists an opportunity to conduct long-duration microgravity science investigations in the absence of any significant gravity effects.

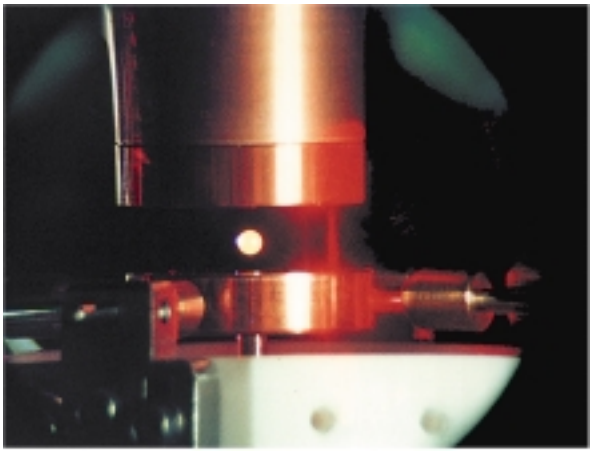
The Materials Science Research Rack (MSRR–1) will be the primary faci-lity for materials science experiments in microgravity aboard the *ISS*. It will operate in the U.S. laboratory module, Destiny, and, along with smaller facilities, accommodate the current and evolving cadre of microgravity materials science investigations.

Research Metrics

- Deliver and operate two fundamental material science investigations in the Microgravity Science Glovebox on the *International Space Station*.
- Fly on STS–107 and retrieve data from the Mechanics of Granular Materials Experiment.
- Complete one peer review of a new investigation science concept.
- Identify and explore the fundamental and unresolved issues in at least one new materials science field.
- Support the release of the first annual NASA Research Announcement to select peer-reviewed research in materials science.



MSRR-1: The cutting edge of materials science research aboard the *ISS*.



Molten sample suspended between the electrostatic levitator electrodes.

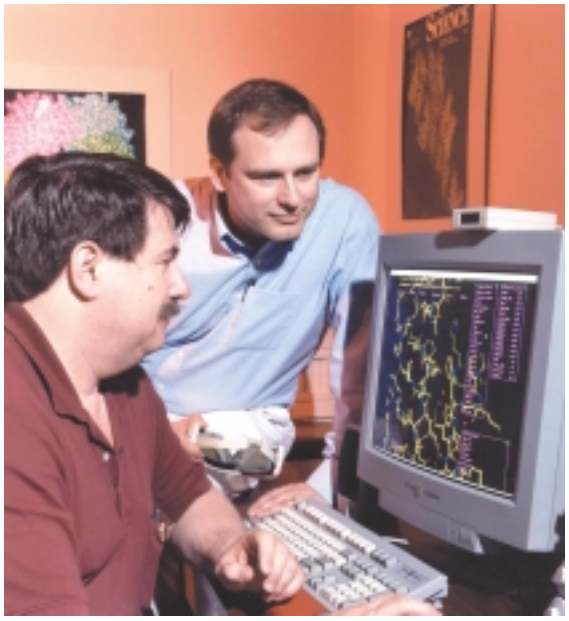
Molecular Biotechnology

MSFC is the focal Center for the study of molecular biophysics and biochemistry for the microgravity program. Historically, the program has been focused on the use of the low-gravity environment to assist researchers in performing experimentation to answer both fundamental and applied scientific questions. New directions include branching out beyond the constraints of research dominated by low-gravity experimentation. The current focus of the Molecular Biotechnology Program is on structural biology. In essence, this is the study of the fundamental building blocks of life. That information is critical to advancing knowledge in a wide variety of areas. Specifically, the goals of the program are to—

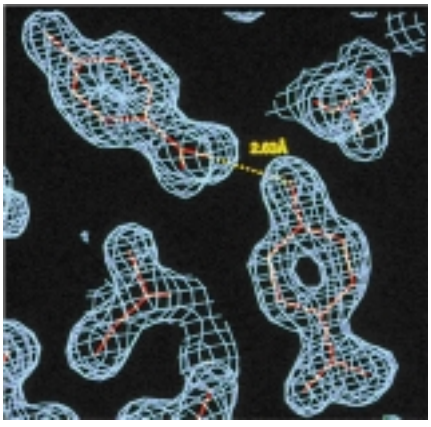
- Provide capability to the Agency to answer the basic question of the existence of life, simple or complex, beyond the planet Earth
- Provide capability to the Agency to the study of biological systems that may assist the exploration and development of space. That study includes both the understanding of the fundamental role of gravity and radiation in vital biological systems and the application of biology-based systems to perform tasks currently performed by inorganic systems
- Transfer or enable the transfer of knowledge gained from the research into products to improve the quality of living in Earth and in space.

Molecular Biotechnology Metrics

- Provide flight opportunities for peer-reviewed investigators to gather data on macromolecular crystal growth.
- Expand student and teacher involvement in the biological crystallization education program to 12 states.
- Support the release of the annual NASA Research Announcement to select peer-reviewed research in molecular biotechnology.



Dr. Craig Kundrot and Dr. Marc Pusey examine a computer model of the three-dimensional structure of a biological crystal grown on a space mission.



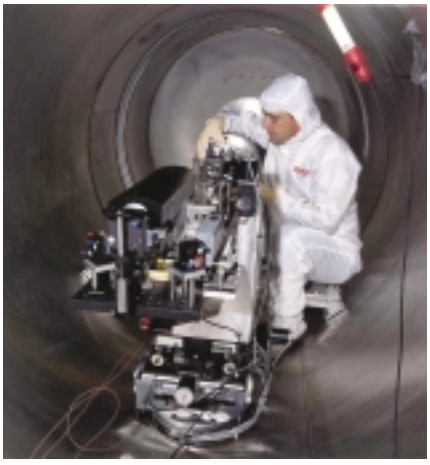
Electron density map of a molecule.

Space Optics Manufacturing Technology

Our goal: Lead the Agency in the development of lightweight, large-aperture space optics manufacturing technology for use in achieving the mission goals of NASA's strategic enterprises.

We Support

- **HEDS Enterprise**
- **Space Science Enterprise**
- **Earth Science Enterprise**
- **Aerospace Technology Enterprise**
- **Industry and Commercial Needs**
- **Other Federal Agencies**



Radius of curvature measurements in the XRCF on developmental mirrors.

Optics is an essential part of NASA's missions. The continuing exploration of the universe requires ever increasing apertures. The development of lightweight optics and optical systems is key to the reduction of launch costs.

The Space Optics Manufacturing Technology Center (SOMTC) is continuing the development of new technologies for the production of large-aperture, lightweight optics for space-based systems. SOMTC is managing and evaluating the development of advanced mirror technologies for use in space-based observatories including the Next Generation Space Telescope (NGST) and the Constellation X-Ray Mission.

SOMTC is organized into four functional groups—Advanced Concepts Group; Optical Test Group; Optical Design, Analysis and Coating Group; and the Optical Fabrication Group.

Advanced Concepts being developed include ultralightweight optics, adaptive optics, and alignment techniques for segmented optical systems. Ultralightweight optics includes membrane optics, inflatable optics, and replicated optics.

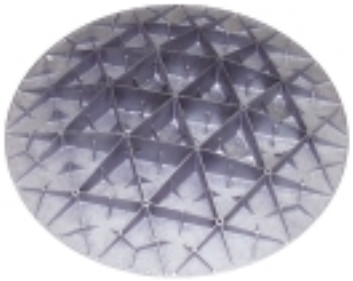
The goal is to eventually get to 0.1 kg/m^2. Normal incidence replicated mirrors have already been produced at 1.0 kg/m^2. Further development of the control of the replication process is on going to improve the optical quality.

Large copper Fresnel mandrel on SOMTC diamond turning machine.

Proof-of-concept demonstrations are in process for solar pumped and solid-state dye lasers for power-beaming applications. Demonstration is being developed for segmented concentrators for photovoltaic systems with a performance goal of 1 kw/kg in support of megawatt solar electric propulsion systems.

Optical Test provides state-of-the-art x-ray testing and optical testing under cryovac conditions. The group utilizes the x-ray calibration facility (XRCF) and the stray light test chamber. These facilities support testing at wavelengths from x ray through infrared. The XRCF has been outfitted with a helium shroud that allows testing below 35 K. The 7-m diameter XRCF chamber has a helium shroud that allows optical figure testing of 2-m aperture optics at temperature below 35 K. The XRCF will be used to evaluate additional technologies

Solar X-Ray Imager (SXI) testing in the XRCF.

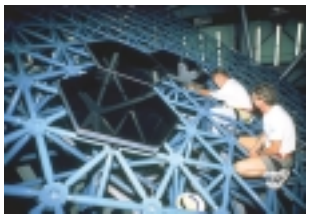


Rear view of the lightweight .5-m diameter carbon silicon carbide (C/SiC) mirror substrate.

for lightweight mirror applications in support of NGST. Additional cryo-vac testing of lightweight mirror systems for various Government systems is planned under space act agreements for contractor Internal Research and Development (IR&D) programs. The group is working with two contractors to help evaluate the performance of additional mirror and metering structure concepts for NGST. The XRCF will also continue to provide x-ray testing for the Solar X-Ray Imager (SXI) telescopes.

Optical Design and Analysis provides the optical design, optomechanical design, optical metrology, and optical data analysis for all systems in SOMTC. The optical metrology team has the capability for measuring the surface finish and figure in process, after completion of the optic and final acceptance of the assembled system. Optical analysis includes performance predictions of optical and x-ray systems based on the component tests. The prediction capability ensures compliance of the final system with the performance specifications.

Optical Fabrication and Coating included classical optical processing, single point diamond turning, computer controlled polishing, and ion milling. The classical optical processing operation has capability to 0.5-meter aperture. The single-point diamond turning has capability of turning components up to 1.5 meters in diameter. The current capacity of the ion polishing facility will be expanded and a precision optical surface generator will be installed during the plan period. A machine shop supplies small parts and tooling tin support of the optical fabrication group.



Mirror installation on truss of Hobby-Eberly Telescope with segment alignment maintenance system (SAMS).

Space Optics Manufacturing Technology Metrics

- Implement a control system for the global radius of curvature on a segmented ground-based telescope.
- Complete a 0.25-meter diameter x-ray mandrel and produce an electroformed shell under 0.25-mm thick.
- Test two additional mirror technologies in the XRCF in support of NGST.
- Produce a diamond turned double-sided Fresnel lens on a curved substrate.
- Install and demonstrate the precision optical generator in the optical fabrication area.
- Implement an advanced mirror algorithm simulation using a large cluster computer.
- Expand the size of the current ion polishing capability.
- Develop rugged laser sources of less than 0.01-m^3 volume and large-gain, medium area for use in sourcing microgravity imaging and diagnostic science.
- Perform experimental characterization of a bandpass modulation element using nonmechanical means for implementing phase modulation.
- Reduce the optical figure in the normal incidence electroformed optics by a factor of two.
- Establish at least one process to monitor and evaluate customer satisfaction.

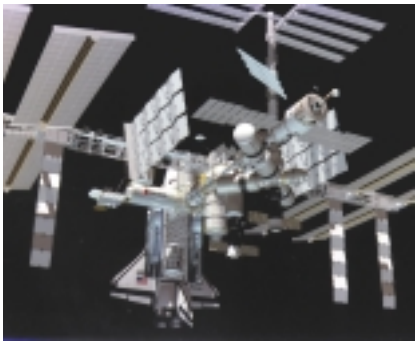
Other Programmatic Assignments

Support Agency and other Center scientific and technical initiatives and various Agency infrastructure activities, in assigned roles delegated to the Center

The following is a brief summary of flight project assignments being implemented by MSFC for the NASA Enterprises and other Lead Centers.

We Support

- **Human Exploration and Development of Space Enterprise**
- **Biological and Physical Research Enterprise**



Node 2 being prepared for transfer to Alenia clean room.

International Space Station

The *ISS* is a U.S.-led, international partnership program to build and operate a unique, world-class orbiting laboratory, free from the effects of gravity. Long-term scientific and technology development will be conducted for the benefit of life on Earth and the continued exploration and development of space.

Marshall supports the *ISS* Program through task agreements with the *ISS* Program Office at the Johnson Space Center (JSC). Marshall plays a vital role in building, operating, and utilizing the *ISS* for NASA through the performance of these tasks.

Specifically, Marshall is responsible for the development of the regenerative life support systems for the *ISS* crew and the research animals. The *ISS* crew will be provided a comfortable environment in which to live and work. Collectively, this is called the Environmental Control and Life Support System (ECLSS). The Marshall managed portions of the ECLSS will include the development of the Water Recovery System (WRS) to recycle wastewater (including urine) to produce drinking (potable) water, storage and distribution of potable water, and use of the WRS recycled water to produce oxygen for the crew via the Oxygen Generation System (OGS).

Marshall is providing technical management oversight of Nodes 2 and 3, which will be provided by Alenia Spazio under contract to the Agenzia Spaziale Italiana (ASI) through a bartered European Space Agency to NASA agreement. The purpose of Node 2 and 3 is to act as the connecting elements for other station elements including the space station system utilities and to provide a safe pressurized passageway between other international elements. Both Node 2 and 3 utilities include commands and data flows; audio, video, electrical power, thermal and atmosphere controls; and water. Node 3 will uniquely provide the crew with a toilet and cleansing areas, and will contain the ECLSS hardware.

Marshall is a leader in the development of payload facilities for the *ISS*. Our innovative Expedite the Processing of Experiments to Space Station (EXPRESS) rack, provides simple, standard interfaces to accommodate drawer-level, locker,

and modular-type payloads from all science disciplines. The EXPRESS rack concept provides for a simple and shortened integration cycle. By leveraging off of a common avionics design, Marshall has been able to develop derivative payload facilities for other NASA customers, at a reduced cost for the *ISS*. Future *ISS* maintenance costs will be reduced, through the ability to share spare replacement units and repair depots on the common avionics.

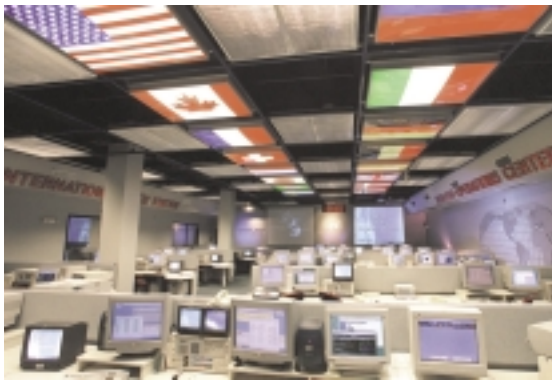
MPLM flight module 1 in Discovery's payload bay during the STS–105/5A.1 mission.

In addition, Marshall is providing various types of hardware to carry essential equipment into space. Among these is the Multipurpose Logistics Module (MPLM), which serves as the *ISS* moving van. The MPLM, loaded with laboratory racks filled with experiments, supplies, and equipment, travels in the Space Shuttle payload bay to dock via the robotic arm to the *ISS*. There, the crew unloads and reloads the MPLM to start the process all over again, giving a quick turn-around to support the *ISS* mission schedule. ASI/Alenia has provided three MPLMs. MSFC is responsible for engineering oversight of the MPLM and sustaining engineering of the MPLM modules, as well as overall project management.

Marshall provides integration support of spacelab pallets and support equipment for Shuttle payloads. The payload carriers project provides several Spacelab Pallets (SLP) and lightweight multi-purpose experiment support structure carriers (LMC) for unpressurized payloads. The SLP is a general purpose unpressurized carrier that has flown on many Space Shuttle missions since 1983. It is also the optimum carrier for cargo items because it maximizes use of the Shuttle's curved orbiter cargo bay. It also provides the services to make the Shuttle compatible with cargo items. The LMC provides a versatile cross-bay carrier to provide payload and cargo accommodations in previously underutilized cargo bay locations. It will fly in the orbiter's bay 13, where no carrier has flown before, and over the top of a preinstalled pressurized tunnel.

Marshall's Testing, Manufacturing and Support Team (TMAS) is providing technical expertise to *ISS* design and development teams. The areas of hardware design, fabrication, manufacturing, and testing including structural, dynamic, environmental, electromagnetic, and acoustics will be supported.

Marshall is responsible for the management, integration, and execution of payload operations and utilization activities onboard the *ISS*. The Payload Operations Center, located at MSFC, is the *ISS* Program focal point for payload operations. MSFC controllers staff the facility and interact with the worldwide scientific research community to plan and conduct payload operations on board the *ISS*.



Payload Operations Center.

MSFC is responsible for the integrated payload training for the increment crews. Execution of the training is a joint effort between MSFC and JSC.

Providing the technology infrastructure for payload operations is also part of Marshall's charter. The command and control systems for operating vehicle systems related to payloads are implemented in the Huntsville Operations Support Center, as well as the data distribution systems to provide command and control connectivity to the international partner payload facilities, and remote U.S. Principal Investigators. Unique payload planning and support systems are also part of this infrastructure. And, even at the remote locations, Marshall is providing the Telescience Resource Kit (TReK) to give remote users a ready-made, low-cost solution for processing and displaying their science data.

International Space Station Metrics

- Generate per-increment plans that utilize at least 90 percent of the resources assigned to utilization.
- Maintain performance metrics to measure the ability of the Payload Operations Center to meet the requirements of the *ISS* Utilization Program.
- Perform resource tracking to ensure that utilization resources are allocated in real-time according to program baselined documentation.
- Launch of MPLM Rafaello (FM–2), UF–1 mission, in 1st quarter FY 2002.
- Launch of multipurpose logistics module Leonardo (FM–1), UF–2 mission, in 3rd quarter FY 2002.
- Conduct monthly payload operation status reviews with MSFC management.
- Conduct quarterly payload operation status reviews with program office management.
- Maintain the payload operations budget within 5 percent of the mark.
- Complete and certify the cargo element for the UF–1 LMC mission. 1st quarter FY 2002.
- Complete and certify the Service Module Debris Shield (SMDP) cargo element for the UF–2 sidewall carrier mission, 2nd quarter FY 2002.
- Complete integration design review for the Ranger Mission, 3rd quarter FY 2002.
- Complete and deliver the UF–4 flight support equipment, 3rd quarter FY 2002.
- Node 2 integration and systems testing completed, 4th quarter FY 2002.
- Node 3 design review number two completed, 4th quarter FY 2002.
- Participate in the Research Program Payload Program manager reviews and support the end of the year review with payload operation metrics.
- Vapor Compression Distillation (VCD) flight experiment, which will be used as an engineering precursor to the final urine processor assembly to fly on STS–107, scheduled for 4th quarter FY 2002.
- Subsystem drawings for WRS, OGS, and power supply module completed, 4th quarter FY 2002.
- WRS/OGS critical design review. 3rd quarter FY 2002.
- Support the implementation of voice over the Internet to drastically reduce the cost of payload operation voice communication requirements.
- Generate per-increment plans that utilize all the middeck lockers assigned to utilization.

Advanced Projects

We Support

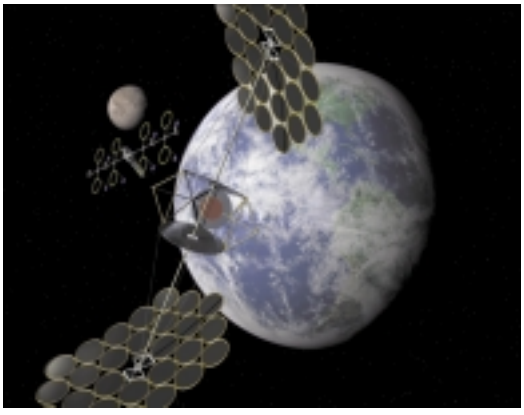
- **Biological and Physical Research Enterprise**
- **Human Exploration and Development of Space Enterprise**
- **Space Science Enterprise**

The Advanced Projects Office provides support to the development of future projects through the Human Exploration and Development of Space (HEDS) Technology Commercialization Initiative (HTCI) and Space Solar Power (SSP) activities. These activities include analysis of systems concepts; technology development and demonstrations to identify viable approaches to future space development, exploration, and SSP for Earth, planetary surfaces, and space applications. Products will enable NASA management to make informed decisions on a portfolio of space development and exploration concepts, including SSP technology investments.

Advanced Projects Metrics

- Provide NASA HQ with technical and program management support as needed for HTCI activities.
- Provide support to NASA HQ with preliminary definition of potential technology flight experiments on the *ISS* for SSP, propellant depots, or other flight project areas as requested.
- Provide NASA HQ with technical and program management support as needed for the international forum activities.

New space industries could result from HTCI activity.



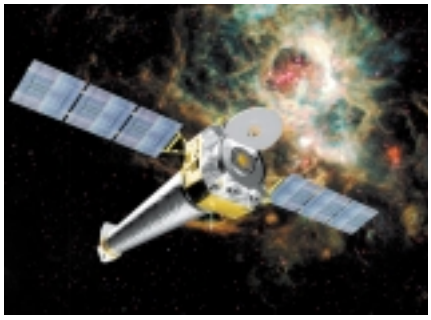
Space solar power.

Space Science Research

MSFC is a Supporting Center to Goddard Space Flight Center for the Space Science Enterprise. Marshall performs cutting-edge research and technology development in six areas of space science and manages several space science missions.

We Support

- **Space Science Enterprise**
- **Human Exploration and Development of Space Enterprise**
- **Aerospace Technology Enterprise**



Chandra X-Ray Observatory.

Marshall performs cutting-edge research in the areas of x-ray astronomy, gamma-ray astronomy, cosmic-ray astrophysics, solar physics, space plasma physics, and astrobiology. This peer-reviewed research includes technology development, scientific observations, and data analysis as well as mission planning and execution.

Chandra

MSFC manages the operation of the MSFC-developed Chandra X-Ray Observatory through the Operations Control Center and the Chandra X-Ray Center at the Smithsonian Astrophysical Observatory in Cambridge, MA. Program goals are to determine the nature of celestial objects from normal stars to quasars, understand the nature of physical processes that take place in and between astronomical objects, and understand the history and evolution of the universe. These goals will be accomplished by extending the range of astrophysical observations significantly beyond that of previous x-ray observatories through increases in sensitivity and resolution.

Gravity Probe-B

MSFC manages the overall design, development, integration, test, and flight operations of the Gravity Probe-B (GP–B) flight experiment. The scientific objective of GP–B is to test two extraordinary predictions of Einstein's Theory of General Relativity, namely geodetic precession and frame dragging, both of which describe distortions in the space-time continuum. To test these subtle effects, GP–B will fly ultraprecise gyroscopes aboard a drag-free spacecraft containing the world's largest space-qualified dewar.

Gravity Probe-B.

Solar X-Ray Imager

The Solar X-Ray Imager (SXI) was successfully launched on July 23, 2001, on the NOAA Geostationary Operational Environmental Satellite (GOES–M). The SXI was designed, built, and tested at MSFC and is the first operational solar x-ray instrument used to monitor solar activity by imaging the x-ray emissions of the sun. After launch, checkout of the GOES–M and SXI indicated that all performance goals have been met. After initial checkout and performance verification, GOES–M took up a position as a "hot spare" and turned off. It will be reactivated when one of the two existing operational GOES satellites fails.

Solar-B

MSFC manages the U.S. contribution to the Japanese Solar-B mission. The goal of this mission is to increase our understanding of the sun and its impact on Earth. Scheduled for launch in 2005, the mission consists of an international array of instruments and scientists, with a significant contribution from the U.S. Delivery of the MSFC-managed flight model hardware is scheduled to take place by December 2003.

GLAST Burst Monitor

Scheduled for flight on the Gamma-Ray Large-Area Space Telescope (GLAST), in 2006, the Glast Burst Monitor (GBM) will provide broad spectral coverage and accurate locations of the enigmatic gamma-ray bursts which remain the hottest topic of research in high-energy astrophysics.

Solar-B.

As one of seven research partnerships in the National Space Science and Technology Center, this element of MSFC's Science Directorate conducts cutting-edge research in six areas—

X-Ray Astronomy

In May, a prototype telescope, consisting of six unique x-ray mirrors, developed at Marshall, obtained the world's first focused, high-energy x-ray images of any astronomical object. The final High Energy Replicated Optics (HERO) payload will consist of 240 mirrors and is scheduled for completion in 2003.

Gamma-Ray Astronomy

In gamma-ray astronomy, MSFC scientists will continue to distribute and analyze data from the Burst and Transient Source Experiment of the Compton Gamma-Ray Observatory. The team will produce final catalogs of gamma-ray bursts and low-energy gamma-ray sources. Team members have initiated a broad collaboration to perform observational and theoretical studies of astrophysical jets and their relation to gamma-ray sources.

Cosmic-Ray Astrophysics

The cosmic-ray team is analyzing data from and preparing for a balloon flight of the advanced thin-ionization calorimeter. The team is also conducting a Phase-A study for an experiment on the Heavy Nuclei Explorer Mission, and developing proposals for an Advanced Cosmic-Ray Composition Experiment on Space Station and for ESA's Extreme Universe Space Observatory.

Solar Physics

A unique solar ultraviolet magnetograph instrument is under development as proof-of-concept for a future space mission. Measurements of the sun's vector magnetic field, taken at Marshall's solar observatory, and measurements from several space platforms are being analyzed to better understand the variability and the dominant solar mechanisms at work in our own star.

Space Plasma Physics

Space observations, modeling, and laboratory experiments are used to reveal the dynamic processes of space weather and the effects on spacecraft. Currently active experiments include the Thermal Ion Dynamics Experiment and the Ultraviolet Imager (UVI) on the Polar spacecraft and the wide-angle imaging camera on the IMAGE spacecraft.

Astrobiology

Marshall scientists are studying microorganisms living at extremes of temperature, alkalinity, acidity, and salinity to understand what life-forms might inhabit other bodies of the cosmos. Studies of fossil bacteria from ancient rocks could yield biomarkers (traces of life) that could be the basis for experiments either on "lander" missions or on "sample return" missions.

Scientific Payloads and Research Metrics

Chandra Metrics

- A commitment for viewing efficiency greater than 50 percent average per year, with a goal of 60 percent.
- Loss due to interruption of program due to ground error/procedures less than five percent per year.
- Data loss from observation to delivery to user less than 5 percent.

- **Gravity Probe-B**

  Launch GP–B in October 2002.

  Mission lifetime of 16 months.

  Measurement accuracy for relativistic drift of 0.5 milliarcsecond/year.

- **Solar-B**

  Mission lifetime of 3 years.

  Engineering models by March 2002.

  Focal plane instrument to ISAS by November 2002.

  Final delivery of XRT by July 2003.

- **Solar X-Ray Imager**

  Mission lifetime of 3 years.

  Full-disk soft x-ray imaging of the sun, including solar flares and coronal holes.

  Support transition to operational status.

- **GLAST Burst Monitor**

  Launch in September 2005.

  Mission lifetime of 5 years.

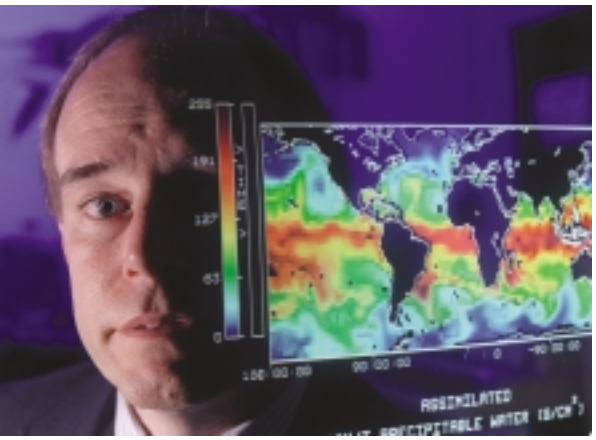
  Detectors delivered by MPE in September 2003.

  Observe gamma-ray bursts from 5 kev to 30 mev.

Global Hydrology and Climate Center

We Support

- **Earth Science Enterprise**
- **National Oceanographic and Atmospheric Administration**



The Global Hydrology and Climate Center (GHCC) is a joint venture between the Earth Science Department of MSFC, the University of Alabama in Huntsville, and the Universities Space Research Association. GHCC, which is located at the National Space Science and Technology Center (NSSTC), engages in research, education, and technology infusion of Earth sciences. The Earth Science Department focuses on using advanced technology to observe and understand the global climate system and applies this knowledge toward understanding basic questions about the Earth system, operational meteorology, urban planning, agriculture, and water resource management. Areas of emphasis include observations of precipitation, lightning, multispectral remote sensing of the Earth's surface, the global hydrologic and energy cycles, and numerical modeling of weather and climate.

Significant advances have recently been made by GHCC scientists in quantifying changes to oceanic evaporation, precipitation, and other components of the global hydrologic cycle. Using a wide range of satellite-based observations, cloud process models, and climate model integrations, research is currently being directed toward an improved understanding of how physical processes involving clouds, water vapor, soil moisture, and snow cover act to constrain or amplify climate variability.

The continued acquisition of global lightning data from the Lightning Imaging Sensor (LIS) onboard the Tropical Rainfall Measurement Mission (TRMM) will contribute to an understanding of the relationship between lightning flash rate and severe storm onset as well as to storm precipitation totals. Advanced lightning measurement techniques will be pursued via a Thunderstorm Observation and Research (ThOR) mission for continuous lightning mapping from geostationary orbit.

Additional lightning data will be gathered utilizing an Uninhabited Aviation Vehicle (UAV) as the observing platform in the ALTUS Cumulus Electrification Study (ACES) Project in the summer of 2002 at KSC. This field program will provide valuable data in studying severe storm processes, as well as demonstrating the UAV technology.

A regional forecast improvement laboratory integrating space technology with ground-based data sets and numerical models is being planned as a cooperative venture with universities as well as the operational forecast offices of the National Weather Service. This effort should accelerate the use of NASA's Earth observing system data in helping to improve the regional short-term weather prediction and warning issues and is part of NASA's contribution to the U.S. Weather Research Program.

Other regional activities include evaluating the interannual climate variability of the southeast U.S. and determining implications on key economic sectors. Other studies are addressing such regional scientific issues as regional sources and sinks for tropospheric ozone and its transport, regional air chemistry and air quality, and water management questions. We are pursuing new formalisms of incorporating urban heat island measurements into predictive meteorological and air quality models as well as the use of intelligent system capabilities to aid state and local regional planning decision makers in dealing with

societal issues. Other areas of expertise include developing improved satellite retrieval techniques to measure and monitor atmospheric aerosol concentration, its transport, and its influence on radiative properties of clouds.

The GHCC also supports unique archaeological studies using remote sensing for studying impacts of climate variability on pre-Columbian American settlement patterns, contributing to ESE global land-use classification, and to support the NASA Memorandum of Understanding (MOU) with Central America for technology transfer in the use of remote sensing in land-use change research there.

Other areas supported by the Earth Science community within the GHCC include the development of improved satellite retrieval techniques to measure and monitor atmospheric state variables, aerosol concentration, their transport and influence on radiative properties of clouds, and validation studies for various EOS instruments. As a research support function, GHCC will continue developing its capabilities through component data information systems for LIS, MSU, AMSU, AMSR, and SSM/I measurements and the efficient accessibility by the science community.

Global Hydrology and Climate Center Metrics

- Continue archival and distribution of global temperature measurement database from orbiting microwave sounding units.
- Begin initial calibration and validation of the new special sensor microwave imager/sounder and demonstrate scientific usefulness.
- Analyze lightning and passive microwave data collected by airborne sensors during the CAMEX–4 hurricane experiment. These data along with that collected by all CAMEX–4 instruments will be cataloged and archived by the GHRC by the end of FY 2002.
- Continue successful operation of lightning imaging sensor on board the tropical rain measuring mission.
- Extend diagnostics of tropical energy and water cycle to quantify water vapor and cloudiness interactions with radiation during El Nino and La Nina (ENSO) events.
- Develop an initial assessment of the ability of current climate models to simulate ENSO-related climate perturbations vis-à-vis Earth observing system satellite observations.
- Support development of the meso-American biological corridor by completing the transfer of remote sensing analysis technology to Central American partners.
- Demonstrate the importance of physical measurements to characterize urban surface properties for parameterization in climate and air-quality models.
- Develop and promote the use of remote sensing, geospatial technologies, and analysis products by decision makers and transportation specialists as part of the DOE/NASA National Consortia on Remote Sensing in Transportation.
- Operate and maintain a GOES ground station to foster the use of geostationary satellite data in regional applications and to support improvements in short-term regional weather prediction.
- Support NSSTC outreach efforts by providing research advisers and speakers on Earth science research to teachers and students.
- Develop a detailed plan for lightning observations on a geostationary platform via the Earth system science pathfinder opportunity.
- Demonstrate the ability of uninhabited air vehicle for remotely monitoring storms and validation of the lightning imaging sensor instrument on the tropical rain measuring mission.
- Successfully integrate the AMSR–E science algorithm into the science computing facility.
- Successfully implement the AMSR–E Science Investigator-led Processing System (SIPS) upon launch of the Aqua satellite.
- Continue successful operations of the Global Hydrology Resource Center and continue its major role as a contributor to the running and organization of the Federation of Earth Science Information Partners.
- Submit plan to establish a Regional Forecast Improvement Laboratory to accelerate the use of EOS data to address NASA's short-term weather prediction initiative.

National Space Science and Technology Center

We Support

- **Earth Science Enterprise**
- **Space Science Enterprise**
- **Biological and Physical Research Enterprise**
- **Human Exploration and Development of Space**
- **Aerospace Technology Enterprise**
- **National Oceanic and Atmospheric Administration**
- **National Scientific Community**
  - Academia
  - Industry
  - Government

The National Space Science and Technology Center (NSSTC) consists of researchers and resources from Government, academia, and industry collaborating in an environment that enables cutting-edge basic and applied research and fosters education of the next generation of scientists and engineers. The NSSTC facility is comprised of two adjoining buildings with a combined total of 202,700 square feet. Both house state-of-the-art laboratories and offices in which scientists perform research in the disciplines of Earth science, space science, propulsion, advanced optics, materials science, biotechnology, and information technology.

The National Weather Service plans to re-establish an operational weather forecast office in Huntsville at the NSSTC. This is a prime example of Federal agencies leveraging their resources to produce improved results that have a positive impact on the American people. The National Weather Service will be able to take advantage of cutting-edge research and forecasting models and implement them into an operational environment. NASA will have the opportunity to evaluate their state-of-the-art forecasting methodologies in an operational setting. More importantly, scientists from both agencies will be working side-by-side to solve severe weather prediction problems.

While completing the infrastructure to support its scientists, the NSSTC is aggressively growing the national aspect of its name. The NSSTC has a new executive director at the helm to promote its advantages and unique characteristics. Through industry alliances the NSSTC plans to continue leveraging resources to create the best team available to solve key research challenges. For example, the collaboration in propulsion research between Government, industry, and academia will result in greater and more rapid advances in knowledge to benefit space exploration.

With formal cooperative agreements in place with each of the Alabama Space Science & Technology Alliance (SSTA) universities, the NSSTC is continuing to recruit other university affiliates. Efforts are underway to establish collaborative relationships with Vanderbilt University, East Tennessee State University, Georgia Institute of Technology, and the University of Arizona. Several other universities have indicated an interest in partnering with the NSSTC. Technical evaluations are being performed to determine those universities that are most complementary to the NSSTC efforts.

National Space Science and Technology Center Metrics

- Complete benchmarking of the NSSTC among peer organizations and develop an appropriate business model including overhead rate and cost-recovery structure.
- Complete occupancy of annex building.
- Establish formal alliances with three industry affiliates and five universities outside the state of Alabama.

Principal Center Support Activities

A broad range of personnel, facility, and operational support services is required to support NASA's mission. NASA Headquarters has assigned the following Agency support activities to MSFC.

Communications Architecture and Providing Agency WAN Services

Provide an Agencywide communications architecture to support NASA's Enterprises that incorporates flexibility of technologies, efficiency in sustaining costs, and ensures full interoperability through standards.

NASA Automated Data Processing Consolidation Center

Centrally locate, operate, and manage nonmission critical mainframe computers, midrange systems, and Agency software contracts required to support the Agency's strategic enterprises.

Sustaining Engineering Support for Agencywide Administrative Systems

Provide sustaining engineering support to maintain Agencywide administrative application software and documentation in a current and operational state.

NASA Integrated Service Network

Provide voice, video, data, and messaging services to Agency customers, including mission, center, programmatic, administrative, and scientific communities through the NASA Integrated Service Network Project Office.

NASA Digital Television Transition

Provide guidelines and lead implementation of High Definition Television (HDTV) capabilities at each NASA field Center in accordance with a space act agreement with Dreamtime Holdings, LLC., and implementation of Standard Definition Television (SDTV) at each NASA field Center via NASA procurements, thus ensuring an efficient transition from NASA's current analog television architecture to the U.S. digital standard.

NASA Technical Standards Program

In accordance with NASA NPD 8070.6A, serves as the Lead Center for the Agency relative to the development, adoption, and data system management for NASA preferred technical standards products and associated standards activities in support of the Agency's programs/projects.

The four principal objectives of the NASA Technical Standards Program are to develop and maintain a NASA Integrated Technical Standards Initiative, integrate NASA experiences into technical standards products, promote increased use and support of national and international non-Government (voluntary consensus) standards in compliance with PL 104–113 and OMB Circular A–119, and sponsor the development of technical standards products specifically focused for use by NASA programs/projects.

NASA Acquisition Internet Service

Provide leadership for the Agency's Web-based acquisition service. Provide technical support for all operational systems and primary technical expertise for several developmental projects, including the Virtual Procurement Office (VPO) and contract bidirectional exchange, which is a major area of focus in the Agency's electronic commerce objectives. Manage the Agencywide team responsible for the NASA Acquisition Internet Service Program.

NASA Materials Replacement Technology Team

(Formerly NOET)

The NASA Operational Environment Team was renamed the NASA Materials Replacement Technology Team (NMRT2) during FY 2001 to reflect the evolving materials technology issues relative to the production of aerospace hardware. NMRT2 provides a continuing capability to support and facilitate materials replacement technology activities related to achieving environmental compliance in the design, development, test, use, and production of aerospace hardware.

Principal Center for Review of Clean Air Act Regulations

A memorandum of agreement (MOA) between NASA HQ, Office of Management Systems (Code J) and Office of Space Flight (Code M), and the Marshall Space Flight Center (MSFC) Materials, Processes, and Manufacturing Department established the roles and responsibilities of the parties and sets forth the principles governing the Principal Center agreement for support of NASA's review of Clean Air Act regulations.

The Principal Center for Review of Clean Air Act Regulations provides proactive management in assessing environmental regulations affecting the design, development, test, production, and operation of NASA programs and supporting facilities.

National Center for Advanced Manufacturing (NCAM)

Enables advanced manufacturing research and technology development and incorporates the use of intelligent synthesis environment into manufacturing to improve the competitiveness of the U.S. aerospace industry.

NASA Engineering Infrastructure

Lead a NASA-wide effort to define, measure, and improve engineering excellence across the Agency, with focus on people, processes, facilities, and tools.

Earned-Value Management

Establish an effective, value-added NASA Earned-Value Management Program and provide oversight and guidance for the implementation of EVM policy throughout the Agency. Support NASA project's in-house EVM activities.

Defense Contract Administrative Service Financial Management Support

Maintain system with cost data as well as the Agency-level accounting associated with the contract administration and audit services provided to NASA from external organizations.

Integrated Financial Management Program Core Financial Project

As the first of several potential projects for the Integrated Financial Management Program, the Core Financial Project will acquire, test, and implement the core financial software at MSFC. Afterwards, the project will lead the effort to implement the system at NASA's other Centers.

Integrated Financial Management Program Integration Project

The Integrated Financial Management Integration Project is responsible for defining, implementing, and maintaining an architecture and infrastructure that provides the integration necessary to accomplish the business objectives of the Integrated Financial Management Program.

Spacelink

Operate and maintain NASA Spacelink, an electronic aeronautics and space resource that places NASA educational materials, news, and reference data at the fingertips of teachers and students around the world. Managed for the Agency by MSFC since 1988, Spacelink is a fundamental component of NASA's national education dissemination network.

Logistics Business Systems Operations and Maintenance

Provide leadership in implementing and sustaining Agency logistics systems that provide the necessary automated tools to professionals that support all NASA Strategic Enterprises, business partners, and logistics business process customers.

Other Support Activities

Space Environments and Effects

Serve as NASA's lead for identifying, developing, and maintaining the technologies required to mitigate effects of hazardous space environments on spacecraft required for future missions.

Environmental Assessments Impact Statements

Provide leadership in implementing the National Environmental Policy Act for all new MSFC programs and projects.

AdminSTAR

Provide leadership in implementing and sustaining a training administration business system across the Agency.

Education Alliances

Provide leadership and implement a wide ranging array of programs for the formal and informal education community that are aligned to and support the Agencywide NASA Education Implementation Plan 1999–2003.

Institutional Functions and Capabilities

Our goal: Enhance and sustain a highly skilled, ethnic, diverse, and motivated workforce committed to safety while working in a creative and productive environment in support of cutting-edge systems and technology development.

Functions	Goals	Metrics
Center Operations	Revolutionize customer-driven products and services for mission success. • Management Support Office/Contractor Industrial Relations • Office of the Chief Information Officer • Environmental Engineering Department • Facilities Engineering Department • Information Services Department • Logistics Services Department • Protective Services Department • Office of Integrated Financial Management Program	• Maintain 90-percent customer satisfaction. • Ensure a minimum 90-percent availability rate for primary mission-related facilities. • Maintain, at a minimum, a 95-percent availability rate for all information technology services. • Provide a multifaceted security education and awareness program to all of the Center workforce to raise awareness of critical asset protection issues and concerns. • Finalize updates to the MSFC Facilities Master Plan to optimize the Center's resources for future facilities development. • Make physical examinations, special screenings, immunizations, first aid, and emergency assistance available to all employees. • Perform annual building inspections and special inspections to ensure a healthy work environment for all employees. • Reduce noncompliance incidents and releases by 5 percent from the FY 2000 level by FY 2005. • Establish environmental liability baseline then reduce liability dollar for dollar by amount spent.
Equal Opportunity	Promote and strive for equal opportunity; equity and diversity in all occupational groups, grade levels, organizational units; MSFC programs and activities; and fully accessible facilities. Conduct educational programs with historically black and other minority universities.	• Increase workforce representation by 5 percent in underrepresented categories as defined in the Center's current Affirmative Employment Plan, provided MSFC receives hiring authority and a diverse pool of applications is available. • Improve the accessibility features in five of the Center's buildings and public access areas. • Increase research participation with historically black and other minority universities by five percent, provided appropriate Agency resources are available for FY 2002. • Establish a customer feedback link on the Equal Opportunity Office Web site.

Functions	Goals	Metrics
Customer and Employee Relations	Facilitate and coordinate the MSFC strategic and implementation planning process and communicate, internally and externally, clear, consistent messages that are traceable to the MSFC Implementation Plan. Partner with other Center organizations to increase collaboration or renew beneficial agreements with Government agencies at all levels. Promote alliances with academia, industry, and national and regional associations to utilize ongoing research and technologies developed at the Center. Involve the educational community in our endeavors to inspire students, create learning opportunities aligned with goals established by the educational community, and enlighten inquisitive minds striving to reach underrepresented groups. Provide a staffing and recruitment program that maintains a level of civil service FTEs to adequately support Center missions and maintains diversity in the Center's workforce. Conduct a nationwide recruiting program that seeks out the best and brightest college graduates for the Center's workforce. Incorporate a strategy into the recruiting program to increase the representation of minorities and individuals with disabilities in the Center's workforce. Ensure an effective workforce that enables MSFC to succeed in a dynamic external environment, and provide quality products and services to our customers. • Education Programs • Employee and Organizational Development • Government and Community Relations • Human Resources • Internal Relations and Communications • Media Relations • Technology Transfer	• Maintain the level of civil service FTEs to adequately support Center missions while maintaining diversity in the Center's workforce, subject to NASA HQ authority. • Achieve greater automation of human resources processes pending sufficient funding from NASA HQ and timely software delivery by the vendor. • Support the development, testing, and evaluation of a prototype Agencywide workforce planning and reporting system that incorporates the Fair Inventory process. • Enhance public knowledge of MSFC programs and activities by conducting a monthly national media campaign. • Take MSFC to the American public by conducting exhibit events that reach 200,000 people nationwide during FY 2002. • Enhance online training needs assessment tool to provide advanced capability to assist in the planning for and development of Center employees. • Establish a disciplined approach for Center organization performance consulting. • Increase training and organizational development opportunities over FY 2001 baseline by 10 percent. • Establish a partnership with the Iowa Mathematics and Science Education Coalition to support the Iowa NASA Linking Leaders Initiative that will be patterned after the successful Alabama Linking Leaders model. NASA Linking Leaders initiatives are intended to provide leadership in improving mathematics, science, and technology education through the facilitation of communication among education, business, and public policy sectors. • Increase the NASA Student Involvement Program participation in the MSFC six-state geographical service region by 10 percent from the previous year. • NASA seeks to be judged by its customer, the education community, as providing excellent and valuable educational programs and services. Therefore, we will attempt to maintain an average "Excellence" rating ranging between 4.0 and 5.0 (on a 5.0 scale) as rated by our customers.

Functions	Goals	Metrics
Customer and Employee Relations (Continued)		• Increase the number of student participants in our summer undergraduate research program by 10 percent from the previous year. • Continue to increase the number of stakeholders briefed on NASA programs, with a focus on members of Congress on NASA oversight committees. • Enhance congressional knowledge of MSFC programs and activities by conducting a forum on Capitol Hill annually. • Develop and implement a strategic outreach plan to educate key stakeholders of the impact of MSFC's programs to their geographic area. • Initiate outreach efforts to at least three relevant congressional caucuses. • Increase speaking opportunities for the Marshall Center Director and other Center employees at the local, regional, and national level. Along with other CaER organizations, develop key Center messages on MSFC roles and missions for speakers to convey. • Increase the number of new partnerships that compliment Marshall's primary mission areas and that leverage the limited resources available to the Center. • Increase the number of new licensing agreements that provide monetary value to the Center and its innovators. • Increase the number of new success stories that highlight the technologies of the Marshall Space Flight Center. • Establish and implement a Balanced Scorecard Web site to track and status all MSFC Center metrics. • Reformat the layout of the Marshall Star to create a more reader-friendly news publication. • Complete the redesign/relocation of the Heritage Gallery to Building 4200. • Perform internal customer satisfaction survey to establish a baseline for future customer satisfaction activities.
Financial Management	Serve as stewards of Government resources. Develop and maintain processes and systems that ensure accurate financial control across the Center.	• Establish a system to measure customer satisfaction. • Obligate 95 percent of authorized funding for the current program year. • Cost 70 percent or more of the resources authority available to cost within the fiscal year. • Implement the Integrated Financial Management Core Financial System at MSFC by September 2002. • Establish an EVM System for Space Launch Initiative projects. • Provide formal EVM process training through Adminstar.

Functions	Goals	Metrics
Legal Support	Support MSFC's assigned roles and missions by providing sound, understandable, timely legal counsel and representation of the highest quality to all MSFC organizational elements. Administer the ethics program and patent prosecution for MSFC.	• Produce at least 20 patent applications (based on NASA Inventions and Contributions Board metrics). • Attain 80-percent positive assessment from our customers.
Procurement	Improve effectiveness and efficiency of Center acquisitions through increased use of techniques and management tools that enhance contractor innovations and performance.	• Increase obligated funds available for performance-based contracts to 80 percent. • MSFC will award 20 percent of its dollars available for contracting to Small Business concerns in FY 2002. • MSFC will award 8 percent of its dollars available for contracting to Small Disadvantaged Businesses in FY 2002. • MSFC will award 4 percent of its dollars available for contracting to Women-Owned Small Businesses in FY 2002. • Establish a Customer Satisfaction System and build a database to use in future years to measure performance.
Systems Management Office	The Systems Management Office (SMO) provides a focal point for excellence in program/project management, systems engineering, and cost/economic analysis for MSFC programs and projects. The SMO provides assistance to Agency and Center management in the conduct of independent evaluations and for PMC support. MSFC SMO goals include providing systems management consulting, leadership, and technical expertise to ensure consistency across programs, projects, and product lines. SMO offers training, mentoring, and independent evaluation in systems engineering and program/project management to aid personnel in the development of tailored systems management processes for programs and projects in formulation and implementation. SMO provides cost and economic benefit assessments, develops and recommends new tools, shares best practices and lessons learned, and supports implementation of NPG 7120.5 and MPG 2190.1	• Provide independent cost/economic assessments of 100 percent of PMC reviewed formulation phase projects above $100M. • Revise NAFCOM cost model every 18 months to include the latest cost data and model enhancements. • Expand REDSTAR database by 5 percent. • Conduct independent evaluations, e.g., independent assessments, independent annual reviews, non-advocate reviews of at least six MSFC projects. • Conduct one Center Export Representative (CER) training course. • Assess the level of satisfaction of all customers supported.

Engineering Capabilities

Engineering Directorate

MSFC's Engineering Directorate provides highly skilled crosscutting engineering services for the MSFC product line directorates and offices and Agency leadership for select crosscutting engineering functions. The Engineering Directorate's long-term vision, mission, and five core strategies are in furtherance of the NASA Strategic Plan and MSFC Implementation Plan.

Vision: Engineering excellence enabling our customers' mission success.

Mission Statement: In partnership with our customers, we provide engineering excellence in research, technology, development, and support essential to mission success and safety, and built upon our core values.

Five Core Strategies: The Engineering Directorate core strategies provide primary strategic guidance for the organization.

Engineering Products and Services

The Engineering Directorate will pursue excellence in providing crosscutting engineering products and services responsive to our customers' needs. Strategic alliances throughout the technical community and integrated engineering solutions will be utilized to enable our customers' success.

New Technology Development

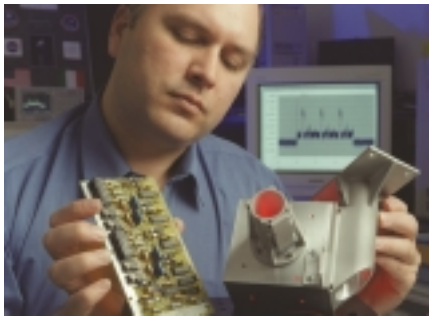
The Engineering Directorate will create new and enabling technologies that advance our customers' visions, meet their goals, and enhance U.S. competitiveness.

People

The Engineering Directorate will build a learning organization through professional development. Employees actively involved in continuous learning will ensure a highly qualified and motivated workforce with the proper skills and customer focus to achieve mission success.

Infrastructure

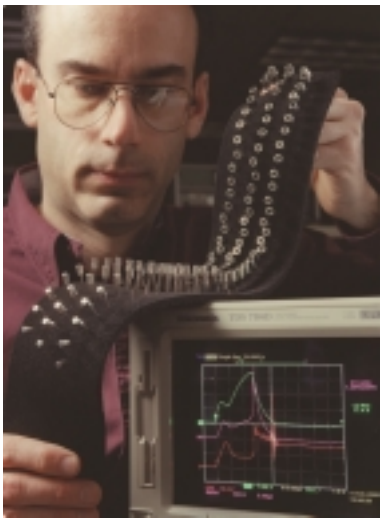
The Engineering Directorate will upgrade and maintain the proper infrastructure of facilities, tools, and equipment to ensure customer success and enhance our competitive posture.

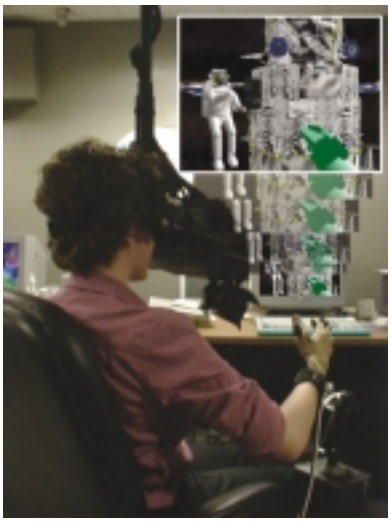


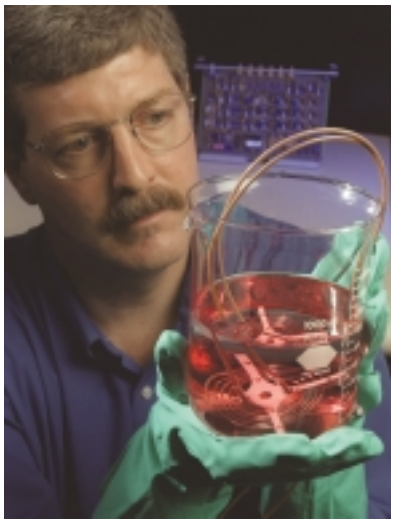
Business

The Engineering Directorate will utilize efficient and effective internal processes and business practices to integrate our solutions with our customers' needs, market our capabilities, and maximize the percentage of resources available to perform engineering work.

The Engineering Directorate provides integrated solutions through highly trained and motivated personnel located in four departments and two offices.







Avionics Department

Plans, performs, and directs research and development in engineering and analysis of electrical systems, guidance and control systems, radio frequency systems, computer and simulation systems, and software and avionics simulations systems related to space vehicles, payloads, and support equipment.

Structures, Mechanics, and Thermal Department

Plans, conducts, and directs research and development in structural, mechanical, and thermal systems for the analysis, design, and/or qualification testing of space and launch vehicles, payloads, and systems.

Materials, Processes, and Manufacturing Department

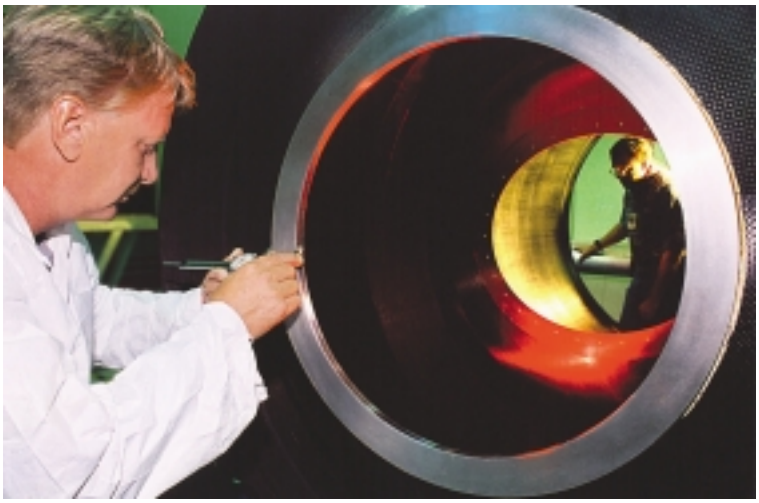
Provides science, technology, and engineering design; development and test of materials, processes, manufacturing technology and products to be used in space vehicle applications including ground facilities, test articles, and support equipment.

Engineering Systems Department

Plans and performs systems-related crosscutting engineering services and supports encompassing NASA standards, mass properties, kinematics, supportability and logistics, modeling and simulation, human engineering, configuration and data management, and environments (EMI/EMC, space and terrestrials). The Engineering Systems Department also manages the Technical Standards Program for NASA.

Engineering Technology Development Office

Facilitates and coordinates the development of advanced technologies within the Engineering Directorate departments to support the needs of the MSFC product lines, other NASA programs, and other Government agencies. The Engineering Technology Development Office also manages the Space Environments and Effects Program for NASA.



Business Management Office

Maximizes use of available resources and integrates efficient standardized business processes throughout the Engineering Directorate. This office also provides general support for the directorate, establishes technical liaisons with each product line for resolving concerns, and actively participates in Center and Agency-wide business practice improvement initiatives.

The Engineering Directorate seeks to achieve significant success in the engineering services area. Engineering Directorate capabilities will continue to be integrated to be responsive, focused, and achieve customer mission success. The Engineering Services Initiatives are listed below—

- Maintain customer focus
- Enhance integration of engineering processes across disciplines
- Maintain cognizance of emerging technologies
- Be fully equipped to establish required development processes
- Practice technical accountability and ownership.

A portion of the Engineering Directorate's people and skill investments are continually focused to advance MSFC's technical expertise and capabilities in selected technology thrust areas. These technology thrust areas are intended to be crosscutting, high impact, and high-value investments for Engineering Directorate customers.

- Space environments and effects
- Advanced avionics architecture
- Advanced cryogenic tanks
- Advanced materials and structures applications
- Advanced manufacturing

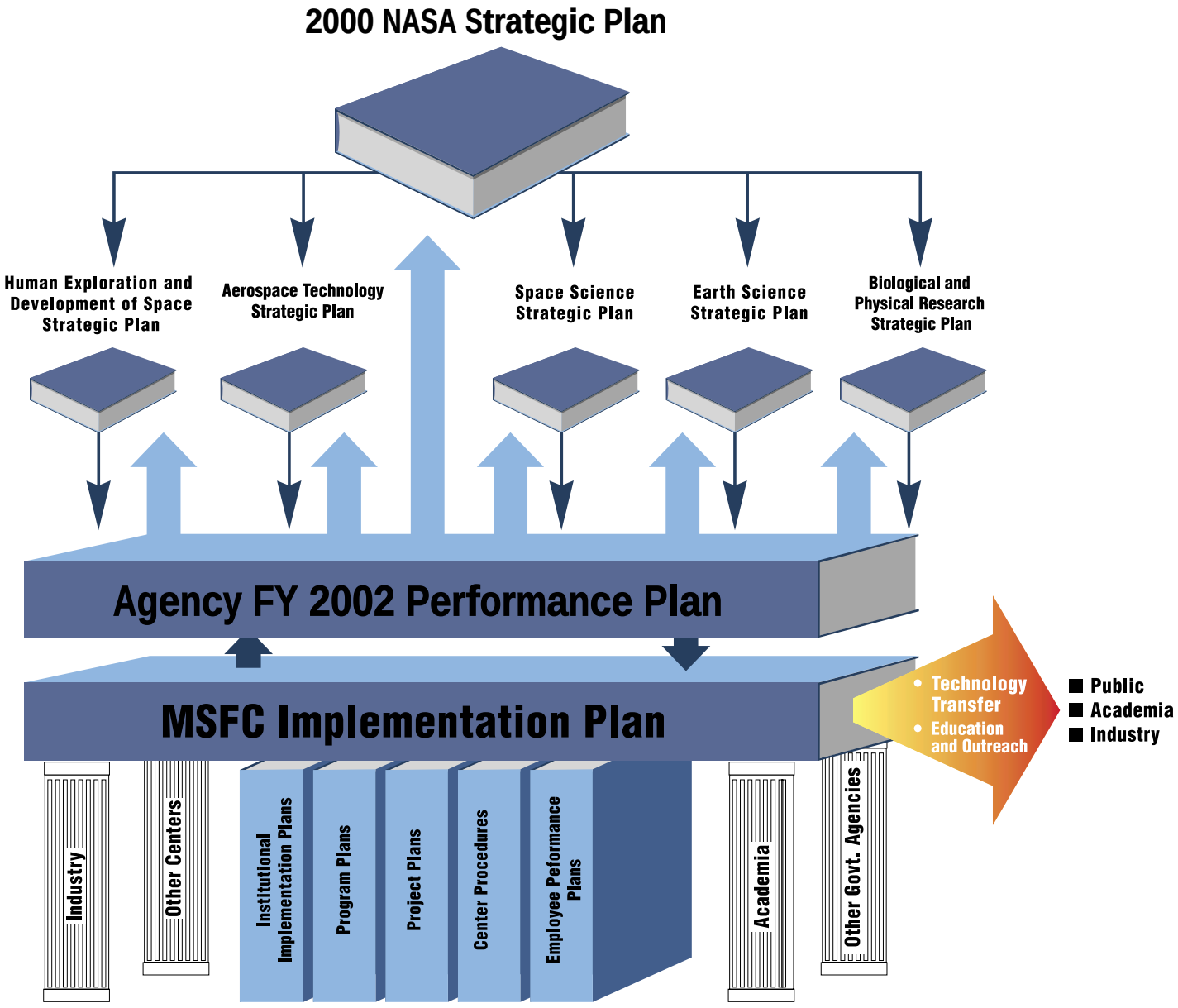
Engineering Directorate Metrics

- Establish and implement three new training initiatives for Engineering Directorate employees.
- Achieve employee participation of 90 percent in targeted professional society technical committees.
- Increase the relative number of Engineering Directorate patent disclosures by 10 percent, as compared to the FY 2001 baseline.
- Achieve a score of 90 percent or better for customer satisfaction, as determined by Engineering Directorate customer surveys of MSFC product line directorates and offices.
- Complete and implement an integrated solutions process, simplifying and enhancing the interface to our customers.
- Define and implement the benchmarking process plan for 2002.

Marshall's Link to the Future

The NASA Strategic Plan defines the Agency's vision, mission, and fundamental questions of science and research that provide the foundation for our goals. The strategic enterprises identify their objectives to meet the Agency's goals in their individual strategic plans.

The MSFC FY 2002 Implementation Plan provides the link for the Center program plans, project plans, institutional implementation plans, Center procedures, and employee performance plans to the Agency and enterprise strategic plans. Our implementation is supported by industry, other Centers, other Federal agencies, and academia. The Implementation Plan reflects MSFC's dedication to NASA's goals and communicates to the Strategic Enterprises, our employees, and our partners and customers the implementation of our roles and missions through metrics tied to the Agency budget.



Points of Contact

For further information regarding the Marshall Space Flight Center FY 2002 Implementation Plan, please contact the following individuals.

Center of Excellence for Space Propulsion

Second Generation RLV Program Office, Propulsion Office	UP30	Gary Lyles
Space Transportation Directorate—http://std.msfc.nasa.gov	TD01	Denny Kross
Propulsion Research Center	TD40	Stephen Rodgers
Space Transportation Engineering	TD50	Helen McConnaughey
Technology Evaluation Department	TD70	John London

Human Exploration and Development of Space

Flight Projects Directorate—http://flightprojects.msfc.nasa.gov	FD01	Jan Davis
Advanced Projects Office—http://flightprojects.msfc.nasa.gov/fd02.html	FD02	Joe Howell
Space Shuttle—http://liftoff.msfc.nasa.gov	MP01	Alex McCool
Development Projects Office	TD10	Norm Brown

Aerospace Technology

Space Transportation Systems Development—http://stp.msfc.nasa.gov	TD01	Denny Kross
Advanced Space Transportation Program—http://astp.msfc.nasa.gov	TD15	Steve Cook
2nd Generation RLV Program Office—http://slinews.com	UP01	Dennis Smith
2nd Generation RLV Program Office (Dep.)	UP01	Dan Dumbacher
2nd Generation RLV Program Planning and Control	UP02	Rose Allen
2nd Generation RLV Propulsion	UP30	Gary Lyles

Office of Biological and Physical Research

Science Directorate—http://science.nasa.gov	SD01	Ann Whitaker
Microgravity Research Program Office	SD10	Lou Baccei
Microgravity Science and Applications Department	SD40	Tom Stinson

Space Science Enterprise

Science Directorate—http://science.nasa.gov	SD01	Ann Whitaker
Space Science Department	SD50	Frank Six
Space Optics Manufacturing Technology	SD70	Scott Smith
Chandra X-Ray Observatory Program Office (CXO)—http://Chandra.nasa.gov	FD03	Tony Lavoie
Gravity Probe-B	SD30	Rex Geveden

Earth Science Enterprise

Science Directorate—http://science.nasa.gov	SD01	Ann Whitaker
Global Hydrology and Climate Center (GHCC) http://www.ghcc.msfc.nasa.gov/ghcc_home.html	SD60	Jim Arnold

Principal Center and Agency Support Activities

NASA Payroll Operations Consolidation	RS10	Mike Clemons
NASA Human Resources Systems	CD02	Lou Nosenzo

National Space Science and Technology Center (NSSTC)—http://www.nsstc.org	SD03	Sandy Coleman
Integrated Financial Management Program Core Financial Projects	RS02	Pam Cucarola
National Space Science and Technology Center	SD03	Sandy Coleman
NASA Engineering Infrastructure	ED42	Amelia Gillis
Integrated Financial Management Program Integration Progect	AD04	Jonathan Pettus
Communications Architecture and Providing Agency WAN Services	AD33	Terry Luttrell
NASA Automated Data Processing Consolidation Center	AD31	Portia Dischinger
Earned Value Performance Management	RS40	Frank Hicks
NASA Preferred Technical Standards Program	ED40	Paul Gill
Space Environments and Effects	ED03	Billy Kaufmann
NASA Digital Television Transition	AD32	Rodney Grubbs
Sustaining Engineering Support for Agencywide Administrative Systems	AD33	Sheila Fogle
Logistics Business Systems Operations and Maintenance	AD40	Nikita Zurkin
AdminSTAR	CD02	Lou Nosenzo
NASA Materials Replacement Team	ED36	Marceia Clark-Ingram
Defense Contract Administrative Service Financial Management Support	RS21	Lee Harp
NASA Integrated Service Network	AD30	Rick Helmick
National Center for Advanced Manufacturing	ED34	John Vickers
NASA Spacelink—http://spacelink.nasa.gov	CD60	Jeff Ehmen
NASA Acquisition Internet Service (NAIS)	PS10	Jim Bradford
Environmental Assessments Impact Statements	AD01	Sheila Cloud
Center for Review of Clean Air Act Regulations	ED36	Marceia Clark-Ingram

MSFC Institutional Functions and Capabilities—http://www.msfc.nasa.gov

Engineering Directorate	ED01	John Kilpatrick
Chief Counsel	LS01	Bill Hicks
Chief Information Officer	AD03	Sheila Cloud
Customer and Employee Relations	CD01	Tereasa Washington
Educational Programs—http://education.msfc.nasa.gov	CD60	Jim Pruitt
Equal Opportunity	OS01	Charles Scales
Financial Management	RS01	David Bates
Human Resources	CD10	Danny Hightower
Internal Relations & Communications	CD40	Steve Durham
Government & Community Relations	CD50	Shar Hendrick
Employee and Organizational Development	CD20	Greg Walker
Information Services	AD30	Rick Helmick
Facilities Engineering	AD20	Edwin Jones
Environmental Engineering	AD01	Sheila Cloud
Logistics Services	AD40	Roy Malone
Procurement	PS01	Steve Beale
Small Business Industry Assistance	PS01	Stan McCall
Safety & Mission Assurance	QS01	Amanda Goodson
Technology Transfer	CD30	Vernotto McMillan
Protective Services	AD50	Bradley Waits
Media Relations	CD70	Dom Amatore
Systems Management Office	VS01	Axel Roth
Occupational Safety	QS10	Herb Shivers
Occupational Health	AD02M	

Marshall Space Flight Center

Implementation Plan Linkage to the FY 2002 NASA Performance Plan

Human Exploration and Development of Space Enterprise

NASA Near-Term Goals	NASA Objectives	NASA Performance Targets	MSFC Implementation	FY 2002 MSFC Metrics
Enable humans to live and work permanently in space.	Provide and make use of safe, affordable, and improved access to space.	Assure public, flight crew, and workforce safety for all Space Shuttle.	MSFC Space Shuttle Projects Office.	Maintain less than one in-flight anomaly (IFA) per mission. Conduct the following Safety Initiatives to ensure a safe workplace environment: - Monthly area walkthroughs and documentation - Monthly project safety meetings - Maintain safety performance records at our contractor facilities that exceed industry standards.
		Have in place a Shuttle safety investment program that ensures the availability of a safe and reliable Shuttles system for *ISS* assembly and operations.	MSFC Space Shuttle Projects Office	The SSME Block-II flights will be fully implemented during FY 2002 ET will implement friction stir welding for production of longitudinal welds. SRB will successfully continue the design, development and qualification for the upgrade of the Altitude Switch Assembly (ASA), within schedule and budget commitments. The ASA's function is to initiate the parachute recovery system for the SRB which allows the SRBs to be recovered from the ocean and reused. The SRB Project will satisfactorily complete the formulation phase for the Integrated Electronic Assembly (IEA) and Automated Booster Assembly and Checkout System (ABACS) supportability upgrades by mid-FY 2002. The RSRM project will identify and reduce risks to flight hardware and personnel caused by human/process error by optimizing human-system interfaces. Industrial Engineering for Safety (IES) upgrades to be pursued to include RSRM robotic glass bead, nozzle handling improvements, and high-pressure reciprocating pumps. The SIO will publish and distribute the Shuttle Environmental Assurance (SEA) Initiative Annual Report which defines the programmatic and technical accomplishments and activities for FY 2001. The SIO will implement the Space Shuttle Program EME Action Plan in response to the Office of Special Council letter concerning potential EMI issues. The SSPO will maintain a 90-percent customer satisfaction (rate) and document continuous improvement using input and feedback from the SSPO Web page. Meet the Manifest and Improve Mission supportability through— - Robust processes - Process control - Production process efficiency - On-time launches with no delays attributed to the MSFC propulsion elements
		Successfully complete 90 percent of the ISS planned mission objectives	Flight Projects Directorate	Generate per-increment plans that utilize at least 90 percent of the resources assigned to utilization. Maintain performance metrics to measure the ability of the Payload Operations Center to meet the requirements of the *ISS* Utilization Program.

Human Exploration and Development of Space Enterprise (Continued)

NASA Near-Term Goals	NASA Objectives	NASA Performance Targets	MSFC Implementation	FY 2002 MSFC Metrics
				Perform resources tracking to ensure that utilization resources are allocated in real-time according to program baseline documentation.
				Launch of multipurpose logistics module Rafaello (FM–2), UF–1 mission, in 1st quarter FY 2002.
				Launch of multipurpose logistics module Leonardo (FM–1), UF–2 mission, in 3rd quarter FY 2002.
		Demonstrate *ISS* program progress and readiness at a level sufficient to show adequate readiness in the assembly schedule	Flight Projects Directorate	Conduct monthly payload operation status review with MSFC management.
				Conduct quarterly payload operation status reviews with program office management.
				Maintain the payload operations budget within 5 percent of the mark.
				Complete and certify the cargo element for the UF–1 LMC mission. 1st quarter FY 2002.
				Complete and certify the service module debris shield (SMDP) cargo element for the UF–2 sidewall carrier mission. 2nd quarter FY 2002.
				Complete integration design review for the range mission, 3rd quarter FY 2002.
				Complete and deliver the UF–4 flight support equipment, 3rd quarter FY 2002.
				Node 2 integration and systems testing completed, 4th quarter FY 2002.
				Node 3 design review number two completed, 4th quarter FY 2002.
	Ensure the health, safety, and performance of humans living and working in space	Demonstrate progress toward *ISS* research hardware development	Flight Projects Directorate	Participate in the research program payload program manager reviews and support the end of the year review with payload operation metrics.
		Select and fund at least 3–5 proposals through the HTCI-focused R&T program	Flight Projects Directorate	Vapor compression distillation (VCD) flight experiment, which will be used as an engineering precursor to the final urine processor assembly to fly on STS–107, scheduled for 4th quarter FY 2002.
				Subsystem drawing for water recovery system, oxygen generator system and power supply module completed. 4th quarter FY 2002.
				Water recovery system/oxygen generator system critical design review, 3rd quarter FY 2002.
Explore the space frontier.	Improve the accessibility of space to meet the needs of commercial research and development.	The Space Communications Program will conduct tasks that enable commercialization and will minimize investment in Government infrastructure for which commercial alternatives are being developed.	Flight Projects Directorate	Support the implementation of voice over the Internet to drastically reduce the cost of payload operation voice communication requirements.
	Invest in the development of high-leverage technologies to enable safe, effective, and affordable human/robotic exploration.	Provide an average of five middeck lockers on each Space Shuttle mission to the *International Space Station.*	Flight Projects Directorate	Generate per increment plans that utilize all the middeck lockers assigned to utilization.
		Begin development of high-leveraged technologies to enable safe, effective, and affordable human/robotic exploration missions beyond LEO.	Advanced Projects	Provide NASA HQ with technical and program management support as needed for the HTCI activities.
		Test at the *International Space Station* competing technologies for human missions beyond LEO, in cooperation with other agencies and international partners, and with U.S. industry.		Provide support to NASA HQ with preliminary definition of potential technology flight experiments on the *ISS* for space solar power, propellant depots, or other flight project areas as requested.
	Develop exploration/commercial capabilities through private sector and international partnerships	Develop and test—on the ground and in space—competing technologies for human missions beyond LEO in cooperation with international partners.		Provide NASA HQ with technical and program management support as needed for the international forum activities.

Aerospace Technology Enterprise

NASA Near-Term Goals	NASA Objectives	NASA Performance Targets	MSFC Implementation	FY 2002 MSFC Metrics
Create a safe, affordable highway through the air and into space.	Mission safety—radically improve the safety and reliability of space launch systems.	Complete risk reduction and architecture reviews to support design and demonstration decisions.	2nd Generation RLV Program	Develop comprehensive Stakeholder Relationship Management System that defines what is important to individuals and groups, measures satisfaction, implements corrective action, and provides mutual development of future requirements.
	Mission affordability—create an affordable highway to space.	Complete risk reduction and architecture reviews and initial hardware demonstrations to support design and demonstration decisions.		Establish an Advanced Engineering Environment to provide a state-of-the-art computer-aided-design/computer-aided engineering capability that enables concurrent systems analysis and design among geographically disperse Government, industry, and university teams.
				Conduct the Interim Architecture Technology Review to assure that processes and plans are in place to successfully achieve a subsequent Systems Requirements Review (SRR), and to assure that work is proceeding to complete necessary product and analyses for the SRR.
	Pioneer technology innovation—enable a revolution in aerospace systems.	Engineering innovation—enable rapid, high confidence, and cost-efficient design of revolutionary systems.	MSFC Space Propulsion Office	Perform the work-horse engine tests for the Auxiliary Propulsion System Reaction Control Engine.
				Complete final testing of the mono-propellant gas generator for powering turbine drives.
				Complete Critical Design Review for the Crossfeed Checkvalve Test Article.
		Develop at least two new materials concepts and demonstrate the feasibility of at least two nanotechnology and two other concepts.		Design and build a hypergolic injector for orbital propulsion.
				Complete the RS–83 system design review.
				Complete the COBRA powerhead critical design review.
				Complete the COBRA Prototype Engine preliminary design review.
				Fly ProSEDS tether propulsion flight experiment.
				Complete design of Propulsion Research Laboratory.
				Provide system analysis for technology and architecture to support NASA's Space Launch Initiative.
			Advanced Space Transportation Technology	Complete systems requirements review (SRR) on Rocket Based Combined Cycle (RBCC) demonstrator engine.
				Release NASA research announcement (NRA) for next generation ion propulsion.
				Release NRA for in-space propulsion transfer technology.

Space Science Enterprise

NASA Near-Term Goals	NASA Objectives	NASA Performance Targets	MSFC Implementation	FY 2002 MSFC Metrics
Chart the evolution of the universe, from origins to destiny, and understand its galaxies, stars, planets, and life.	Support of Strategic Plan Science Objectives; Development/ Near-Term Investments	Design, develop, and launch projects to support future research in pursuit of Strategic Plan science objectives.	Space Science Research	Chandra - A commitment for viewing efficiency greater than 50 percent average per year, with a goal of 60 percent. - Loss due to interruption of program due to ground error/procedures < 5 percent per year. - Data loss from observation to delivery to user < 5 percent. Gravity Probe-B Launch GP-B in October 2002. Mission lifetime of 16 months. Measurement accuracy for relativistic drift of 0.5 milliarcsecond/year. Solar-B Mission lifetime of 3 years. Engineering models by March 2002. Focal plane instrument to ISAS by November 2002. Final delivery of XRT by July 2003. Solar X-Ray Imager Mission lifetime of 3 years. Full-disk soft x-ray imaging of the sun, including solar flares and coronal holes. Support transition to operational status. GLAST Burst Monitor Launch in September 2005. Mission lifetime of 5 years. Detectors delivered by MPE in September 2003. Observe gamma-ray bursts from 5 kev to 30 mev.
Technology/Long-Trm Future Investments: Develop new technologies to enable innovative and less expensive research and flight missions	Acquire new technical approaches and capabilities. Validate new technologies in space. Apply and transfer technology.	Focus technology development on a well-defined set of performance requirements covering the needs of near-term to midterm strategic plan missions.	Space Optics Manufacturing Technology Center	Implement a control system for the global radius of curvature on a segmented ground-based telescope. Complete a 0.25 meter diameter x-ray mandrel and produce an electroformed shell under 0.25 mm thick. Test two additional mirror technologies in the X-Ray Calibration Facility in support of the Next Generation Space Telescope. Produce a diamond turned double-sided Fresnel lens on a curved substrate. Install and demonstrate the precision optical generator in the optical fabrication area. Implement an advanced mirror algorithm simulation using a large-cluster computer. Expand the size of the current ion polishing capability. Develop rugged laser sources of less that $0.01m^3$ volume and large gain medium area for use in sourcing microgravity imaging and diagnostic science. Perform experimental characterization of a bandpass modulation element using nonmechanical means for implementing phase modulation. Reduce the optical figure in the normal incidence electroformed optics by a factor of two. Establish at least one process to monitor and evaluate customer satisfaction.

Space Science Enterprise (Continued)

NASA Near-Term Goals	NASA Objectives	NASA Performance Targets	MSFC Implementation	FY 2002 MSFC Metrics
Education and public outreach—share the excitement and knowledge generated by scientific discovery and improve science education	Share the excitement of space science discoveries with the public. Enhance the quality of science, mathematics, and technology education, particularly at the precollege level. Help create our 21st century scientific and technical workforce.	Make progress in the identified focus areas	National Space Science and Technology Center	Establish formal alliances with three industry affiliates and five universities outside the state of Alabama. Complete benchmarking of NSSTC among peer organizations and develop an appropriate business model including overhead rate and cost recovery structure. Complete occupancy of the annex.
			Science@NASA Internet Outreach	Increase readership of OSS stories at Science@NASA Web sites by 25 percent in FY 2002. Add audio stories to Ciencia@NASA Web site.

Earth Science Enterprise

Observe, understand, and model the Earth system to learn how it is changing, and the consequences for life on Earth	Discern and describe how the Earth is changing	Increase understanding of trends in atmospheric constituents and solar radiation and the role they play in driving global climate.	Global Hydrology and Climate Center	Continue archival and distribution of global temperature measurement database from orbiting microwave sounding units Begin initial calibration and validation of the new special sensor microwave imager/sounder and demonstrate scientific usefulness.
	Determine how the Earth system responds to natural and human-induced changes.	Increase understanding of the effects of clouds and surface hydrologic processes on climate change.	Global Hydrology and Climate Center.	Successfully integrate the AMSR–E science algorithm into the science computing facility. Successfully implement the AMSR–E science investigator-led processing system upon launch of the Aqua satellite.
	Enable the prediction of future changes in the Earth system.	Increase understanding of the extent that transient climate variations can be understood and predicted.	Global Hydrology and Climate Center.	Analyze lightning and passive microwave data collected by airborne sensors during the CAMEX–4 hurricane experiment. These data along with that collected by all CAMEX–4 instruments will be cataloged and archived by the GHRC by the end of FY 2002. Continue successful operation of lightning imaging sensor (LIS) on board the Tropical Rain Measuring Mission (TRMM). Demonstrate ability of uninhabited air vehicle (UAV) for remotely monitoring storms and validation of the LIS instrument on TRMM.
Develop and adopt advanced technologies to enable mission success and serve national priorities.	Partner with other agencies to develop and implement better methods for using remotely sensed observations in Earth system monitoring and prediction.	Collaborate with other agencies to develop and implement better methods for using remotely sensed observations in Earth system monitoring and prediction.	Global Hydrology and Climate Center.	Extend diagnostics of tropical energy and water cycle to quantify water vapor and cloudiness interactions with radiation during El Niño and La Niña (ENSO) events. Develop and promote the use of remote sensing, geospatial technologies, and analyses products by decision makers and transportation specialists as part of the DOE/NASA National Consortia on Remote Sensing in Transportation. Support development of the meso-American biological corridor by completing the transfer of remote sensing analysis technology to the Central American partners.

Earth Science Enterprise (Continued)

NASA Near-Term Goals	NASA Objectives	NASA Performance Targets	MSFC Implementation	FY 2002 MSFC Metrics
		Safely operate airborne platforms to gather remote and in situ Earth science data for process and calibration/validation studies.	Global Hydrology and Climate Center	Develop an initial assessment of the ability of current climate models to simulate ENSO-related climate perturbations vis-à-vis Earth observing system satellite observations. Demonstrate the importance of physical measurements to characterize urban surface properties for parameterization in climate and air quality models. Submit plan to establish a Regional Forecast Improvement Laboratory to accelerate the use of EOS data to address NASA's short-term weather prediction initiative. Develop detailed plan for lightning observations on a geostationary platform via the Earth System Science Pathfinder (ESSP) opportunity. Operate and maintain a GOES ground station to foster the use of geostationary satellite data in regional applications and to support improvements in short-term regional weather prediction.
Expand and accelerate the realization of economic and societal benefits from Earth science, information, and technology.	Stimulate public interest in and understanding of Earth system science and encourage young scholars to consider careers in science and technology.	Share NASA's discoveries in Earth science with the public to enhance understanding of science and technology.	Global Hydrology and Climate Center	Support NSSTC outreach efforts by providing research advisers and speakers on Earth science research to teachers and students. Continue successful operations of the Global Hydrology Resource Center (GHRC) and continue its major role as a contributor to the running and organization of the Federation of Earth Science Information Partners (ESIP).
			Science@NASA Internet Outreach	Increase readership of Earth Science stories at Science@ NASA Web sites by 25 percent in FY 2002. Add audio stories to Ciencia@NASA Web site.

Biological and Physical Research

Use the space environment as a laboratory to test the fundamental principles of physics, chemistry, and biology.	Investigate chemical, biological, and physical processes in the space environment, in partnership with the scientific community.	Earn external review rating of green or blue by making progress in the following areas: - Advance the scientific understanding of complex biological and physical systems.	Microgravity Research Program	Support emergent microgravity research programs in biophysics and tissue engineering by selecting up to 10 new investigations. Conduct biotechnology, fluid physics, and small multidiscipline investigations on *ISS* according to the U.S. Partner Utilizing Plan. Launch and operate 12 *International Space Station* research investigations. Launch and operate six Space Shuttle microgravity research investigations. Establish at least one process to monitor and evaluate customer satisfaction.

Biological and Physical Research (Continued)

NASA Near-Term Goals	NASA Objectives	NASA Performance Targets	MSFC Implementation	FY 2002 MSFC Metrics
			Microgravity Program/Glovebox	Deliver the microgravity science glovebox (MSG) facility to *ISS* for flight.
				Deliver the vibration isolation system glovebox integrated microgravity technology (g-Limit) to *ISS* for flight.
				Integrate four experiments into MSG for flight.
				Hold a postflight workshop for potential MSG investigators after the facility becomes operational.
			Materials Science Research	Deliver and operate two fundamental material science investigations in the Microgravity Science Glovebox on the *International Space Station*.
				Fly on STS-107 and retrieve data from the Mechanics of Granular Materials Experiment.
				Complete one peer review of a new investigation science concept
				Identify and explore the fundamental and unresolved issues in at least one new materials science field.
				Support the release of the first annual NASA Research Announcement to select peer-reviewed research in materials science.
			Space Product Development	Launch and operate seven Space Shuttle Space Product Development research investigations.
			Molecular Biotechnology	Provide flight opportunities for peer-reviewed investigators to gather data on macromolecular crystal growth.
				Support the release of the annual NASA Research Announcement to select peer-reviewed research in molecular biotechnology.
Use space research opportunities to improve academic achievement and the quality of life.	Advance the scientific, technological, and academic achievement of the nation by sharing our knowledge, capabilities, and assets.	Provide information and educational materials to American teachers.	Microgravity Research	Publish abstracts and reports of progress for over 90 percent of FY 2000 research investigations.
				Support publication of approximately 1,500 journal articles in referenced journals.
				Through the use of national teacher conferences and workshops, provide approximately 300 elementary and high school classrooms nationwide with electronic (multimedia/computer technologies) and printed materials that focus on activities in science, math, and technology relating to life sciences and microgravity research and specifically written for students in grades K–12.
			Science@NASA Internet Outreach	Increase readership of OBPR stories at Science@ NASA Web sites by 25 percent in FY 2002.
				Add audio stories to Ciencia@NASA Web site.
Enable and promote commercial research in space	Provide technical support for companies to begin space research.	Engage the commercial community and encourage non-NASA investment in commercial space research .	Molecular Biotechnology	Expand student and teacher involvement in the biological crystallization education program to 12 states.
			Space Product Development Program	Maintain a ratio of non-NASA funding to NASA funding not less than 3:1 in FY 2002.
				Ensure that 1 of 39 product lines currently under investigation is brought to market in FY 2002.
				Enable at least 10 new active industrial partnerships to be established with Space Product Development Commercial Space Centers.

Manage Strategically

NASA Near-Term Goals	NASA Objectives	NASA Performance Targets	MSFC Implementation	FY 2002 MSFC Metrics
Enable the Agency to carry out its responsibilities effectively, efficiently, and safely through sound management decisions and practices.	Protect the safety of our people and facilities and the health of our workforce.	NASA will increase the safety of its infrastructure and the health of its workforce through facilities safety improvements, reduced environmental hazards, increased physical security, enhanced safety and health and health awareness, and appropriate tools and procedures for health enhancement.	Safety and Mission Assurance Office	Achieve a world-class lost-time injury rate of 0.1 or less, with an ultimate goal of 0.
				Zero type A or B mishaps in FY 2002.
				Maintain a mission success rate of 100 percent.
				All MSFC projects will complete safety reviews on time.
	Invest wisely in our use of human capital, developing and drawing upon the talent of all our people.	Attract and retain a workforce that is representative of all levels of America's diversity.	Human Resources Department	Maintain the level of civil service FTEs to adequately support Center missions while maintaining diversity in the Center's workforce, subject to NASA HQ authority.
				Achieve greater automation of human resources processes pending sufficient funding from NASA HQ and timely software delivery by the vendor.
				Support the development, testing, and evaluation of a prototype Agencywide workforce planning and reporting system that incorporates the Fair Inventory Process.
			Equal Opportunity Office	Increase workforce representation by 5 percent in underrepresented categories as defined in the Center's current Affirmative Employment Plan, provided MSFC receives hiring authority and a diverse pool of applications is available.
				Improve the accessibility features in five of the Center's buildings and public access areas.
				Increase research participation with historically black and other minority universities by 5 percent, provided appropriate Agency resources are available for FY 2002.
				Establish a customer feedback link on the Equal Opportunity Office Web site.
		Align management of human resources to best achieve Agency strategic goals and objectives.	Employee and Organizational Development	Enhance online training needs assessment tool to provide advanced capability to assist in the planning for and development of Center employees.
				Establish a disciplined approach for Center organization performance consulting.
				Increase training and organizational development opportunities over FY 2001 baseline by 10 percent.
	Manage our fiscal and physical resources optimally.	None listed	Marshall Quality Council	Obtain full scope, ISO 9001:2000 registration.
		Revitalize Agency facilities and reduce environmental liability.	Center Operations	Maintain 90 percent customer satisfaction.
				Ensure a minimum 90 percent availability rate for primary mission-related facilities.
				Maintain, at a minimum, a 95 percent availability rate for all information technology services.
				Provide a multifaceted security education and awareness program to all of the Center workforce to raise awareness of critical asset protection issues and concerns.
				Reduce noncompliance incidents and releases by 5 percent from FY 2000 level by FY 2005.
				Establish environmental liability baseline then reduce liability dollar for dollar by amount spent.

Manage Strategically (Continued)

NASA Near-Term Goals	NASA Objectives	NASA Performance Targets	MSFC Implementation	FY 2002 MSFC Metrics
	Manage our fiscal and physical resources optimally.	Revitalize Agency facilities and reduce environmental liability.	Center Operations	Finalize updates to the MSFC Facilities Master Plan to optimize the Center's resources for future facilities development.
				Make available to all employees physical examinations, special screenings, immunizations, first aid, and emergency assistance.
				Perform annual building inspections and special inspections to ensure a healthy work environment for all employees.
		None listed	Legal Support	Produce at least 20 patent applications (based on NASA Inventions and Contributions Board metrics).
				Attain 80 percent positive assessment from our customers.
	Manage our fiscal and physical resources optimally	Improve the Agency's financial management and accountability.	Financial Management	Establish a system to measure customer satisfaction.
				Obligate 95 percent of authorized funding for the current program year.
				Cost 70 percent or more of the resources authority available to cost within the fiscal year.
				IFMP—Implement the IFM Core Financial System at MSFC by September 2002.
				Establish an Earned Value Management (EVM) system for Space Launch Initiative projects.
				Provide formal EVM process training through Adminstar.
	Achieve the most productive application of Federal acquisition policies	Continue to take advantage of opportunities for improved contract management by maintaining a high proportion of performance-based contracts (PBCs)	Procurement	Increase obligated funds available for performance-based contracts to 80 percent.
		Continue integrating small, small disadvantaged, and women-owned businesses together with minority universities into the competitive base from which NASA can purchase goods and services.		MSFC will award 20 percent of its dollars available for contracting to small business concerns in FY 2002.
				MSFC will award 8 percent of its dollars available for contracting to small disadvantaged businesses in FY 2002.
				MSFC will award 4 percent of its dollars available for contracting to women-owned small businesses in FY 2002.
				Establish a customer satisfaction system and build a database to use in future years.
	Manage our fiscal and physical resources optimally.	None listed	Systems Management Office	Provide independent cost/economic assessments of 100 percent of PMC reviewed formulation phase projects above $100M.
				Revise NAFCOM cost model every 18 months to include the latest cost data and model enhancements.
				Expand REDSTAR database by 5 percent per year.
				Conduct independent evaluations, e.g., independent assessments, independent annual reviews, nonadvocate reviews of at least six MSFC projects.
				Conduct one Center Export Representative (CER) training course.
				Assess the level of satisfaction of all customers supported.
			Internal Relations and Communications Department	Establish and implement a Balanced Scorecard Web site to track and status all MSFC Center metrics.

Provide Aerospace Products and Capabilities

NASA Near-Term Goals	NASA Objectives	NASA Performance Targets	MSFC Implementation	FY 2002 MSFC Metrics
Enable NASA's Strategic Enterprises and their Centers to deliver products and services to customers more effectively and efficiently.	Improve NASA's engineering capability to remain as a premier engineering research and development organization.	Strengthen the NASA engineering capability through the completion of two indicators in FY 2002.	Engineering Directorate	Establish and implement three new training initiatives for ED employees Achieve employee participation in 90 percent of targeted professional society technical committees. Increase the relative number of ED patent disclosures by 10 percent, as compared to the FY 2001 baseline. Achieve a score of 90 percent or better for customer satisfaction, as determined by ED customer surveys of MSFC product line directorates and offices.
	Facilitate technology insertion and transfer, and utilize commercial partnerships in research and development to the maximum extent practicable.	Dedicate 10 to 20 percent of the Agency's research and development budget to commercial partnerships.	Engineering Directorate	Complete and implement an integrated solutions process, simplifying and enhancing the interface to our customers.
	Capture engineering and technological best practices and process knowledge to continuously improve NASA's program/project management.	Improve program and project management through the completion of two of the three indicators in FY 2002.		Define and implement the benchmarking process plan for 2002.

Communicate Knowledge Crosscutting Process

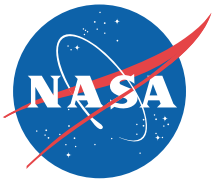
Ensure that NASA's customers receive information from the Agency's efforts in a timely and useful form.	Share with the public the knowledge and excitement of NASA's programs in a form that is readily understandable.	Share the experience of expanding the frontiers of air and space with the public and other stakeholders.	Media Relations	Enhance public knowledge of MSFC programs and activities by conducting a monthly national media campaign. Take MSFC to the American public by conducting exhibit events that reach 200,000 people nationwide.
		None Listed	Customer and Employee Relations Directorate	Perform internal customer satisfaction surveys to establish a baseline for future customer satisfaction activities.
			Government and Community Relations	Continue to increase number of stakeholders briefed on NASA programs, with a focus on members of Congress on NASA oversight committees. Enhance congressional knowledge of MSFC programs and activities by conducting a forum on Capitol Hill annually. Develop and implement a strategic outreach plan to educate key stakeholders of the impact of MSFC's programs to their geographic area. Initiate outreach efforts to at least three relevant congressional caucuses. Increase speaking opportunities for the Marshall Center Director and other Center employees at the local, regional, and national level. Along with other CaER organizations, develop key Center messages on MSFC roles and missions for speakers to convey.
			Internal Relations and Communications Department	Reformat the layout of the Marshall Star to create a more reader-friendly news publication. Complete the redesign/location of the Heritage Gallery to building 4200.

Communicate Knowledge Crosscutting Process (Continued)

NASA Near-Term Goals	NASA Objectives	NASA Performance Targets	MSFC Implementation	FY 2002 MSFC Metrics
	Support the nation's education goals.	The general public will have increased learning opportunities in science and technology fields through NASA-sponsored programs	Education Programs	Establish a partnership with the Iowa Mathematics and Science Education Coalition to support the Iowa NASA Linking Leaders Initiative that will be patterned after the successful Alabama Linking Leaders model. NASA Linking Leaders initiatives are intended to provide leadership in improving mathematics, science, and technology education through the facilitation of communication among education, business, and public policy sectors. Increase the NASA Student Involvement Program (NSIP) participation in the MSFC six-state geographical service region by 10 percent from the previous year. Increase the number of student participants in our summer undergraduate research program by 10 percent from the previous year. NASA seeks to be judged by its customer, the education community, as providing excellent and valuable educational programs and services. Therefore, we will attempt to maintain an average excellence rating ranging between 4.0 and 5.0 (on a 5.0 scale) as rated by our customers.
	Transfer NASA technologies and innovations to U.S. private industry and the public sector with the overall goal of affording positive impact on U.S. economic competitiveness.	Ensure consistent, high-quality, external communication.	Technology Transfer Department	Increase the number of new partnerships that compliment Marshall's primary mission areas and that leverage the limited resources available to the Center. Increase the number of new licensing agreements that provide monetary value to the Center and its innovators. Increase the number of new success stories that highlight the technologies of the Marshall Space Flight Center

The Marshall Space Flight Center recognizes the significant contribution of the following individuals in the generation of this document:

Michael Mc Lean	Customer and Employee Relations Directorate
Tina Palacios-LaBair	Space Transportation Directorate
Ron Koczor	Science Directorate
David Smitherman	Flight Projects Directorate
Dan Mellen	Engineering Directorate
Patrick Rasco	Center Operations Directorate
Jim Ellis	Safety and Mission Assurance Office
T. Jerry Williams	Procurement Office
Jim Frees	Office of Chief Counsel
Frank Hicks	Office of Chief Financial Officer
Billie Swinford	Equal Opportunity Office
Randy Sacks	Space Shuttle Project Office
Rip Nabors	Systems Management Office
Tommy Reagh	Cortez III Technical Illustrations and Publications



National Aeronautics and
Space Administration

George C. Marshall Space Flight Center
Marshall Space Flight Center, Alabama 35812

NP-2002-03-54-MSFC
Pub 8-40000